SC6.4.4.7 ~~Bicycle, pedestrian and shared path design~~ Pathway and Cycleway

SC6.4.4.7.1 Introduction

(1) Purpose

This sub-section aims to set standards and document requirements related to the provision of ~~bicycle paths, pedestrian and shared paths~~ pathways and cycleways for the use of pedestrians and cyclists, for both on road and off road which encourage pedestrian activities and cycling for transportation and recreational purposes. ~~Bicycle, pedestrian and shared paths~~ Pathways and Cycleways are to be safe and convenient and ~~shall~~ must maintain a satisfactory level of service for path users of all abilities including users with disabilities and/or limited mobility. Pathways and Cycleways should provide a clear and continuous accessible path of travel, void of tripping hazards and unsafe obstacles.

The design of a development must encourage~~s~~ the use of pedestrian and cycle facilities and ensure that priority is given to pedestrians with direct links between a building's main entrance and any adjoining local activities and public transport services and recreational areas.

(2) Scope

(a) This sub-section sets out requirements to be used in the design of various types of ~~bicycle, pedestrian and shared paths~~ pathways and cycleways for the use of pedestrians and cyclists.

(b) All relevant design principles contained in the Austroads' Guides referenced below must be integrated in the design of all pathways and cycleways and their associated infrastructure.

(3) Reference and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

9.4.6 Transport impact, access and parking code
SC6.4.4.1 Geometric road design
SC6.4.4.8 Standard drawings
SC6.4.3.3 Footpath Treatment Policy

(b)
SC6.4.3.5 Car parking and public transport facilities guidelines
SC6.4.3.6 Landscape Policy

(c)

Australian Standards

AS 1428.1	*Design for access and mobility Part 1: General requirements for Access – New building work*
AS 1428.2	*Design for access and mobility Part 2: Enhanced and additional requirements- Buildings and facilities*
AS/NZS 1428.4.1	*Design for access and mobility Part 4.1: Means to assist the orientation of people with vision impairment-Tactile ground surface indicators*
AS 2890.3	*Parking facilities Part 3: Bicycle parking facilities*

(d)

Austroads

Guide to Road Design Part 3: *Geometric Design*
Guide to Road Design Part 4: Intersections and Crossings – General
Guide to Road Design Part 6A: Pedestrian and Cyclist Paths
Cycling Aspects of Austroads Guides
Guide to Traffic Management Part 11: Parking

(e)

Queensland government

Department of Transport and Main Roads specifications,
Manual of uniform traffic control devices (MUTCD)
Road Planning and Design Manual Volume 3 Part 6A
TRUM Manual
Technical Standards Publications - Technical Notes
Queensland Development Code, MP 4.1 – *Sustainable Buildings*

Other

Bicycle Network Victoria – www.bicyclenetwork.com.au
Institute of Public Works Engineering Australia, Queensland, *Complete Streets - Guidelines for Urban Street Design.*

(4) Definitions

Pedestrian	A person walking, and including people in wheelchairs, on roller skates or riding vehicles such as skate boards or other vehicles, other than a bicycle, powered by effort or a motor and with a maximum speed of 7 km/h.
Walking	to advance or travel on foot at a moderate speed or pace; proceed by steps; move by advancing the feet alternately to move about or travel on foot for exercise or pleasure
Cyclist	Rider of a bicycle or human-powered vehicle. On a vehicle with one or more wheels that is built to be propelled by human power through a belt, chain or gears (whether or not it has an auxiliary motor), and includes a pedicab, penny-farthing and unicycle: but not a wheelchair, wheeled toy or pedelec.
Cycling	also called **bicycling** or **biking**, is the use of bicycles for transport, recreation, exercise or sport.[1] Persons engaged in cycling are referred to as "cyclists",[2] "bikers",[3] or less commonly, as "bicyclists".[4] Apart from two-wheeled bicycles, "cycling" also includes the riding of unicycles, tricycles, quadracycles, recumbent and similar human-powered vehicles (HPVs).
Path / Pathway	Series of links along a public way defining the connection between nodes in a network, reserved for the movement of pedestrians, motorised wheelchairs and personal mobility devices, and cyclists to chosen destinations via suitable desire lines
Cycleway	Portion of a road or path devoted to the use of bicycles.

SC6.4.4.7.2 Consultation

The designer should consult with council, the applicant's landscape consultants and relevant authorities prior to and during the preparation of ~~bicycle, pedestrian and shared path~~ pathway and cycleway designs.

SC6.4.4.7.3 Design concepts

The Designer should be familiar with the different geometric design requirements for the various types of pathways and cycleways in terms of:

(1) width;

(2) grade;

(3) stopping sight distance;

(4) change in grade;

(5) horizontal curvature;

(6) crossfall and drainage; and

(7) sight distance on horizontal curves.

These requirements are discussed in the Austroads Guides.

SC6.4.4.7.4 ~~Bicycle, pedestrian and shared paths: types~~ Types of Pathways and Cycleways

(1) By definition pedestrian paths are "off road" in that, pedestrian facilities are usually designed adjacent to roadways, and meet the criteria outlined in Austroads Guides, ~~and~~ SC6.4.4.8 Standard drawings, and SC6.4.4.1 Geometric road design, and to take into consideration ~~-~~SC6.4.3.3 Footpath treatment policy

Common pathway types include:

(a) footpath;

(b) shared path; and

(c) separated path.

(2) ~~Bicycle paths~~Cycleways can be provided on road and off road. The Austroads Guides provide detailed descriptions, warrants, widths, pavement marking etc. for the majority of these ~~bicycle paths~~cycleways. The Austroads Guides provide advice on the suitability of pavement conditions, drainage pit grates etc. for on road ~~bicycle paths~~ cycleways. All cycleways may diverge from the road alignment to provide a safer alternative access.

Common ~~bicycle path~~ cycleway types include:

(a) On road:

(i) bicycle lane;

(ii) bicycle awareness zone (BAZ);

(iii) cycle route; and

(iv) bicycle/car parking lane; and

(b) Off road:

(i) footpath;

(ii) shared path;

(iii) separated path; and

(iv) bicycle path.

(3)

Provisions for ~~bicycle, pedestrian and shared paths~~ pathways and cycleways at structures.

(4)

Designers ~~shall~~ must consider the best way to provide for a safe uninterrupted movement of pedestrians and cyclists ~~and pedestrians~~.

The reference and source documents provide information on:

(i) acceptable widths and clearances;

(ii) types of ~~bicycle paths and pedestrian paths~~ pathways and cycleways;

(iii) handrails;

(iv) bridges;

(v) approach ramps;

(vi) safety; and

(vii) crime prevention through environmental design (CPTED) principles.

(5) Developments must make appropriate provision for the safe and convenient movement and provide accessibility of pedestrians and cyclists, both on-site and to and from surrounding networks. Design should include the provision of suitable routes and end-of-trip facilities to encourage and facilitate these forms of movement.

SC6.4.4.7.~~6~~ 5 End of trip facilities

(1) Where appropriate, consideration ~~should~~ must be given to the provision of adequate facilities at destinations for pedestrians and cyclists, ~~so as~~ to encourage the usage of the pathways and cycleways.

(2) Such facilities could include:

(a) seats;

(b) secure bicycle parking;

(c) toilets and showers; and

(d) picnic facilities.

(3) The provision of bicycle parking ~~should~~ must meet appropriate criteria discussed in the *Austroads Guide to Traffic Management Part 11: Parking* and in accordance with AS 2890.3.

SC6.4.4.7.~~5~~ 6 Signage and pavement marking

(1) Adequate signage design for ~~bicycle paths and pedestrian paths~~ pathways and cycleways ~~is to~~must be provided.

(2) Signs and pavement marking ~~will~~ must provide for the safe and convenient use of the facility. The signs and pavement marking ~~will~~ must comply with *MUTCD* and SC6.4.4.8 Standard drawings, SC6.4.6.22 Pavement markings and SC6.4.6.24 Signposting.

SC6.4.4.7.7 Design standards

(1) Notwithstanding the guidelines provided in this sub-section and referenced documents, the following minimum standards have been determined as shown in Table SC6.4.4.7.1. Where these values are less than those in the referenced documents, Table SC6.4.4.7.1 may only be used in special circumstances with separate approval.

Table SC6.4.4.7.1 Minimum design standards

	Footpath	Shared Path
Path width	1.5 m minimum preferred 1.5 m minimum for one wheelchair and pedestrian (people with disabilities) 1.8 m desirable minimum for two wheelchairs	2.5 m absolute minimum 3~~.0~~ m – 4~~.0~~ m (3.5 m desirable) major recreation paths
Crossfall	2.5% maximum (1 in 40) Aids people with a disability	2.5% maximum (1 in 40)
Gradient	1:33 25 m interval* 1:20 15 m interval* 1:14 9 m interval for ramps*	1:33 25 m interval* 1:20 15 m interval* 1:14 9 m interval for ramps*
* Level rest areas 1.2m long should be provided if length is exceeded, and at each change in direction Intervals between 1:33 and 1:20 should be interpolated		
Lateral clearance beside path	0.3 m absolute minimum	1~~.0~~ m desirable (cycling) 0.5 m absolute minimum (0.3 m absolute minimum fencing smooth features aligned parallel)
Vertical clearance	~~2.2~~ 2.5 m (pedestrians)	2.5 m (cyclists)

Formation Width: During the design process allow 0.5 m minimum either side of reinstatement works. Ensure design for free draining across surface of the verge so as to not create ponding or tripping hazards.

Alternative situations

<table>
<tr><th></th><th colspan="3">Separated Path</th><th>Bicycle Path</th></tr>
<tr><td rowspan="4">Path width</td><td colspan="3">Two-way</td><td rowspan="4">2.5m acceptable minimum
3.0m desirable for high speeds
2.0m absolute minimum very low use at all times</td></tr>
<tr><td>Bicycle Path
2.5m desirable minimum</td><td>Footpath
2.0m desirable
≥1.5m absolute minimum</td><td>Total
4.5m</td></tr>
<tr><td colspan="3">One-way</td></tr>
<tr><td>Bicycle Path
1.5m desirable
2.0m maximum</td><td>Footpath
1.5m</td><td>Total
3.0m</td></tr>
<tr><td>Crossfall</td><td colspan="3">2.5% maximum (1 in 40)</td><td>2%-4% on sealed surfaces
Up to 5% on unsealed surfaces</td></tr>
<tr><td>Gradient</td><td colspan="3">1:33 25m interval*
1:20 15m interval*
1:14 9m interval for ramps*</td><td>3% maximum 200m
5% maximum 20m (if 3% cannot be achieved)
Steeper gradients should not be provided unless unavoidable</td></tr>
<tr><td>Superelevation for cycling</td><td colspan="3">2.5% maximum</td><td>Consider horizontal radii
2.5% desirable
Can go greater than or equal to 3% dependent on site and situation</td></tr>
<tr><td colspan="5">* Level rest areas 1.2m long should be provided if length is exceeded, and at each change in direction intervals between 1:33 and 1:20 should be interpolated</td></tr>
</table>

(2) To assist with the safety of pedestrians and cyclists during night time use, illumination of ~~a bicycle, pedestrian or shared paths~~ the off road pathways and cycleways may be required. The lighting ~~is to~~must be designed in accordance with AS/NZS 1158.3.1 Pedestrian area (Category P) lighting – Performance and design requirements and SC6.4.3.20 Public lighting and utilities services

(3) Safety and good alignment should not be compromised by inappropriate landscaping. The principles of crime prevention through environmental design (CPTED) should be a key design focus.

(4) Tactile ground surface indicators (TGSI) where required ~~shall~~ must be:

(5)

(a) standard yellow Polyurethane Tactile Indicator Studs (warning tactiles) and bars (directional tactiles), drill and lock installation; and
~~refer manufacturers specification for application details.~~

(b) supplied and installed in accordance with AS/NZS 1428.4.1, providing correct illuminance contrast; and AS 1428.1 and AS 4586 Slip Resistance of Pedestrian Surfaces and as per manufacturers specifications and in accordance with AS 1884.
~~. standard yellow Polyurethane Tactile Indicator Studs (warning tactiles) and bars (directional tactiles), refer manufacturers specification for application details.~~

(6) Kerb ramps ~~are to~~must be:

(a) in accordance with the standard drawings see SC6.4.3.3.3(3)(b) - SD-025: Kerb Ramp,

(b) in accordance with AS1428.1 *Design for Access and Mobility, Part 1: General requirements for access – New Building Works;*

(c) installed facing the direction of travel and aligned parallel and perpendicular with opposite kerb ramp ;

(d) located as per requirements for the flow of pedestrian traffic and the position of the signal button;

(e) constructed of broom finished plain natural concrete;

(f) installed with sharp transitions between adjacent surfaces (top and bottom); and

(g)Installed with Tactile Ground Surface Indicators (TGSI) in accordance with AS/NZS 1428.4.1 *Design for Access and Mobility, Part 4.1: Means to assist the orientation of people with vision impairment – Tactile ground surface indicators.*

~~**SC6.4.4.7.8 9 Documentation**~~

~~All drawings shall be in accordance with the minimum drafting requirements in SC6.4.2 Development application guidelines.~~

SC6.4.4.8 Standard drawings

(1) Introduction

This sub-section comprises the current Townsville City Council standard drawings.

Standard drawings show the minimum standard that council has adopted with regard to certain types of work. Standards have been developed for works on drainage, irrigation, roads, sewerage, transport, water and other miscellaneous activities.

(2) List of standard drawings

Table SC6.4.4.8.1 Townsville City Council standard drawings for drainage ~~(4)~~
Table SC6.4.4.8.2 Townsville City Council standard drawings for irrigation ~~(82)~~
Table SC6.4.4.8.3 Townsville City Council standard drawings for roadworks ~~(28)~~
Table SC6.4.4.8.4 Townsville City Council standard drawings for sewerage ~~(28)~~
Table SC6.4.4.8.5 Townsville City Council standard drawings for transport ~~(21)~~
Table SC6.4.4.8.6 Townsville City Council standard drawings for water ~~(21)~~

Table SC6.4.4.8.1 Townsville City Council standard drawings for drainage ~~(4)~~

Drawing No.	Title	Revision No.
SD-200	Precast Grated Kerb Inlet System and Cast Insitu Stormwater	C
SD-205	Stormwater Manhole Details	C
SD-210	Precast Stormwater Manhole – Slab Top Details	A
SD-215	Raised Grate Field Inlet Manhole	A

Table SC6.4.4.8.2 Townsville City Council standard drawings for irrigation ~~(82)~~

Drawing No.	Title	Revision No.
SD-4.1	XR 1 - 4 Panel and Screw Hole Layout	-
SD-4.2	XR 1 - 4 Terminal Layout and Power Diagram	-
SD-4.3	XR 1 - 4 Control Enclosure	-
SD-4.4	¤ XR 1 - 4 Base and Antenna	-
SD-4.5	XR 1 - 4 Preferred Equipment List – Controller and Telemetry	-
SD-5.1	AC Irrinet ACE DR 24 – 48 Panel Layout	-
SD-5.2	AC Irrinet ACE DR 24 – 48 Terminal Layout	-
SD-5.3	AC Irrinet ACE DR 24 – 48 Control Enclosure	-
SD-5.4	AC Irrinet ACE DR 24 – 48 Base and Pole	-
SD-5.5	AC Irrinet ACE DR 24 – 48 Electrical Diagram	-
SD-5.6	AC Irrinet ACE DR 24 – 48 Screw Holes	-
SD-5.7	AC Irrinet ACE DR 24 – 48 Preferred Equipment List – Controller and	-
SD-5.8	AC Irrinet ACE DR 24 – 48 Panel Layout Photo	-
SD-5.9	AC Irrinet ACE DR 24 – 48 Chassis Mounting Photo	-
SD-5.10	AC Irrinet ACE DR 24 – 48 Door Layout Photo	-
SD-7.1	Irrigation Design Data Example	-
SD-7.2	Irrigation Cabling Wiring Schedule Example	-
SD-8.1	Plan Conventions	-
SD-9.1	Survey Dimensions	-
SD-10.1	Water meter assembly 50MM and Above Type A	-
SD-10.2	Water meter assembly 50MM and Above Type B	-
SD-10.3	Water meter assembly 25M-32MM Type A	-
SD-10.4	Water meter assembly 25M-32MM Type B	-
SD-10.5	Water Meter Stands	-
SD-10.6	Valve Assembly Side View	-
SD-12.1	Sprinkler Installation	-
SD-12.2	Sprinkler Riser Large and Small	-
SD-13.1	Subdivision Services Allocation (figure 1, 2, 3, 4, 5, 6)	-
SD-14.1	Drip Irrigation Overview	-
SD-14.2	Drip Valve Assemblies	-

Drawing No.	Title	Revision No.
SD-14.3	Drip Valve Assembly 25MM and 40MM Internal Reg	-
SD-14.4	Drip Valve Assembly 25MM External Reg	-
SD-15.1	Drip Tube Holding Pin	-
SD-16.1	Curved Road Sprinkler Layout	-
SD-17.1	Conduit Placement in Valves	-
SD-17.2	Valve Assembly - Plan View and Electrical Pit	-
SD-18.1	Typical Pipe Trench Details	-
SD-19.1	Scheduling Co-efficient	-
SD-20.1	AC Irrinet M Slave 12 – 24 Panel Layout	-
SD-20.2	AC Irrinet M Slave 12 – 24 Terminal Layout	-
SD-20.3	AC Irrinet M Slave 12 – 24 Control Enclosure	-
SD-20.4	AC Irrinet M Slave 12 – 24 Base and Pole	-
SD-20.5	AC Irrinet M Slave 12 – 24 Electrical Diagram	-
SD-20.6	AC Irrinet M Slave 12 – 24 Screw Holes	-
SD-20.7	AC Irrinet M Slave 12 – 24 Preferred Equipment List – Controller and	-
SD-21.1	AC Irrinet M Slave 36 – 48 Panel Layout	-
SD-21.2	AC Irrinet M Slave 36 – 48 Terminal Layout	-
SD-21.3	AC Irrinet M Slave 36 – 48 Control Enclosure	-
SD-21.4	AC Irrinet M Slave 36 – 48 Base and Pole	-
SD-21.5	AC Irrinet M Slave 36 – 48 Electrical Diagram	-
SD-21.6	AC Irrinet M Slave 36 – 48 Screw Holes	-
SD-21.7	AC Irrinet M Slave 36 – 48 Preferred Equipment List – Controller and	-
SD-22.1	AC Irrinet M 12 – 24 Panel Layout	-
SD-22.2	AC Irrinet M 12 – 24 Terminal Layout	-
SD-22.3	AC Irrinet M 12 – 24 Control Enclosure	-
SD-22.4	AC Irrinet M 12 – 24 Base and Pole	-
SD-22.5	AC Irrinet M 12 – 24 Electrical Diagram	-
SD-22.6	AC Irrinet M 12 – 24 Screw Holes	-
SD-22.7	AC Irrinet M 12 – 24 Preferred Equipment List – Controller and	-
SD-23.1	AC Irrinet M 36 – 48 Panel Layout	-
SD-23.2	AC Irrinet M 36 – 48 Terminal Layout	-
SD-23.3	AC Irrinet M 36 – 48 Control Enclosure	-
SD-23.4	AC Irrinet M 36 – 48 Base and Pole	-
SD-23.5	AC Irrinet M 36 – 48 Electrical Diagram	-
SD-23.6	AC Irrinet M 36 – 48 Screw Holes	-
SD-23.7	AC Irrinet M 36 – 48 Preferred Equipment List – Controller and	-
SD-26.1	Door Bracket	-
SD-26.2	Door Bracket Position	-
SD-26.3	Door Bracket – Irrinet M	-
SD-26.4	Door Bracket Position – Irrinet M	-
SD-27.1	Enclosure Earth Wiring	-
SD-28.1	Transceiver Interface Cable Type 1	-
SD-28.3	Aux Data Cable – RJ45 Modified Crossover Cable	-
SD-29.1	Rain Switch Installation	-
SD-31.1	Hydrometer Covers 50mm – 100mm	-
SD-31.2	Multijet Covers 25mm - 32mm	-
SD-32.1	Drinking Fountain Assembly	-
SD-32.2	Drinking Fountains Base	-
SD-33.1	Valve Nest Cover (sheet 1)	-
SD-33.2	Valve Nest Cover (sheet 2)	-
SD-33.3	Valve Nest Cover (sheet 3)	-
SD-33.4	Valve Nest Cover (sheet 4)	-

Table SC6.4.4.8.3 Townsville City Council standard drawings for roadworks ~~(28)~~

Drawing No.	Title	Revision No.
SD-001	Typical Road Cross Sections – Urban Streets	B
SD-002	Typical Road Cross Sections – Collector Roads	B
SD-003	Typical Road Cross Sections – Sub Arterial Roads	B
SD-004	Typical Road Cross Sections – Arterial Roads	B
SD-005	Typical Road Cross Sections – Industrial Roads	B
SD-006	Typical Road Cross Sections – B-Double Turning Path and Access Plan Example	B
SD-010	Typical Road Cross Sections – Rural Roads	B
SD-015	Verge Service Corridors – General Type Sections	E
SD-020	Concrete Kerbing	D
SD-025	Kerb Ramp	D
SD-030	Driveway Access Urban Residential Properties	I
SD-031	Driveway Access Industrial Properties	G
SD-032	Driveway crossovers urban residential properties	F
SD-055	Road Crossing and Footpath Reinstatement for Trench Laid Services	A
SD-060	Traffic Sign Installation	A
SD-065	Street Name Sign and Installation Details	A
SD-066	Miscellaneous Traffic Details – Shared Path Terminal Treatments Deflection Rail	B
SD-067	Miscellaneous Traffic Details – Pedestrian Refuge and Holding Rail	A
SD-070	Concrete Pathway Reinforced Concrete (Mesh) Alternative	D
SD-075	Concrete Pathway Reinforced Concrete (Fibre) Alternative	E
SD-080	Subsoil Drain	D
SD-085	Kerb and Channel Drainage Connections	A
SD-090	Driveway Access Rural Properties Type 1 - Access With Invert Slab	B
SD-091	Driveway Access Rural Properties Type 2 - Conc. Access With Culvert Cast	B
SD-092	Driveway Access Rural Properties Type 3 - Gravel Access With Culvert Cast	B
SD-093	Driveway Access Rural Properties Type 4 - Conc. Access With Culvert Inverted	B
SD-094	Driveway Access Rural Properties Type 5 - Gravel Access With Culvert Inverted	B
SD-095	Driveway Access Rural Properties Type 6 – Access With Culvert Cast Insitu	B
SD-096	Driveway Access Rural Properties Type 7 - Conc. Access With Culvert	B
SD-097	Driveway Access Rural Properties Type 8 - Gravel Access With Culvert	B

Table SC6.4.4.8.4 Townsville City Council standard drawings for sewerage ~~(28)~~

Drawing No.	Title	Revision No.
SD-400	~~Townsville Water~~ Sewerage Standard Drawing List	B
SD-405	Legends for Sewerage Drawings	B
SD-410	Typical Layout of Sewerage Details Example Plan	A
SD-411	Sewer Maintenance Shaft Typical Layout	A
SD-420	Small Sewerage Pump Stations Typical Plans, Sections and Details	B
SD-421	Sewerage Pump Stations Package Fibre Reinforced Plastic	A
SD-425	Small Sewerage Pump Stations Two Part Access Cover and Frame	B
SD-430	Sewerage Pump Stations Safety Grill Details	B
SD-435	Sewerage Pump Stations Washdown Service Installation	B
SD-440	Pressure Main Discharge to Maintenance Hole	B
SD-445	Overflow Maintenance Hole Arrangement	B

Drawing No.	Title	Revision No.
SD-450	Vents at Sewerage Rising Main Receiving Inspection Chambers and Pump	C
SD-455	Property Connection Details Buried Interface Method	C
SD-460	Embedment and Trench Fill Typical Arrangement (sewer)	B
SD-461	Pipe Embedment Support Types	B
SD-463	Special Embedment - Piles, Concrete and Stabilised Supports	B
SD-470	Maintenance Holes - Sewers Less Than DN300 Cast In-Situ	B
SD-471	Maintenance Holes - Sewers Less Than DN300 Changes In Level Details and	B
SD-473	Maintenance Holes - Typical Channel Details	B
SD-474	Maintenance Holes - Alternative Drop Connections	C
SD-475	Maintenance Holes - Typical MH Cover Arrangements	B
SD-476	Maintenance Holes - Sewer DN375 to DN750	B
SD-480	Design Layouts - Longitudinal Sections	A
SD-481	Soil Classification Guidelines and Allowable Bearing Pressures for	A
SD-482	Trench Drainage Bulkheads and Trenchstop (sewer)	A
SD-483	Trench Drainage Typical Systems (sewer)	A
SD-484	Maintenance Holes - Pipe Connection Details	A
SD-485	Maintenance Holes - Connection Details DN110 to DN450 PE Pipes	A

Table SC6.4.4.8.5 Townsville City Council standard drawings for transport ~~(21)~~

Drawing No.	Title	Revision No.
SD-500	Standard Bus Shelter Framing Details Sheet 1 of 2	E
SD-502	Standard Bus Shelter Slab and Footing Details Sheet 2 of 2	D
SD-505	Regional Bus Shelter Framing Details Sheet 1 of 2	C
SD-510	Regional Bus Shelter Construction Details Sheet 2 of 2	C
SD-515	Standard Bus Stop Urban Location Layout Details Type 1 and 2	D
SD-520	Regional Bus Stop Urban Location Layout Details Type 3 and 4	D
SD-525	Basic Bus Stop Layout Details Urban Location	B
SD-530	Standard Bus Stop Urban and Rural Locations Layout Details Type 7	B
SD-535	J Pole, Timetable Display Case, Rubbish Bin and Sleeve Installation	D
SD-540	School Bus Bus Stop Sign Details	B
SD-545	Bus Setdown – Urban Locations Layout Details	A
SD-550	Bus Setdown – Parking and Indented Details Urban Locations	A
SD-555	Bus Setdown Rural Location Layout Details	C
SD-560	Bus Setdown Rural Location Table Drain Culvert Crossing	C
SD-565	Bus Setdown Rural Location Table Drain Grated Culvert Crossing	B
SD-570	Standard-Country Bus Shelter – Framing, Slab and Footings Details	A
SD-575	Standard-City Bus Shelter ~~Steel Work and Concrete~~Framing Details	B
SD-580	Standard-City Bus Shelter ~~Steel Work Connection~~Slab and Footing	B
SD-585	Standard-City Bus Stop Urban Location Layout Details - Type 9 and	B
SD-590	Parking for People with Disabilities	A
SD-595	Taxi Rank	A
SD-596	Taxi sign details	A

Table SC6.4.4.8.6 Townsville City Council standard drawings for water ~~(21)~~

Drawing No.	Title	Revision No.
SD-300	Water Standard Drawing List	B
SD-305	Street Positioning of Mains, Valves, Hydrants and Domestic Water Service	B
SD-310	Domestic Water Service Connections for 20mm Diameter Water Meters Rural	B
SD-315	Typical Mains Construction Reticulation Main Arrangements	B
SD-320	Typical Mains Construction Connection to Existing Mains	B
SD-325	Embedment and Trench Fill Typical Arrangement (water)	B
SD-330	Standard Embedment - All Pipe Types	B
SD-335	Special Embedments - Inadequate and Poor Foundation	B
SD-340	Special Embedments - Concrete, Geotextile and Cement Stabilised	B
SD-345	Valve and Hydrant Identification - Identification Markers and Marker	B
SD-350	Typical Valve and Hydrant Installation Valve Arrangement	B
SD-355	Typical Valve and Hydrant Installation Hydrants and Air Relief Valves	B
SD-360	Typical Appurtenance Installation Scour Arrangements	B
SD-370	Soil Classification Guidelines and Allowable Bearing Pressures for Anchors and	A
SD-371	Thrust Block Details - Concrete Blocks	A
SD-372	Thrust and Anchor Blocks - Gate Valves and Vertical Bends	A
SD-373	Restrained Joint System DN100 to DN375 DI Mains	A
SD-374	Trench Drainage Bulkheads and Trenchstop (water)	A
SD-375	Trench Drainage Typical Systems (water)	A
SD-376	Buried Crossings Bored and Jacked Encasing Pipe Details	A
SD-377	Flanged Joints Bolting Details	A

SC6.4.5 Construction management

(1) This section outlines the standards and provides advice and guidelines for construction management of development and covers pre-construction, construction and quality management systems.

(2) All development works shall be supervised by a Registered Professional Engineer of Queensland with relevant experience. Where the owner or developer does not have such a Professional Engineer in their employ, a Registered Consulting Professional Engineer shall be retained for the purpose of supervising the development works prior to commencement of work.

(3) This section aims to clearly define the role of council, Superintendent, Consultant, Principal Contractor and the Developer. This section seeks to ensure that inherited development works are constructed to achieve a cost effective operation and maintenance asset and perform adequately for their design lives.

(4) Reference and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.1 Water sensitive urban design construction and establishment guidelines
SC6.4.6.2.5 Pipeline testing and restoration (Water supply sub-section)
SC6.4.6.3.4 Pipeline testing and restoration (Sewerage system sub-section)
SC6.4.6.19 Stabilisation
SC6.4.6.22 Pavement markings
SC6.4.6.29 Boundary fencing
SC6.4.6.30 Control of traffic

(b) Australian Standards

AS 1012.1	*Methods of testing concrete - Sampling of fresh concrete*
AS 1012.3.1	*Methods of testing concrete - Determination of properties related to the consistency of concrete - Slump test*
AS 1012.14	*Methods of testing concrete - Method for securing and testing cores from hardened concrete for compressive strength*
AS 1012.4	*Methods of testing concrete - Determination of properties related to the consistency of concrete - Compactibility index*
AS 1012.8	*Methods of testing concrete - Method of making and curing concrete*
AS 1012.9	*Methods of testing concrete - Determination of the compressive strength of concrete specimens*
AS 1141.11	*Methods for sampling and testing aggregates - Particle size distribution*
AS 1141.12	*Methods for sampling and testing of aggregates - Materials finer than 75 micrometre in aggregates (by washing)*
AS 1141.14	*Methods for sampling and testing aggregates - Particle shape, by proportional caliper*
AS 1141.15	*Methods for sampling and testing aggregates - Flakiness index*
AS 1141.18	*Methods for sampling and testing aggregates - Crushed particles in coarse aggregate derived from gravel*
AS 1141.22	*Methods for sampling and testing aggregates - Wet/dry strength variation*
AS 1141.23	*Methods for sampling and testing aggregates - Los Angeles value*
AS 1141.24	*Methods for sampling and testing aggregates - Aggregate soundness - Evaluation by exposure to sodium sulphate solution*

AS 1141.25	*Methods for sampling and testing aggregates - Degradation factor*
AS 1141.25.1	*Methods for sampling and testing aggregates - Degradation factor - Source rock*
AS 1141.42	*Methods for sampling and testing aggregates - Pendulum friction test*
AS 1160	*Bituminous emulsions for the construction and maintenance of pavements*
AS 1289.3.2.1	*Methods of testing soils for engineering purposes - Soil classification tests - Determination of the plastic limit of a soil - Standard method*
AS 1289.3.3.1	*Methods of testing soils for engineering purposes - Soil classification tests - Calculation of the plasticity index of a soil*
AS 1289.3.6.1	*Methods of testing soils for engineering purposes - Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving*
AS 1289.3.7.1	*Methods of testing soils for engineering purposes - Soil classification tests - Determination of the sand equivalent of a soil using a power-operated shaker*
AS 1289.4.2.1	*Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method*
AS 1289.4.3.1	*Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the pH value of a soil - Electrometric method*
AS 1289.4.4.1	*Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the electrical resistivity of a soil - Method for sands and granular materials*
AS 1289.5.1.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort*
AS 1289.5.2.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density or moisture content relation of a soil using modified compactive effort*
AS 1289.5.4.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.5.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the minimum and maximum dry density of a cohesionless material - Standard method*
AS 1289.5.7.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Hilf density ratio and Hilf moisture variation (rapid method)*
AS 1289.5.8.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of field density and field moisture content of a soil using a nuclear surface moisture–Density gauge - Direct transmission mode*
AS 1289.6.1.1	*Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen*

AS 1432	*Copper tubes for plumbing, gasfitting and drainage applications*
AS 1477	*PVC pipes and fittings for pressure applications*
AS 1478	*Chemical admixtures for concrete, mortar and grout*
AS 1580.107.3	*Paints and related materials - Methods of test - Determination of wet film thickness by gauge*
AS 1741	*Vitrified clay pipes and fittings with flexible joints - Sewer quality*
AS 1742.3	*Manual of uniform traffic control devices - Traffic control for works on roads*
AS 2008	*Bitumen for pavements*
AS/NZS 2032	*Installation of PVC pipe systems*
AS 2129	*Flanges for pipes, valves and fittings*
AS 2280	*Ductile iron pipes and fittings*
AS 2150	*Hot mix asphalt - A guide to good practice*
AS 2544	*Grey iron pressure fittings*
AS 2638	*Gate valves for waterworks purposes*
AS 2758.1	*Aggregates and rock for engineering purposes - Concrete aggregates*
AS 2891.9.3	*Methods of sampling and testing asphalt - Determination of bulk density of compacted asphalt - Mensuration method*
AS/NZS 1477	*PVC pipes and fittings for pressure applications*
AS 3439	*Low-voltage switchgear and controlgear assemblies*
AS 3582.1	*Supplementary cementitious materials for use with portland and blended cement - Fly ash*
AS 3583.1	*Methods of test for supplementary cementitious materials for use with portland and blended cement - Determination of fineness by the 45 micrometre sieve*
AS 3583.12	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of available alkali*
AS 3583.13	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of chloride ion content*
AS 3583.14	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of insoluble residue content*
AS 3583.2	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of moisture content*
AS 3799	*Liquid membrane-forming curing compounds for concrete*
AS/NZS 3905.12	*Quality system guidelines - Guide to AS/NZS ISO 9001 for architectural and engineering design practices*
AS 3952	*Water supply - Spring hydrant valve for waterworks purposes*

AS 3972	*General purpose and blended cements*
AS 4198	*Precast concrete access chambers for sewerage applications*
AS 4373	*Pruning of Amenity Trees*
AS/NZS 4455	*Masonry units, pavers, flags and segmental retaining wall units*
AS 4687	*Temporary Fencing and Hoardings*
AS 4970	*Protection of trees on development sites*
AS 5101.4	*Methods for preparation and testing of stabilized materials - Unconfined compressive strength of compacted materials*
AS/NZS ISO 9001	*Quality management systems - Requirements*
AS ISO 10006	*Quality management systems - Guidelines for quality management in projects*
AS ISO 10006	*Quality management systems - Guidelines for quality management in projects*
AS ISO 10013	*Guidelines for quality management system documentation*

(c) Department of Transport and Main Roads

Standard specifications roads

MRTS17 - Bitumen
MRTS18 - Polymer Modified Binder
MRTS21 - Bituminous Emulsion
MRTS22 - Supply of Cover Aggregate
MRTS30 - Dense Graded and Open Graded Asphalt

Materials testing manual

Q103A Particle size distribution (wet sieving)
Q104A - Liquid limit (cone penetrometer)
Q104D - One-point liquid limit (cone penetrometer)
Q105 - Plastic limit and plasticity index
Q113A - California bearing ratio (standard compactive effort)
Q115 - Unconfined compressive strength of compacted materials
Q142A - Dry density- moisture relationship (standard compaction)
Q201 - Flakiness index
Q205B - Ten percent fines value (wet)
Q205C - Wet/dry strength variation
Q208A - Degradation factor (source rock)

(d) Other

ASTM International, ASTM-D 2434-68 - *Standard Test Method for Permeability of Granular Soils (Constant Head)*
Environmental Protection (Noise) Policy (EPP (Noise))
International Erosion Control Association, *Best Practice Erosion and Sediment Control Document (BPESC)*
NSW Department of Transport, Roads and Maritime Services (RMS), *Test method T432: Rate of slaking of quicklime, October 2012*
TCC-001
Work Health and Safety Act 2011

SC6.4.5.1 Pre-construction guidelines

SC6.4.5.1.1 Pre-construction steps

The chart presented below indicates the steps required to be undertaken prior to commencement of works.

(1) Notice to commence works

The Developer must give council's Development Assessment Unit (DAU) notification of at least 5 business days (in writing) of their intention to commence construction works. Refer to SC6.4.5.1 Attachment A Development works – notice to commence works. Refer to the Development works - notice to commence works form for a list of requirements to be submitted prior to or at the pre-start meeting.

(2) Pre-start meeting

The nominated Consultant must ensure that a pre-start meeting is conducted on the premises between the contractor, supervising engineer (RPEQ), the design consultant and council representatives. This meeting represents a hold point and works may not proceed until the meeting is held and any further requirements identified during the course of the meeting have been satisfied. The pre-start meeting must be based on an agenda which includes:

(a) introduction of the principal contractor, supervising engineer (RPEQ), design consultant (including any specialist) and council representative. A statement of their respective roles and relevant personnel contact details must also be tabled and distributed at that meeting;

(b) confirmation that all relevant statutory permits/approvals have been obtained;

(c) evidence of current public liability insurance. Refer to SC6.4.5.2(21~~0~~) Insurance and

(d) indemnity; review and discussion of all relevant conditions of the development approval;

(e) review and confirmation of the site establishment and access arrangements including all necessary site security fencing and signage requirements;

(f) review and discussion of the approved traffic management plan and haulage routes if applicable;

(g) review and discussion on a schedule of "hold-points" to be adopted throughout the construction phase. This schedule of "hold-points" is to be approved by council prior to construction proceeding;

(h) discussion of site specific workplace health and safety issues and an approved work method statement and safety plan in compliance with the *Work Health and Safety Act 2011*;

(i) review of the approved erosion and sediment control plan including site base stormwater management

plans and sediment controls during and post construction. Refer to SC6.4.5.2(11~~2~~) Erosion and sediment control and SC6.4.3.8 Stormwater quality management plans for further details regarding this requirement;

(j) location confirmation and identification of all existing public utilities, services and council assets if applicable, including any approved demolition/rectification actions if required;

(k) scheduling and identification of all necessary responsible persons to undertake any council required works (e.g. disconnection of irrigation systems, sewer line connections etc.);

(l) review of the vegetation protection plan if applicable and confirmation that any necessary vegetation protection measures are in place;

(m) construction schedule and program and any other details that requires review before construction work commences e.g. work quality plan and/or quality manual review of quality requirements (SC6.4.5.3 Quality management system) and inspection test plan requirements;

(n) if required, a development notice (project sign in accordance with SC6.4.5.2.1(6) Development notice) is to be erected;

(o) confirmation of possession of site by the contractor; and

(p) any other relevant matters specified by the principal contractor, supervising engineer (RPEQ), consultant/s and/or council representative that may be pertinent to the successful completion of the project.

Attachments

SC6.4.5.1 Attachment A Development works - notice to commence works form

Click here to view SC6.4.5.1 Attachment A Development works - notice to commence works form

Note—this form is to be completed, signed and submitted to council by the developer at least 10 working days prior to commencement of any development works.

SC6.4.5.2 Construction

SC6.4.5.2.1 General standards and guidelines

The following are general standards and guidelines during the construction of development works:

(1) Superintendent

The superintendent is to be nominated or appointed by the supervising engineer (RPEQ) and must be supervised by the RPEQ at all times throughout the construction period. The supervising engineer (RPEQ) is to take full responsibility for all construction work on the development site.

(2) Hours of work

Unless otherwise approved by council (in writing), works involving machinery of any description shall only be carried out on site from 6.30am to 6.307:00pm Monday to Saturday, subject to legislative requirements. No construction work is to take place on Sundays and public holidays without prior approval. Construction work includes deliveries to the site of the works and the onsite servicing of equipment.

(3) Relocation/alteration and repair to existing utility services

The location and level of all existing public utilities and services and the alignment for any new service utility or service in association are to be identifiedwith the relevant authority or council asset owner. The developer is responsible for any relocation and/or alteration to any public utility installation required as a result of any works carried out in connection with this development at no cost to council.

The contractor is to ensure that utmost care is to be exercised during the progress of the development works to prevent damage to any existing utility or service. Any damage to existing utilities or services directly resulting from the development works shall be the responsibility of the developer.

(4) Provision for traffic management

No works shall be conducted within an existing public road without approval (i.e. Road work permit). Any proposed road closure (partial or full), or traffic diversion is to be presented (with full details of proposed traffic management) for approval. Proposed traffic management is to comply with the relevant sections of SC6.4.6.30 Control of traffic.

The developer is to ensure that all appropriate approvals and permits are obtained from council for work zones, gantries and scaffolding prior to commencement of construction.

The developer shall be held responsible for implementing the approved traffic management plan including the safety of all vehicles, pedestrians and cyclists and must provide all necessary measures to prevent any accident, damage and loss.

(5) Condition of entry to adjoining properties

The developer or its representative must effectively protect all adjoining properties against any loss, damage or injury that may occur as a result of development works.

Works must not be undertaken on adjoining properties without prior written consent of the lawful owner. All adjoining property which has been disturbed as a result of the development shall be reinstated to a finish similar to its pre-development state or to an alternative state agreed to in writing by the affected property owner.

Upon completion of the development works, written approval from any affected property owners will be required by council prior to acceptance of the completed development works.

(6) Development notice

Where required, a project sign is to be erected within the site boundaries on the road frontage of the subject site or any other council approved location that is prominent and visible to the public. The developer is responsible for maintaining the signage for the duration of the construction. The signage shall have the following information (as a minimum):

(a) description of development (include an overall concept plan);

(b) name of developer;

(c) name of project;

(d) street address of the site;

(e) supervising engineer's name and phone number;

(f) consultant's name and phone number;

(g) principal contractor's name and phone number; and

(h) other specialist consultants' names and phone numbers.

(7) Signage and security

All necessary signage and site security shall be provided wholly within the site and in strict accordance with current Workplace Health and Safety (QLD) guidelines and requirements.

(8) Site access

The construction site shall be accessed via one convenient access from a public road. The location and details of this access point is to be approved by council prior to construction commencing. This access point shall be used by all vehicles, equipment and personnel during the approved construction hours of the site. Appropriate vehicle "shake-down" facilities are to be provided at the point of access in accordance with appropriate water quality management objectives for the site. The vehicle shake-down facility is to be a minimum 1.5m long by 3m wide for one-way or 6m wide for two way entrances.

(9) Site fencing

The developer must erect a temporary man-proof fence to restrict unauthorised access into the construction site. The fence is to extend around the entire perimeter of the site with access being provided as outlined above. The developer is to refer to SC6.4.6.29 Boundary fencing for details of the temporary fence.

(10) Site management

The Contractor is responsible for the management of the construction site and control of construction activities throughout the period of works, with particular attention to reducing the impact of the construction work on the public, adjacent and nearby properties and other areas of the site not part of the works. The primary objective is to eliminate the impacts of the temporary and permanent works having regard to:

(a) work health and safety;

(b) erosion control;

(c) acid sulphate soils;

(d) run-off;

(e) traffic management;

(f) disposal of all materials;

(g) gaseous discharges and odour;

(h) noise; and

(i) dust.

Adjacent waterways shall be regularly monitored for turbidity plumes, algal blooms and dead marine life which may be attributable to the construction of the works.

(11) Erosion and sediment control

During the construction phase and up until council accepts the development works or at the end of the defect liability period the contractor shall be responsible for the installation and maintenance of all erosion and sediment control measures on site.

The approved erosion and sediment control plan (ESCP) submitted as part of the operational works or compliance application must be presented during the pre-start meeting. This plan must be presented to council's nominated representative for review and "fit-for-purpose" implementation on the site. If the ESCP

requires revision to suit the current conditions of the development site, the plan must be amended to achieve the approved set of water quality outcomes required by council. Upon approval of the ESCP, the procedures and guidelines outlined in the plan for establishing, managing (inspection and monitoring) and maintaining water quality across the development site shall be the responsibility of the contractor.

At the end of the agreed period of implementation and maintenance, all identified temporary sediment control measures must be removed by the developer and the ground reinstated to council's satisfaction.

(12) Suppression of dust

At all times the Contractor shall ensure that dust resulting from the proposed works, including excavation, backfilling, grading and stockpiles is kept to an absolute minimum. The standards for the suppression of dust are the Townsville City Council Management of Dust from Development Sites – Guidance for developing a dust emission control plan, found at SC6.4.5.2 Attachment B. ~~and to the satisfaction of council, by approved methods.~~

(13) Noise control

All construction work is to be undertaken pursuant to the *Environmental Protection (Noise) Policy (EPP (Noise))*. Construction works shall be carried out in accordance with the requirements and restrictions relating to hours of work specified in SC6.4.5.2.1(2) and the *Environmental Protection Act 1994*.; ~~relevant Local Laws and *EPP (Noise)*.~~

(14) Hazardous material

Hazardous materials ~~shall not be stored on site~~are to be stored in a hazardous goods store such that it is free from flood and storm tide inundation. The hazardous goods store must ensure that materials cannot enter the environment or cause a public safety nuisance or hazard. Hazardous goods may only be kept on site for the duration of construction and are to be safely removed from site at completion of works, unless otherwise approved by council.~~.~~

(15) Machinery refuelling

During construction, fuel and petroleum products shall not be stored on the site nor shall construction equipment and machinery be serviced on the site. Procedures shall be developed and implemented by the contractor for the refuelling of machinery and equipment which will minimise any potential for contamination of the site by way of spillage. The procedures shall ensure that refuelling on the site occurs within a designated area that does not drain directly into adjacent stormwater systems or waterways. Any procedures developed and implemented in this regard must include bunding of the refuelling area.

Any spillage of fuels and petroleum products during construction shall be reported to the superintendent. All steps necessary to rectify the contamination shall be undertaken by the contractor prior to the completion of the works and at no cost to council.

(16) Material storage

Materials shall not be stored on site unless approved in writing by the Superintendent or unless material storage details are shown on the drawings and approved by council.

All necessary measures shall be implemented to reduce the potential for environmental damage, which may arise from the storage of materials.

(17) Stockpiling of materials

Wherever possible, materials shall be installed directly in place or continually removed from site, eliminating the need for stockpiles. In all other cases, stockpiling of materials shall be on a temporary basis at the discretion of superintendent.

The location of approved stockpiles shall be in accordance with the ESCP and as a minimum stockpiles shall:

(a) Remain on site for as little time as practical;
(b) Be limited in height of 2m;
(c) Not to be located within 10m of a residential boundary;
(d) Have batter slopes, covers and drainage which limit the potential for erosion and/or segregation;

Bnaged in accordance with SC6.4.5.2 Attachment B;

e (a) The contractor is to erect and maintain a temporary sediment fence around all stockpiles for the duration of the stockpile being on the site.:

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a

(remain on site for as little time as is practical;
a
)
(be limited to a height of 2 m;
b
)
not to be located within 10 m of a residential boundary;
(have batter slopes, covers and drainage which limit the potential for erosion and/or segregation;
c
)
be aerated, rotated and watered at regular intervals as required to prevent degradation of the materials; and
(The contractor is to erect and maintain a temporary sediment fence around all stockpile/s for the
d
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~~duration of the stockpile being on the site.~~

(18) Vegetation disposal

Burning or burying of waste vegetation on site is not permitted unless otherwise approved by council. Clearing and grubbing of the development site shall otherwise be undertaken in accordance with SC6.4.6.11 Clearing and grubbing.

(19) Work adjacent to trees and protection of environmentally significant vegetation

(a) Protection of trees and vegetation – general

All existing and newly planted trees and vegetation should be noted on the drawings and protected from damage during construction. The approved vegetation protection plan should be available onsite prior to commencement and during works. The vegetation protection plan will identify key stages where monitoring and certification will be required.

As specified in the vegetation protection plan, a vegetation protection zone must be established on site to ensure the required retention of existing trees and vegetation identified for protection and retention. The vegetation protection zones must be identified as *"no-go"* areas for construction traffic and meet the following requirements:

(i) For trees, the extent of the vegetation protection zone is to be determined in accordance with the tree protection zone (TPZ) requirements of AS 4970 - *Protection of trees on development sites.*

(ii) For areas of vegetation not including trees, other areas of natural heritage or hydrologically sensitive features, the extent of the Vegetation Protection Zone is to be determined by a qualified arborist, ecologist, or other approved officer.

(iii) The Vegetation Protection Zone is to be fenced or barricaded to prevent unauthorised vehicle and machinery access, as per AS4970 *Protection of trees on development sites* and AS4687 *Temporary Fencing and Hoardings*.

(iv) Signage to indicate "Vegetation Protection Zone - No Access" should be installed as per AS4970 *Protection of trees on development sites* and AS1319 *Safety signs for the occupational environment*.

(v) Where required, the tree bark is to be protected by wrapping a triple layer of hessian or rubber matting around the tree trunk.

(vi) Fixing of temporary service wires, nails, screws, stays, guys and or any other fixing device to trees should be avoided.

(vii) No fuel, oil dumps or chemicals are allowed to be used or stored within the Vegetation protection zone and the servicing or re-fuelling of equipment and vehicles must be carried out away from the vegetation protection zones.

(viii) Deposition of wind-blown materials (such as cement) into the protection area should be avoided through the attaching of cloth to the Vegetation Protection Zone fencing.

(ix) Soil compaction and removal of top soil within the Vegetation Protection Zone is to be avoided. Where compaction occurs, hand methods to de-compact the soil should be used.

(x) No vehicles are to access or be parked within the Vegetation Protection Zone. Where traffic is unavoidable within the zone, a 300 mm thick layer of mulch over a geotextile fabric should be placed in the area to protect the trees surface roots and to reduce the risk of soil compaction.

(xi) No storage of material, equipment or temporary building is to take place within the Vegetation Protection Zone, including the placing of spoil from excavation against tree trunks.

(b) Fill and excavation near trees and vegetation

(i) Any underground service installations within the Vegetation protection zone must be bored and the utility authorities must utilise a common trench where possible. Where practical, trenching is to be combined with locations where roots need to be severed for other reasons.

(ii) Within the Vegetation protection zone, all excavation must be carried out by hand digging or with the use of "air-excavation" techniques.

(iii) Where required, trees roots or branches are to be cut cleanly without tearing, with clean, sharp tools (chainsaw, secateurs or hand saw) in accordance with the AS 4373 *Pruning of Amenity Trees* and under the supervision of a qualified arborist with formal qualifications (Level 3 Australian Qualification Framework) or at least 5 years recognised experience in arboriculture.

(iv) Cutting of tree roots exceeding 50 mm in diameter should be avoided. Where roots must be cut, this should not unduly disturb the remaining root system.

(v) Any ripped or torn roots are cleanly re-cut as soon as noted.

(vi) Roots to be left exposed for any period of time are covered with wet hessian and maintained in a moist condition until recovered.

(vii) Immediately after cutting of any roots, Copper Naphthanate or an equivalent alternative solution is to be applied to the cut surface to prevent the incursion of rot or disease - as deemed necessary.

(viii) Backfill to excavations around tree roots should be with a soil mix similar in consistency and pH value to that of the existing soil.

(ix) Backfill should be placed in layers of 300 mm loose depth and be compacted to a dry density similar to that of the original surrounding soil using hand methods or light compaction equipment.

(x) Backfill layers should generally match the soil horizon of the surrounding soil.

(xi) The depth of fill within the vegetation protection zone should not exceed 200 mm from the original surface level. Immediately after placing any fill around a tree, the area should be watered thoroughly.

(c) Trees to be transplanted

(i) Trees to be transplanted shall be noted on the drawings and/or shall be marked on site by the superintendent prior to the commencement of construction.

(ii) Requirements and procedures for transplanting of trees are to be issued by council for each particular species.

(d) Damage to tree or vegetation

(i) Any unauthorised removal, damage or disturbance undertaken prior to the identification of the protected zone/s (without the required approval) or within the identified protected zone/s shall be rehabilitated by the contractor to the satisfaction of council and at no cost to council.

(ii) In the event of an unauthorised removal and that rectification works to damaged tree/s or vegetation is impractical, or the rectification work has been carried out by the contractor and is rejected by council, then council may direct the contractor to remove the trees/vegetation as part of the rectification work. The contractor will:

(A) replace the damaged tree/vegetation with a tree/vegetation of the same species and similar size to council's satisfaction; or

(B) replace the damaged tree/vegetation with a tree/vegetation of a similar size but different species to council's satisfaction; or

(C) pay for the cost of replacing the tree/vegetation with the same size and species to council's satisfaction;or

(D) replace the damaged tree/vegetation with a smaller tree/vegetation of an approved species and pay for the difference in cost between the new replacement and a specimen of the same size and species, to council's satisfaction.

(iii) The replacement value of an existing tree/vegetation will be calculated using the Revised Burnley Method under the Draft Australian Standard DR99307 *Amenity Trees – Guide to Valuation system*.

(20) Stormwater quality

Development works may cause changes to the quality, quantity and flow rate of stormwater discharged from the site. During the construction phase where soil disturbance and construction activity significantly increases the risk of soil erosion or where the development is required to implement a Stormwater Quality Management Plan (SQMP) that has been approved during the operational works approval phase. Council will then require a detailed maintenance regime to control stormwater quality during the construction phase to be presented during the pre-start meeting for review and acceptance by council unless a detailed maintenance regime has

been presented and accepted by council during the design process.

If the development works involves construction of stormwater quality device/s or is part a catchment with an existing stormwater quality device, then the developer and his contractor must ensure that no stormwater discharge will be permitted to enter such device (directly or indirectly) unless otherwise permitted by council. Refer to SC6.4.6.1 Water sensitive urban design construction and establishment guidelines.

Any temporary stormwater quality device proposed as part of the development works is to be removed and any land or existing infrastructure disturbed or damaged during the installation of any temporary stormwater quality device shall be reinstated to its former condition to the satisfaction and at no cost to council.

(21) Insurance and indemnity

From the commencement of construction until council accepts the development works or the commencement of the maintenance period, the developer or contractor must insure the works against public liability ($10 million dollar minimum cover) and other claims arising from the works, and indemnify council against that liability. Council must be included as an interested party to the insurance policy. The developer must provide council with evidence and a certificate of currency for the insurance and indemnification before commencing the construction works.

(22) Dilapidation survey

Where required by council and where development is directly adjacent to existing infrastructure and improvements, it may be prudent for the developer or his contractor to carry out a dilapidation survey of all the existing adjoining structures prior to construction commencing. This may reduce any damage claims during the construction period. Any damages to adjacent structures as a result of the development works shall be the responsibility of the developer.

(23) Fencing

While undertaking development works, and where appropriate, site fencing is to be erected for the duration of construction activities. Fencing is required to restrict unauthorised site access and to ensure the safety of persons from the subject site and any works on the adjoining road reserve and/or premises.

If existing fencing is to be altered or if there is no existing site fencing, temporary fencing, as a minimum, shall be provided and maintained for the duration of the construction to prevent unauthorised entry into the property or work area from any adjoining road reserve or property. The reinstatement of fencing and removal of temporary fencing on completion of the work shall be undertaken.

A construction site may provide any additional amount of security and/or fencing that is considered necessary that will improve the safety of the public or persons working on the site.

(24) Environment

All work shall be carried out in such a manner as to avoid nuisance and/or ~~damage to the environment~~Environmental Harm. Development shall be planned and executed so that the works undertaken avoid contamination of the site and its surroundings by taking all reasonable and practical measures to prevent or minimise harm (general environmental duty).

Herbicides and other toxic chemicals shall not be used on the site without the prior written approval of the council or other relevant authority.

(25) Lighting

All lighting associated with the construction activity shall be installed and used so that lighting does not adversely affect the adjoining amenity of nearby sensitive uses, sensitive environmental areas or pose a safety hazard on adjacent road networks. All public road/street lighting systems must be designed in accordance with AS 1158 and must be approved by Ergon prior to construction.

(26) Blasting

Blasting will generally not be permitted. If blasting is necessary and there are no alternatives, it shall be carried

out strictly in accordance with SC6.4.6.10 Earthworks (construction) and any other relevant construction specifications found in SC6.4.6 of the Development manual.

(27) Vibration

Ground vibration levels, transmitted from the construction works, rock breaking, drilling, and piling, operating items of plant or other noisy activities shall not exceed levels that are close to the lower level of human perception nor is it to cause any unacceptable damage to any adjoining buildings or infrastructure. Acceptable practices and vibration thresholds shall be determined in accordance with current Statutory Regulations.

A complaints management system should be devised which includes corrective and preventative actions. Consultation with and information supplied to nearby residents, workers and any other sensitive noise receptors is to be undertaken when vibration is known to be generated and is considered sufficient to warrant notification.

Editor's note—the results and recommendations of reporting on noise and vibration, as detailed in SC6.4.3.15 Noise and vibration assessment guidelines, associated with a particular development will be required to be implemented.

Editor's note—the Contractor shall be responsible for any damage and compensation payments as a result of vibration.

The control of ground vibration as a result of blasting shall be strictly in accordance with SC6.4.6.10 Earthworks (construction) and any other relevant construction specifications found in SC6.4.6 of the Development manual and will be solely at the risk and responsibility of the developer.

SC6.4.5.4 Attachment B – Townsville City Council Management of Dust from Development Sites – Guidance for developing a dust emission control plan

SC6.4.5.4.1 Introduction

(1) Dust from demolition and construction work, if badly managed, can cause environmental nuisance and impact those living adjacent or near the work site. Impacts can affect quality of life and can lead to potential health impacts. Dust can also impact on the health and safety of workers on the construction site.

The Townsville region is forecast to have a population of over 300,000 in the next 25 years. In response to this Townsville City Plan has moved towards the concept of approving developments within the community where infrastructure already exists (infilling). This reduces the need for new infrastructure by utilising the existing and therefore creating a sustainable community.

Measures to prevent nuisance to existing residential developments will therefore be crucial to ensure the continual amenity within the community.

A dust emission control plan is a useful tool to identify where dust emitting activities are likely to occur and when, who might be affected by that activity and how it might be controlled. Implementing a dust emission control plan will also assist with compliance of the environmental nuisance provisions of the *Environmental Protection Act 1994*.

This document aims to assist in the development of a dust emission control plan by providing information on:

(a) how to complete a site impact assessment;
(b) provide information on the control and mitigation methods; and
(c) a monitoring program.

SC6.4.5.4.2 Legislative Framework

There are various sources of air pollutants (which include dust) that affect air quality, and that can cause harm or injury to persons. As a result there is a variety of legislative measures in place aimed at improving air quality or protecting persons from harm or injury. These are from a national, state and local level.

(1) National Legislation

National Environment Protection (Ambient Air Quality) Measure 1998.This national piece of legislation sets goals for various pollutants including particles.

(2) State Legislation

Environmental Protection Act 1994

At a State level the *Environmental Protection Act 1994*, *Environmental Protection Regulations 2008* and the *Environmental Protection (Air) Policy 2008* are in place to protect and improve air quality in Queensland.

The object of the *Environmental Protection Act 1994* is "to protect Queensland's environment while allowing for development that improves the total quality of life…" (Queensland Government, n.d.). Within this legislation is a requirement that environmental harm or nuisance must not be caused by an activity. Environmental harm and nuisance can be caused by contaminants which include particles such as dust.

Environmental Nuisance

Section 15 of the Act refers to the offence of environmental nuisance. This is when there is unreasonable interference with an environmental value.

Should dust be uncontrolled and causing an environmental nuisance as defined by the Act, the person causing the nuisance can be issued with a Direction Notice to remedy the situation; receive an on-the-spot fine; or in some cases, face prosecution.

General Environmental Duty

The general environmental duty, section 319 of the Act, makes it a requirement for a person to take all reasonable and practicable measures to minimise environmental harm.

Section 21 of the Act cites best practice environmental management which is the management of the activity to minimise environmental harm through cost effective measures. (Queensland Government, n.d.)

Environmental Protection Regulation & Policy

The *Environmental Protection Regulation 2008* provides a list of activities that require an environmental authority (EA) to operate. These EA's usually come with a suite of conditions which limit emissions and set the operating standards. Dust emission controls are often incorporated within these conditions.

The *Environmental Protection (Air) Policy 2008* (the Policy) provides a list of long term objectives which includes the emission limits for particles. Two examples of this are PM2.5 and PM10 which have been given a limit within this Policy to protect the environmental value of human health and wellbeing.

Section 9 of the Policy lays down the management hierarchy for air emissions. These are in order of preference:

(a) Avoid
(b) Recycle
(c) Minimise
(d) Manage

(3) Other Legislative Acts

Sustainable Planning Act 2009

The *Sustainable Planning Act 2009* requires that any development approval conditions that are placed upon a development must be relevant and reasonable. Conditions can include the requirement of documents including a dust emission control plan.

Public Health Act 2005

The dispersal or release of a by-product which could be hazardous to health, from construction or demolition work (not a workplace) is considered to be a public health risk. The release of asbestos fibres from demolition work or alterations from a home renovator is an example of this.

Work Health & Safety Act 2011

At a State level the *Work Health and Safety Act 2011* aims to secure the health and safety of workers in Queensland by protecting both the workers and other people from harm to their health, safety and welfare.

The Act lays down the requirement to ensure the health and safety of people through eliminating or minimising risks to health and safety.

Workplace Health and Safety Codes of Practice

There are a number of Codes of Practice which provide information about the health and safety obligations and the steps that need to be taken to ensure the health and safety of employees. Risks associated with the work should be identified, assessed and controls implemented to control the identified risks. Reviewing and maintaining the effectiveness of the controls should also be undertaken.

Formwork Code of Practice 2006

Formwork is the casting of concrete walls or columns.
Potential hazards during erection, alteration and/or dismantling formwork include noise and dust.
Engineering controls such as dust extraction or by wetting down can be used to minimise dust emissions.

Excavation Work Code of Practice 2013
Excavation work means involving the removal of rock or soil from a site to form an open face, hole or cavity. This is usually completed using tools, machinery or explosives.
Potential hazards include airborne and buried contaminants such as asbestos.

Demolition Work Code of Practice 2013
Demolition work means to demolish or dismantle a structure or part of a structure.
Hazardous materials associated with demolition include asbestos, lead, polychlorinated biphenyls (PCB's) and synthetic mineral fibres and dust.
A demolition plan might be prepared which may include how the demolition would affect neighbouring properties.

SC6.4.5.4.3 Background

(1) What is dust?

Dust is made up of solid, dry particles which are dispersed in the air and are usually between 1-100 µm (micrometre or micron) in diameter. Types of dust include:

- Metallic (e.g. lead, nickel)
- Mineral (e.g. cement, soil)
- Organic (e.g. wood)
- Biohazards (e.g. spores & moulds)

(2) Dust Sources

There are various sources of dust that can arise from a construction (or demolition) site. These include:

- Wind-blown dust from exposed surfaces from land clearing
- Mining and quarrying
- Crushing and screening activities
- Loading and unloading dusty material
- Wind-blown dust from stockpiling
- Vehicle movements from unsealed roads
- Wind-blown dust from demolition activities

(3) Health Impacts

Particles of dust can be inhaled into the body through the nose or mouth. Some of the larger particles are filtered within the nose; however the smaller particles can reach the lungs where they are deposited. Particles that are not cleared by the body can remain for a long time leading to an increased potential to cause disease.
The health effects of dust are associated with the particle size usually about 10 microns in size (called PM10.) (Ministry For the Environment New Zealand, n.d.). The Environmental Protection (Air) Policy 2008 has a PM10 limit of 50 micrograms per cubic metre within a 24 hour period.
There are a number of health risks associated with dust which include:

- Eye irritation
- Lung cancer
- Silicosis
- Asthma (Health & Safety Executive, n.d.)

(4) Nuisance Impacts

Under the Environmental Protection Act 1994, dust is considered an environmental nuisance when the release of dust interferes with an environmental value. Section 9 of the Act describes an

environmental value as:

(a) A quality or physical characteristic of the environment conducive to ecological health or public amenity or safety; or

(b) Another quality of the environment identified and declared under an environmental policy or regulation.

An example of nuisance is dust released from the grinding of paving slabs which is entering a neighbour's residence which then subsequently is affecting their health.

It is an offence to cause an environmental nuisance as per Section 440 of the Act and all reasonable steps should be taken to prevent the release of dust.

(5) Enforcement Options

Council has the authority to enforce both the *Environmental Protection Act 1994* and the *Sustainable Planning Act 2009*. Other State agencies including the Queensland Government enforce laws such as the Workplace Health & Safety legislation.

Under these laws there are various enforcement options available should breaches of the legislation occur. These include:

On-the-spot fines (All)

- Direction Notices (Env. Protection Act)
- Environmental Protection Orders (Env. Protection Act)
- Improvement Notices (WHS Act)
- Prohibition Notices (WHS Act)
- Prosecutions (All)

SC6.4.5.4.4 What is a dust emission control plan

A dust emission control plan is a document that records details of the construction site, what work will take place and when, and what mitigation methods will be used during the lifetime of the construction site.

A document will assist council with drafting and incorporating reasonable conditions about dust into development approvals and helps developers in understanding the requirements in relation to dust mitigation and control.

A dust emission control plan should be provided to the council with the development application.

A dust emission control plan should contain the following information:

- Summary of work to be carried out;
- Map of site layout – including the roadways, location of site equipment and stockpiles;
- Location (or indication) of the nearest sensitive receptor
- Timetable of dust generating activities;
- Details of the site impact assessment;
- List of dust control methods to be used;
- Information on the responsible persons for the site (contact details etc.);
- Sampling methods, levels and procedures (if required); and
- Log book of complaints and any actions taken

SC6.4.5.4.5 Developing the dust emission control plan

(1) There are three phases in producing a dust emission control plan. These are:

Phase 1: Site Impact Assessment

A site impact assessment is undertaken to determine the risk (high, medium or low) that the site will pose in relation to dust emissions. The results of the impact assessment will help to determine the level of risk that the site poses and subsequent mitigation and control measures that will be required to minimise this risk.

Phase 2: Site Control Measures

Based on the site impact assessment the minimum controls for the site can be determined and drafted into the plan.

Phase 3: Site Monitoring

Depending on the site impact assessment, it may mean that dust will need to be monitored. Development conditions may include a limit to the amount of dust that is permitted to leave the site. Monitoring programmes are a way to ensure compliance with nuisance laws and any development conditions.

A dust emission control plan template has been provided in Appendix 4. This can be used to capture the information required in each phase, creating dust emission control plan.

SC6.4.5.4.6 Phase 1 – Site impact assessment

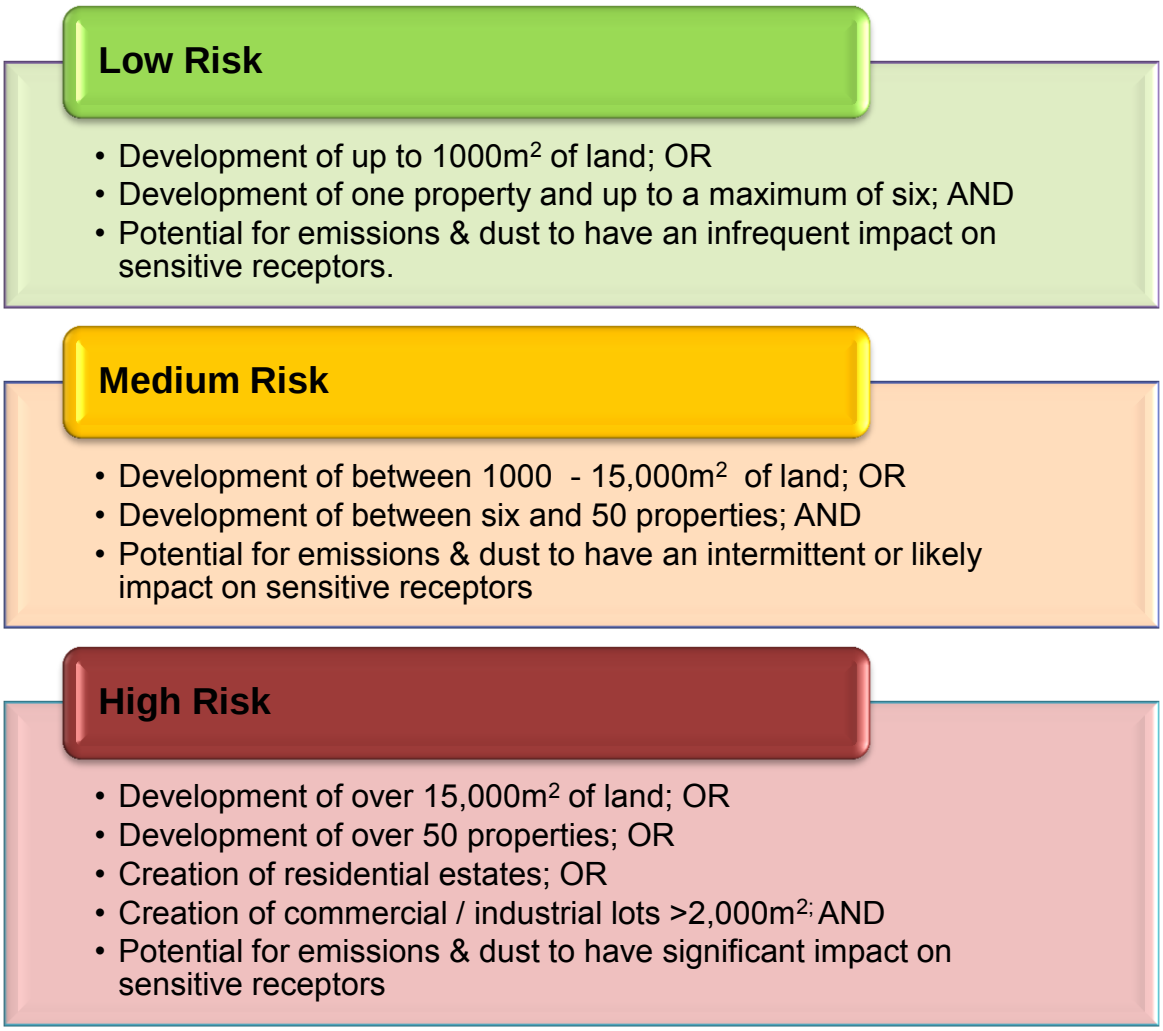
(1) Site Impact Assessment

Initially the site will need to be evaluated to determine whether it is a low, medium or high risk. This will be assessed using:

- the area/size of the development;
- the number of properties to be built; and
- the potential for the dust emissions to cause issues to neighbouring sensitive receptors (e.g. schools, residential dwellings, library, childcare centre, hospitals or public park).

Other considerations during the site evaluation include:

- Occurrence of a demolition stage;
- Location, size and length of time any stockpiles will be on site;
- Prevailing weather conditions;
- Potential for traffic movements to cause dust during construction;
- Location of the nearest sensitive receptors
- Scale and occurrence of dust generating activities such as sawing; and
- Need for on-site concrete crusher



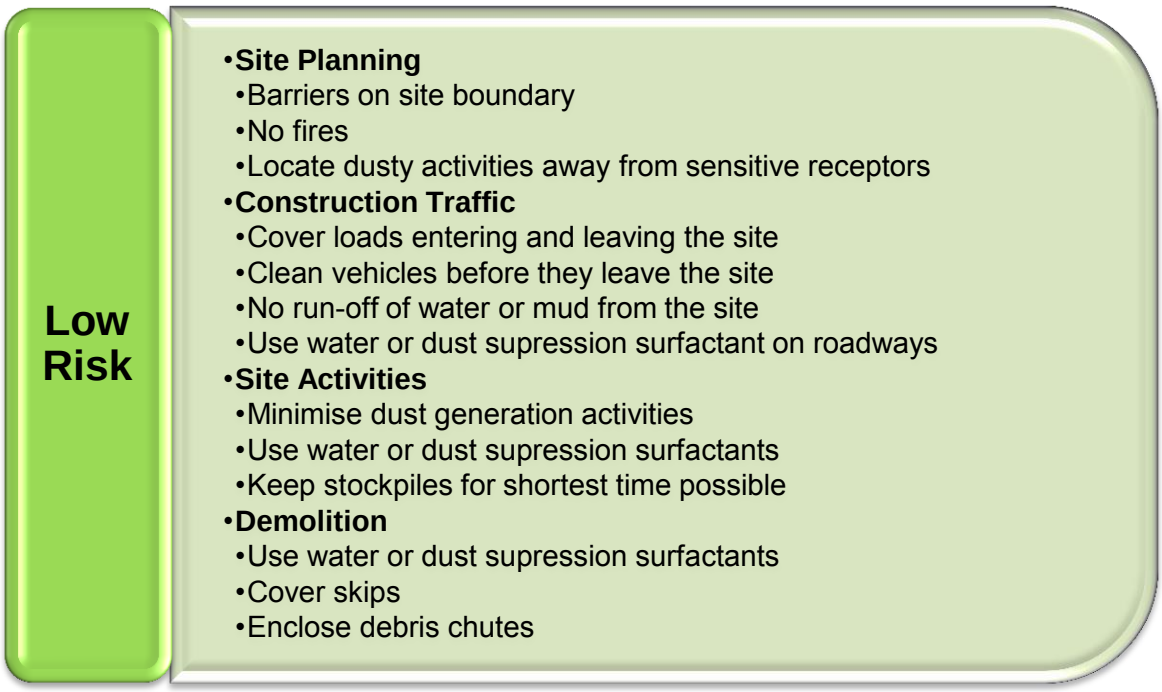
FigureSC6.4.5.4 Risk classifications

SC6.4.5.4.7 Phase 2 – Site control methods

Listed below are the minimum site controls for the different sites according to their risk (low, medium or high). Each risk type has been provided with a list of best practice measures which can be used to minimise dust emissions from the site.

A summary table can be found in Appendix 3 – Site Control Method Table.

SC6.4.5.4.8 Low risk site planning control methods



FigureSC6.4.5.5 Low Risk Site Planning Control Methods

(a) Pre-site Preparation

- Machinery and dust generating activities should not be located close to boundaries and sensitive receptors.
- Erect barriers around the dusty activities or the site boundary.
- Burning of waste should not be carried out on site
- Locate plant and vehicles away from the boundary
- Keep log of all complaints

(b) Construction Traffic

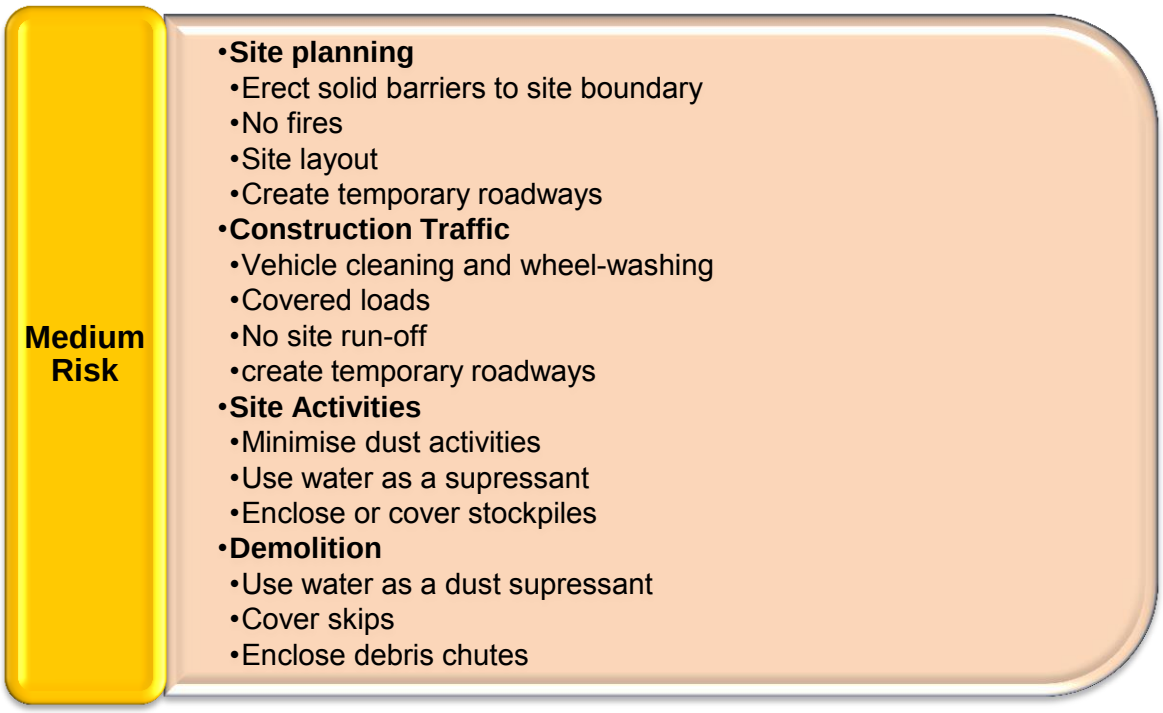
To prevent dust being spread outside the site use the following control measures at entry and exit points:

- Wash / clean or use rumble pad to remove excessive dirt and dust from vehicle tyres.
- All loads must be covered
- Ensure that there is no water runoff from the site
- Use water or dust suppression surfactants on unpaved roadways

(c) Site Activities

- Use water as a dust suppressant when cutting blocks etc.
- Cover rubbish skips and ensure that they are serviced on a regular basis
- Enclose debris chutes
- Minimise debris chute heights
- Regularly damp down surfaces
- Vacuum waste dust – not sweep
- Damp down earthworks in dry weather
- Keep stockpiles for shortest time possible

SC6.4.5.4.9 Medium risk site planning control methods



FigureSC6.4.5.6 Medium Risk Site Planning Control Methods

(1) Pre-site Preparation

Machinery and dust generating activities should not be located close to boundaries and sensitive receptors.

- Erect solid barriers to site boundary.
- Burning of waste should not be carried out on site
- Locate plant and vehicles away from the boundary
- Place hard surface down for major haul routes
- Large areas of land are not to be left without vegetation cover for long periods of time with at least 70% vegetation cover. This is to prevent windblown dust.
- Regularly inspect and repair haul routes
- Keep log of all complaints
- Monitor the site for dust levels following a complaint (dust deposition & Total Suspended Particulates (TSP))

(2) Construction Traffic

To prevent dust being spread outside the site use the following control measures at entry and exit points:

- Wash / clean or use rumble pad to remove excessive dirt and dust from vehicle tyres.
- All loads must be covered
- Ensure that there is no water runoff from the site
- Hard surface and clean the haul routes
- Have appropriate speed limit on site

(3) Site Activities

- Use water as a dust suppressant when cutting blocks etc.
- Cover rubbish skips and ensure that they are serviced regularly
- Enclose debris chutes
- Minimise debris chute heights
- Regularly damp down surfaces
- Vacuum waste dust – not sweep

- Damp down earthworks in dry weather
- Keep stockpiles for shortest time possible
- Cover stockpiles where practicable
- Keep stockpiles away from boundary, sensitive receptors and watercourse/easements

SC6.4.5.4.10 High risk site planning control methods

FigureSC6.4.5.7 High Risk Site Planning Control Methods

(1) Pre-site Preparation

- Machinery and dust generating activities should not be located close to boundaries and sensitive receptors.
- Erect solid barriers to site.
- Burning of waste should not be carried out on site
- Have waste minimisation plan in place.
- Separate waste types using separate bins/skips
- Cover waste and store away from sensitive receptors
- Locate plant and vehicles away from the boundary
- Place hard surface down for major haul routes
- Camber the road to prevent water ponding
- Regularly inspect and repair haul routes
- Keep log of all complaints
- No reconfiguration of the land between January – March (minimise sediment & erosion)
- Large areas of land are not to be left without vegetation cover for long periods of time with at least 70% vegetation cover. This is to prevent windblown dust.
- Monitor the site for dust levels during the lifetime of the site (dust deposition & Total Suspended Particulates (TSP))

(2) Construction Traffic

- To prevent dust being spread outside the site use the following control measures at entry and exit points:
- Wash / clean or use rumble pad to remove excessive dirt and dust from vehicle tyres.
- Place wheel wash at exit to site
- All loads securely covered
- Ensure that there is no runoff from the site
- Hard surface and clean the haul routes
- Damp down haul routes at least twice daily (more in dry weather or as monitoring dictates)
- Have appropriate speed limit on site

(3) Site Activities

- Use water as a dust suppressant when cutting blocks etc.
- Cover rubbish skips and ensure that they are serviced regularly
- Enclose debris chutes
- Minimise debris chute heights
- Regularly damp down surfaces
- Vacuum waste dust – not sweep
- Damp down earthworks in dry weather
- Keep stockpiles for shortest time possible
- Cover stockpiles where practicable
- Enclose stockpiles within bunkers
- Keep stockpiles away from boundary, sensitive receptors and watercourse/easements
- Re-vegetate earthworks or exposed areas to stabilise surfaces
- Do not reconfigure the whole site at once – do this in stages
- Use mulch or tackifiers if re-vegetation not possible
- Position the stockpiles taking into account the predominant wind direction
- Re-vegetate long term stockpiles
- Use windbreaks around stockpiles or use vegetation such as trees

SC6.4.5.4.11 Phase 3 – Site monitoring

(1) Monitoring of a site can determine the environmental impacts of the development as well as a tool to evaluate the effectiveness of the control methods. Site monitoring can include:

- Compliance monitoring which is the measurement against specific emission limits used as an indication for nuisance
- Monitoring the level of complaints received from the community
- Carrying out visual daily checks on the site and the level of dust being emitted or found on the site

(2) Compliance Monitoring

This is the monitoring of the activity against specific emission levels that have been specified on the development approval conditions of a development. Examples of the levels that should be achieved could be:

Dust deposition should not exceed 120 milligrams per square metre per day (averaged over one month).

To measure compliance with dust depositions there are Australian Standards that should be followed. Some of the relevant Australian Standards for dust monitoring include (but not limited to):

- *AS/NZS 3580.10.1:2003 Methods for sampling and analysis of ambient air - Determination of particulate matter - Deposited matter - Gravimetric method*
- *AS/NZS 3580.9.6:2003 Methods for sampling and analysis of ambient air - Determination*

of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method OR AS/NZS 3580.9.8:2008 Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM10 continuous direct mass method using a tapered element oscillating microbalance analyser

- *AS/NZS 3580.9.3:2003 Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method*

(3) Background Monitoring

Before works start, measuring the levels of dust within the area will provide baseline data. These measurements are most effective when undertaken over a couple of years which will provide data on the seasonal variations. If the development is smaller scale, for example up to six months, the collection of four weeks' worth of data is a good indication of existing background air quality. (Department of Environment and Conservation, WA, 2011)

(4) Control Site Sampling

This method involves sampling from a similar site to that which is to be developed, usually upwind of the site. This allows for a comparison or control with the development site.

(5) Number and Location of Monitoring Sites

The number and location of the monitoring sites should be considered using the following factors:

- prevailing weather conditions;
- topography;
- predicted area of greatest impact;
- location of the sensitive receptors; and
- risk of dust exposure to the community

AS/NZS 3580.1.1:2007 Methods for sampling and analysis of ambient air – Guides to Siting Air Monitoring Equipment can provide further guidance on where to position any site monitoring stations.

(6) Types of Dust Monitoring Techniques

(a) Dust Deposition

Dust deposition is the measurement of the dust that has settled out of the air. The dust is captured within a collection jar or gauge usually over a fixed period of time. They are relatively low cost (less than $500) but cannot be used for short term measurements of less than a month. This is usually used to determine whether a statutory nuisance is occurring.

(b) Total Suspended Particulates

Total suspended particulates or TSP are the particulates that are suspended within the air at the time of sampling. Air is sucked through a filter which catches the particulates. These samples are usually collected over 24 hours. The monitors are more expensive depending on the type of system and are usually used to determine if a statutory nuisance is occurring.

(c) PM10

PM10 are the particulates within the air that are of 10 microns in diameter. These can be inhaled into the lungs and can cause issues with human health. Sampling methods include passing the air through a Tapered Element Oscillating Microbalance (TEOM) instrument.

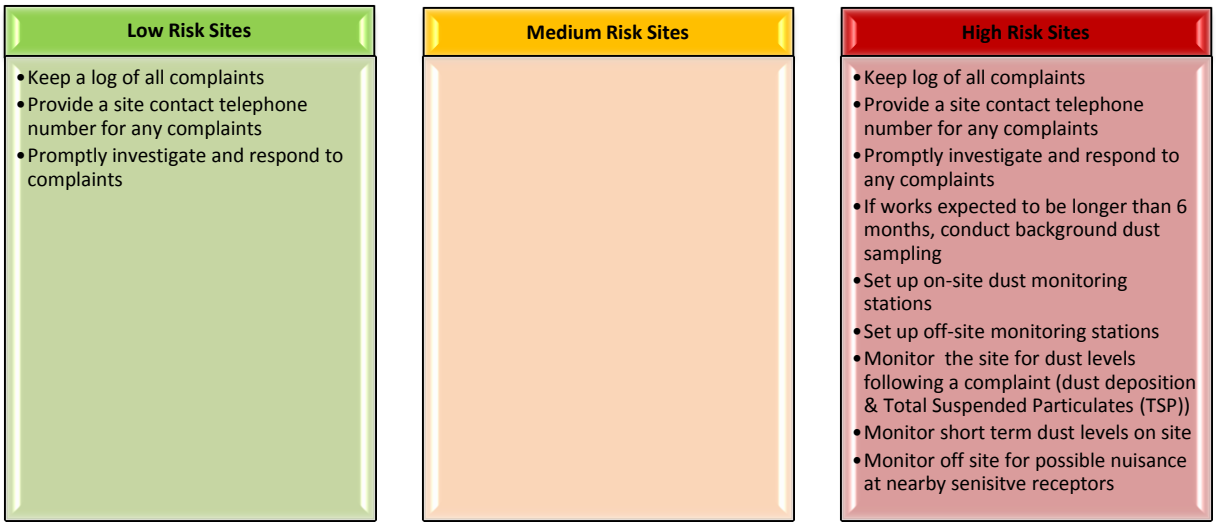
(d) Complaint Monitoring from the Community

Consulting with the community at an early stage about the project and the potential timeframes of the work and expected operations can assist in building the relationships with the community. Providing the community with a contact number and/or person for the site also assists should there be any issues arising from the site. This will alert the person in charge of the development site of any occurring problems on site and allow them to be dealt with in a timely manner.

A dust emission control plan is recommended to include how complaints about the site will be managed. All complaints received in relation to the activities on the site should be promptly investigated. This may highlight issues where controls are failing or missing and prompt corrective action to be undertaken. The recording of any complaints, the response and actions proposed should be documented. Providing the complainant with feedback of the investigation is also recommended.

(7) Site Monitoring Requirements

Depending on the site impact assessment, the following methods of monitoring could be undertaken at a development/ construction site.



FigureSC6.4.5.8 Methods of monitoring

SC6.4.5.4 Appendix 1 Environmental objectives

The *Environmental Protection (Air) Policy* provides an air quality objective for Total Suspended Particulates (TSP) as 90µm/m3 as an annual average. Trigger levels provided by the New Zealand Ministry for the Environment (NZMFE) can be used to compare short term TSP levels to help to determine whether there is a dust nuisance.

Table SC6.4.5.4.1 Environmental objectives

Measure	Averaging Time	Air Quality Objective or Trigger Value	Comment	Measurement Method	NZMFE Trigger Levels
Deposition Rate	Month	4g/m2/30 days (120mg per square meter per day)	Trigger value – total including background level	AS/NZS 3580.10.1:2003	
PM10 Concentration	24 Hours	50µg/m3	Air quality objective taken from EPP (Air).	AS/NZS 3580.9.6:2003 or AS/NZS 3580.9.8:2008	
Total Suspended particulates (TSP) concentration	Year	90µg/m3	Air quality objective taken from EPP (Air).	AS/NZS 3580.9.3	Sensitive area = 80µg/m3 (24hr average) Moderate sensitive area =100µg/m3 (24hr average) insensitive area =120µg/m3 (24hr average)

SC6.4.5.4 Appendix 2 Suggested dust conditions on development approvals

- The development is not permitted to release dust and/or particulate matter beyond the boundary of the development approval site.
- Undertake meteorological monitoring in accordance with AS3580.14-2011: Methods for sampling and analysis of ambient air. Part 14: Meteorological monitoring for ambient air quality monitoring applications.
- Dust deposition should not exceed 120 milligrams per square metre per day (averaged over one month).
- The mitigation methods and controls detailed within the dust emission control plan dated xxxx will be implemented during the life of the development site.
- Any complaints concerning dust received by the developer should be recorded. Details of the date, time and location of the complaint, weather conditions (wind speed and direction), any identified cause and the corrective action taken.
- A copy of the adopted dust emission control plan must be kept on the work site at all times so that it can be viewed by an employee or Council Officer.

SC6.4.5.4 Appendix 3 Site control method table

Low Risk

- Pre-site Preparation
  - Machinery and dust generating activities should not be located close to boundaries and sensitive receptors.
  - Erect barriers around the dusty activities or the site boundary.
  - No burning of waste should be carried out on site
  - Locate plant and vehicles away from the boundary
  - Keep log of all complaints
- Construction Traffic
  - Wash / clean or use rumble pad to remove excessive dirt and dust from vehicle tyres.
  - All loads securely covered
  - Ensure that there is no runoff from the site
  - Use water or dust suppression surfactants on unpaved roadways
- Site Activities
  - Use water as a dust suppressant when cutting blocks etc.
  - Cover rubbish skips
  - Enclose debris chutes
  - Minimise debris chute heights
  - Regularly damp down surfaces
  - Vacuum waste dust – not sweep
  - Damp down earthworks in dry weather
  - Keep stockpiles for shortest time possible

Medium Risk

- **AS LOW RISK PLUS:**
- Pre-site Preparation
  - Place hard surface down for major haul routes
  - No large areas of land to be left without vegetation cover (to prevent windblown dust) at least 70% vegetation cover
  - Regularly inspect and repair haul routes
  - Monitor the site for dust levels following a complaint (dust deposition & Total Suspended Particulates (TSP))
- Construction Traffic
  - Hard surface and clean the haul routes
  - Have appropriate speed limit on site
- Site Activities
  - Cover stockpiles where practicable
  - Keep stockpiles away from boundary, sensitive receptors and watercourse/easements

High Risk

- **AS LOW AND MEDIUM RISK, PLUS:**
- Pre-site Preparation
  - Have waste minimisation plan in place.
  - Separate waste types using separate bins/skips
  - Cover waste and store away from sensitive receptors
  - Camber the road to prevent water ponding
- Construction Traffic
  - Place wheel wash at exit to site
  - Ensure that there is no runoff from the site
  - Damp down haul routes at least twice daily (more in dry weather or as monitoring dictates)
- Site Activities
  - Enclose stockpiles within bunkers
  - Keep stockpiles away from boundary, sensitive receptors and watercourse/easements
  - Re-vegetate earthworks or exposed areas to stabilise surfaces
  - Do not reconfigure the whole site at once – do this in stages
  - Use mulch or tackifiers if re-vegetation not possible
  - Position the stockpiles taking into account the predominant wind direction
  - Re-vegetate long term stockpiles
  - Use windbreaks around stockpiles or use vegetation such as trees

SC6.4.5.4 Appendix 4 Dust emission control plan template

Dust Emission Control Plan Template	
Project Name	
Details of the Site	
Street Address:	
Lot of Plan Description:	
Project Time	
Start Date	End Date
Developer/Project Manager	Developer Contact Details
Name:	Name:
Address:	Address:
Email:	Email:
Phone:	Phone:
Responsible Person for the Works	Dust plan prepared by
Name:	Name:
Address:	Address:
Email	Email:
Phone:	Phone:
Summary of Work to be Carried out:	
Site Description Including Layout map: Please include a map to scale showing project boundary, topography etc. Include: □ Bulk Material Storage Areas □ Roads/haulage Routes and whether paved or unpaved □ Exit / Entry points □ Water Supply positions (for use as dust control)	

Site Impact Assessment: Include: □ Area of the development □ Number of properties to be developed □ Details of nearest sensitive receptors (residential, schools, day care, churches, hospitals etc.) □ Sources of Dust (e.g. demolition, grading, vehicle movements, stockpiles) □ Prevailing weather conditions

Site Impact Assessment		
Low □	Medium □	High □

Timetable for Dust Generating Activities	Dust controls/mitigation methods to be used

Sampling Methods to be Used (if applicable): □ Details of any background monitoring to be undertaken □ Details of compliance monitoring to be undertaken □ Types of Dust monitoring techniques to be used
Complaint Procedure: Insert details of the complaints procedure including how the complaints will be recorded and actioned.

SC6.4.5.4 Appendix 5 Works cited

Department of Environment and Conservation, WA, 2011. A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Developments sites, contaminated sites remediation and other related activities., s.l.: s.n.

Health & Safety Executive, n.d. Construction Information Sheet No. 36.(Revision 2). [Online].

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SC6.4.5.4 Appendix 5 Bibliography

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Australian/New Zealand Standard, 3580.9.6:2003 Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method OR Australian/New Zealand Standard, 3580.9.8:2008 Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM10 continuous direct mass method using a tapered element oscillating microbalance analyser

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SC6.4.5.3 Quality management system

(1) Townsville City Council requires an emphasis on quality for the development works being delivered by developers. Where a condition for the approval of the development works requires the works to be completed as a "Quality Controlled and Assured Development", the developer must engage consultants and contractors with the necessary level of Quality Assurance accreditation to undertake and certify the development works.

(2) Quality management system – It is a requirement for a "Quality Controlled and Assured Development Contract" that the contractor shall plan, develop and maintain a documented Quality System in accordance with this section and the current requirements of AS/NZS ISO 9001.

(a) Quality manual
This is a document setting out the general quality policies, procedures and practices of an organisation. The development of this document shall cover and include the requirements as specified in the Quality System Documentation section of AS/NZS 3905.12 with guidance to preparation by AS/NZS ISO 10013. Additionally, it must include standard method statements and inspection and test plans for the activities undertaken by the Contractor. The following details shall be provided by appropriate annexures to the Company Quality Manual:

(i) Organisational Structure – this provides information regarding the management structure of the project with details of the specific responsibilities and authorities of the nominated personnel, which includes but is not limited to:

(A) a project quality management representative – is appointed by the Contractor for a specific project with the authority and responsibility for the implementation and operation of the quality plan, to ensure that Quality System requirements are not subordinated to design and productivity. Details of this person's qualifications, technical experience and present position are also to be provided;

(B) the contracted testing organisation – details of the personnel who will be conducting each type of compliance inspection of testing; and

(C) the person authorised to change construction processes on site; and

(ii) Register of Method Statements – the register shall list all Method Statements that are to be included in the project quality plan for the development contract and shall include any suitable method statements already incorporated in the Company Quality Manual.

(b) Project quality plan
The Quality System as expressed in the project quality plan shall be used throughout the course of the construction to ensure that the quality of the Contractor's and any sub contractor's work complies with all the requirements under this section. The Company Quality Manual, method statements and checklists and other project specific components shall make up the Project Quality Plan. The project quality plan must generally conform to the recommendations of AS/NZS ISO 10006. A concept illustration is shown in Figure SC6.4.5.3.1 Project quality management system documentation.

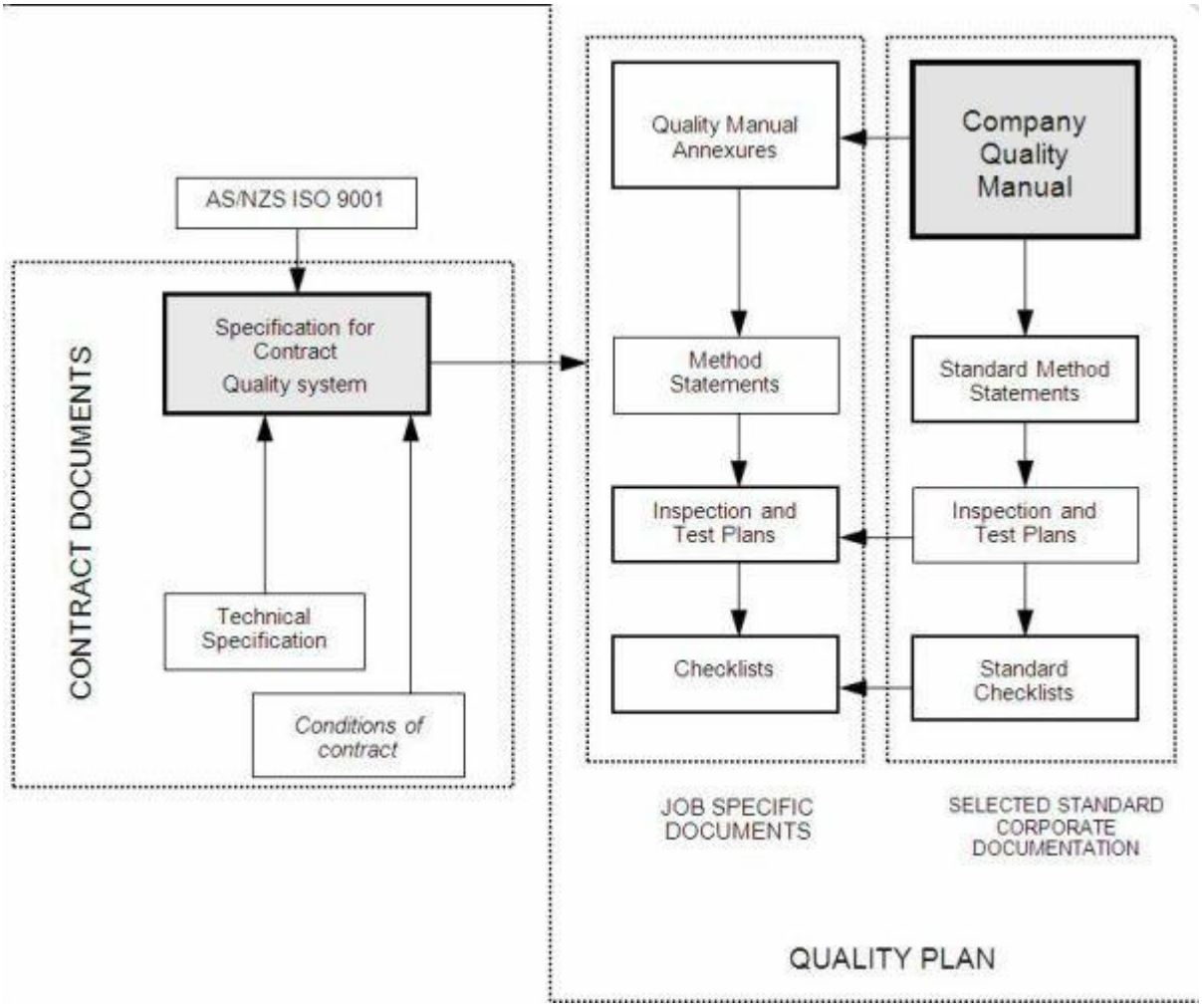


Figure SC6.4.5.3.1 Project quality management system documentation

(3) Where a “Quality Controlled and Assured Development” is not a requirement, a quality plan is not therefore required to be provided but it will be necessary as a minimum requirement that:

(a) the nominated Superintendent or Consultant are suitably and appropriately qualified and experienced;

(b) a work quality plan must be submitted to council for review and acceptance prior the pre-start meeting or commencement of works. The work plan must outline a program of inspection and testing regime that will ensure an adequate control of the progress and correctness of the work in accordance with the accepted design plans and specification;

(c) upon completion of the development works and prior to council accepting the completed development works, all records as required on the work quality plan must be submitted to council to demonstrate compliance with the accepted work quality plan; and

(d) the full cost of all required testing as per the work plan shall be the responsibility of the developer or the contractor. These tests are required to ensure that the materials and the works that were carried out conform to the accepted design specification and standard.

(4) Quality management system procedures

(a) Quality control system

(i) Lots

All items of work shall be subdivided into lots. Each lot shall be given a unique lot number and shall be chosen by the Contractor but must be within the limits given in SC6.4.5.3 Attachment A Maximum lot sizes and minimum test frequencies. In general, the size of the lot shall not exceed one day's output for each work process designated for lot testing.

The lot numbers shall be used as identifiers on all surveys and test results. The Contractor shall determine the bounds of each lot before sampling and shall identify each lot clearly. The

boundaries of a lot may be changed if subsequent events cause the original lot to be no longer essentially homogeneous.

The lot identification system and sample numbering system shall allow test results to be positively identified with material incorporated in the works.

(ii) Sampling and testing

All compliance inspections and tests shall be based on lots. The maximum lot sizes and minimum testing frequencies are listed in the Attachments to the relevant sub-sections and/or in SC6.4.5.3 Attachment A Maximum lot sizes and minimum test frequencies.

Where no minimum frequency of testing, or maximum lot size is stated in the sub-section, the Contractor shall nominate appropriate frequencies for the Superintendent's approval. Sampling shall not be restricted to locations dimensioned or otherwise defined for setting out the works in the drawings or sub-section, but shall be undertaken in a random or unbiased manner, as approved by the Superintendent, at any location within the works to demonstrate its compliance with the sub-section.

Where test methods are nominated in the sub-section, sampling and testing shall be carried out by a (NATA) National Association of Testing Authorities registered laboratory accredited for those test methods and sampling procedures. Sampling shall be conducted by personnel from the NATA registered laboratory which has been accredited for that sampling procedure and shall be supervised by the approved signatory from that laboratory. Test results shall be reported on NATA endorsed test documentation which shall include a statement by the approved signatory certifying that the correct sampling procedures have been followed.

Random sampling techniques shall be used for each lot for the control of compaction of each continuous layer of earthworks, flexible pavement and asphalt. SC6.4.5.3 Attachment B Random sampling defines the method to be used for determining test locations of random sampling in each lot. For quality control of processes other than compaction of layers of earthworks, flexible pavement and asphalt, the sampling locations will be proposed by the Contractor and will require the approval of the Superintendent. All samples shall be each considered to be representative of the lot and all test results will be required to meet the appropriate tolerances for the lot.

The latest NATA advice of the terms of registration and current signatories for the laboratories are to be included within the quality plan shall which will be providing the compliance test reports.

The NATA registered laboratory must provide inspection, testing and measuring equipment capable of producing the precision and/or degree of accuracy specified in the referenced test methods and this shall be made available by providing evidence or records of calibration.

(iii) Surveying

The Contractor shall engage qualified surveyors who are eligible for membership of the Institution of Surveyors, Australia or the Institution of Engineering and Mining Surveyors, Australia to supervise and take responsibility for all Surveying Control.

(iv) Surveying Control shall include all measurement, calculation and record procedures necessary to:

(A) set out the works;

(B) verify conformance to the drawings and sub-section in relation to dimensions, tolerances and three dimensional position; and

(C) determine lengths, areas or volumes of materials or products, where required for measurement of work.

The procedures and equipment used must be capable of attaining the tolerances required in the relevant construction specification. Sampling for conformance verification purposes shall not be restricted to the locations used to set out the Works.

The Contractor shall submit a survey conformance report to the Superintendent for each lot or

component where design levels, position and/or tolerances have been specified. The report shall show “specified vs. actual” for position (defined by co-ordinates or chainage and offset), level and tolerance as appropriate and shall be certified by the qualified surveyor responsible for the verification survey.

(v) Records and quality control documentation
Conformance records shall be stored and maintained such that they are readily retrievable and in facilities that provide a suitable environment to minimise deterioration or damage and to prevent loss.

The Contractor shall submit all conformance records to the Superintendent for inspection and approval. If requested by the Superintendent, the Contractor shall provide copies of the records or test results at no cost to the Developer.

The Contractor shall maintain a quality register which contains all quality control records such as test results, completed check lists, certificates of compliance, and consignment dockets for materials procured.

Prior to achieving practical completion or the commencement of the defects liability period or prior to acceptance of work as “Finally Complete”, the Contractor shall provide council through the Superintendent a copy of the quality register and other required quality control documents as required in this section.

(5) Quality assurance system – is the management of actions covering planning, quality control testing, inspection and verification procedures integrated with production to provide a product fit for the purpose.

(a) Inspection and test plan (ITP) is the document which identifies the specific inspections and tests required to be carried out for on development works including hold points. The ITP is to be prepared by an appropriately experienced consultant identifying specific inspections and tests to be carried out for each item of development works. Refer to council’s minimum ITP requirement on SC6.4.5.3 Attachment D Minimum inspection and test plan.

As a minimum, the inspection and test plans must contain the following information:

- lot references;
- activity description;
- specification requirements (if not provided, referenced specification);
- sampling methodology;
- test frequency and method; and
- identify responsibilities for inspection and testing and approval.

The superintendent shall audit the contractor’s work on a regular basis and provide sufficient site presence and in particular at inspection points identified in the Inspection and testing plan as set out in the construction schedules and agreed to and accepted by council. Inspections by council shall not in any way diminish the responsibility of the consultant and the superintendent to adequately audit the works. Auditing shall include regular site inspections which will be conducted with the presence of the contractor’s representative to confirm acceptability of works as complying with the design intent and other council requirements.

Inspection and test plans will typically have an associated check list which shall require completion for each particular lot. Prior to council’s acceptance of completed development works all documentation relating to compliance to the agreed and accepted ITP are to be submitted by the Contractor and/or the Superintendent which will form part of the Consultants’ certification that the works have been carried out and inspected in accordance with the agreed and accepted ITP.

(A) Inspections
The contractor shall ensure that any particular stage of work to be inspected has been satisfactorily completed before requesting an inspection by the superintendent and/or council. A minimum of 24 hours’ notice (except for off maintenance inspection which requires a minimum of 7 days) is required to enable arrangements to be made for an

inspection. Responses to the requests within the prescribed minimums are not guaranteed, although every effort will be made by council to accommodate request where possible. All council required inspections must be carried out Monday to Friday unless other arrangements have been agreed.

Incoming inspections shall be required for deliveries of materials that will be subsequently included in one or more lots. When completing check lists for particular lots the inspection status shall be cited.

In-process and compliance inspections shall be completed by a responsible officer nominated in the check list and certified by the Contractor's Quality Management Register (QMR) indicating that the work has been completed in accordance with the contract documents.

The Contractor shall establish and maintain a system to ensure and demonstrate that all products or parts of products requiring inspection and/or testing are so inspected and/or tested. The Contractor shall also establish and maintain a system for identifying the inspection status for all lots of work.

(B) Hold points and witness points

To assure compliance with the specified standards and requirements, mandatory hold points shall apply. Hold points are those stages during the construction/manufacturing process where the technical specifications require "approval by the Superintendent" or where a non-conformance report (NCR) or notice of non-conformance (NNC) has been issued. The Contractor shall not proceed past the hold point until approval has been received from the Superintendent to proceed. For ease of identification hold points may also be annotated on the margins of technical specifications.

To obtain the approval to proceed from the Superintendent, the Contractor shall:

- provide the information required by the technical specifications
- ensure and certify that the particular lot/process is conforming;
- ensure and certify that all underlying and adjacent lots affected by the lot in question are conforming; and
- submit the appropriate form (check list, NCR or NNC) at least 24 hours prior to the time the Contractor wishes to proceed with the placement/construction of the next lot, unless some alternative arrangements have been agreed with the Superintendent.

If the hold point has resulted from a NCR or NNC, the Superintendent's approval may be conditional on a witness point being included.

(b) Quality assurance activities

(A) Document control

In addition to the requirements of AS/NZS ISO 9001 and AS/NZS 3905.2, the quality plan shall specify the method of keeping quality registers, tracking and handling of NCRs, NCC, NNCs and other site correspondence.

(B) Method statements

A document that specifies the key steps and sequence in the manufacture/construction for an activity; what, how and by whom it shall be done; what materials and equipment shall be used to achieve the required quality standards.

Method statements shall be provided for all activities scheduled in SC6.4.5.3 Attachment C Method statement requirements. This requirement applies to both contract and subcontracted work. The documentation shall cover, as applicable, planning, methods, verification and control.

The presentation of method statements may be either descriptive, in the form of flow charts or a combination of both. In either case it must be accompanied by a check list which shall include the

relevant inspection and test points, surveying control points and Hold Points and the officer responsible to verify each check point.

A system audit of each method statement shall be carried out by the Contractor whilst the process is in effect. In the absence of a method statement for activities where it has been specified, this will automatically create a hold point.

(C) Identification of lots and traceability

All items of work shall be subdivided into lots. Lots shall be chosen by the Contractor but shall be within the limits given in SC6.4.5.3 Attachment A. lot numbers are to be used as identifiers on all quality system data. Each lot shall be given a unique lot number. The allocation of lot numbers shall be carried out by the Contractor specific to each item of work and provides a lot numbering system which conforms to these requirements:

The Quality Register must contain records of lot number which provides information such as:

- location of the lot (e.g. start and end chainage, layer and lateral location or a particular structure);
- note regarding conformance/non-conformance (e.g. NCR, CPAR Registers); and
- table of test results (summary) and their respective locations and numerical identification.

In cases where non-conforming lots are identified, a new identification number shall be allocated to the resubmitted documentation, but reference to the original lot number must be included.

The Contractor is responsible in determining the bounds of each lot before sampling and shall physically identify each lot clearly. The physical identification of a lot shall be maintained until the Contractor has ensured that the lot has achieved the specified quality.

To ensure all site personnel can readily identify where the particular lots are in the field, the Contractor shall implement a field identification system which will clearly identify the bounds of each lot and the lot number. This identification system shall be detailed in the quality plan and shall be maintained during all stages of construction of the lot.

The boundaries of a lot may be changed if subsequent events cause the original lot to be no longer essentially homogeneous. This will require appropriate notation in the Quality Register by the QMR.

The lot identification system, site records and sample numbering system shall allow test results to be positively identified with material incorporated in the works. Traceability is required for concrete loads, asphalt loads and steel plate as follows:

- concrete used in bridge components, cast-in-place box culverts, retaining walls, road pavement sub base and base. Asphalt used in wearing courses, intermediate courses and drainage layers;
- the trace shall start at the batch plant and finish at the location where the concrete or asphalt is incorporated in the Works. Records shall be kept of the batch quantities, mix and despatch time, testing details and location of placement; and
- steel plate in bridge girders and bridge columns. The trace shall start at the steelworks and finish at the location of the plate in the girder or column. Records shall be kept of the steel heat number, testing details and location of the plate in the girder or column.

(D) Surveying control

Surveying control shall be treated as a separate system element and shall include all measurement, calculation and record procedures necessary to:

- set out the Works;
- verify conformance to the drawings and specification in relation to dimensions, tolerances and three dimensional position; and
- determine lengths, areas or volumes of materials or products, where required for

measurement of work.

The method statements for surveying control shall address the process control parameters in AS/NZS 3905.2 for special processes which cannot be fully verified by subsequent inspection and test.

The Contractor shall appoint qualified surveyors who are eligible for membership of the Institution of Surveyors, Australia or the Institution of Engineering and Mining Surveyors, Australia to supervise and take responsibility for all surveying control.

The procedures and equipment used must be capable of attaining the tolerances nominated in the specification. Sampling for conformance verification purposes shall not be restricted to the locations used to set out the Works.

The Contractor shall submit a survey conformance report for each lot or component where design levels, position and/or tolerances have been specified.

The survey conformance report shall show “specified vs. actual” for position (defined by co-ordinates or chainage and offset), level and tolerance as appropriate and shall be certified by the qualified surveyor responsible for the verification survey.

Where work is to be covered up after conformance has been achieved, a hold point shall apply until the survey conformance report has been submitted.

All survey records shall be included in the quality records and recorded in the quality register. Verification field book pages shall be clearly labelled, dated and signed by the surveyor with cross indexed references to equipment used lot/component identification and associated survey conformance reports. Where automatic data recording systems are used for verification surveys, a printout of both raw (field) data and reduced data shall be retained in a similar manner as conventional field books.

(E) Sampling and testing

The inspection and test plans shall include details of the sampling methods. Sampling shall not be restricted to locations dimensioned or otherwise defined for setting out the works in the drawings or specification, but shall be undertaken in a random or unbiased manner, as approved by the Superintendent, at any location within the works to demonstrate its compliance with the specification.

The maximum lot sizes and minimum testing frequencies are listed in the attachments to the relevant sub-sections and/or in SC6.4.5.3 Attachment A to this sub-section. Where no minimum frequency of testing, or maximum lot size is stated in the specification, the inspection and test plan(s) shall nominate appropriate frequencies for the Superintendent's approval.

The inspection and test plans shall also uphold any time limits for testing which may be imposed by the specifications. The responsibility for completion of inspections, tests and documentation shall be stated in the quality plan.

Statistical techniques - random sampling techniques shall be used for each lot for the control of compaction of each continuous layer of earthworks, flexible pavement and asphalt. SC6.4.5.3 Attachment B defines the method to be used for determining test locations of random sampling in each lot. SC6.4.5.3 Attachment A lists the maximum lot sizes and minimum test frequencies for the specified activities.

For compaction control of processes other than layers of earthworks, flexible pavement and asphalt, the sampling procedure will be proposed by the Contractor in his method statement and will require the approval of the Superintendent. In such cases the samples shall be each considered to be representative and all test results will be required to meet the appropriate

tolerances for the lot.

Every testing agency or person providing written test reports for any and all testing undertaken shall use unique consecutive project specific serial numbering of the reports for identification and auditing purposes.

The Contractor shall reinstate all core holes, test holes, excavations and any other disturbance resulting from any testing activity. The reinstatement shall be to a standard which is at least equal to the specified requirements for the particular work.

(F) Records and quality assurance documentation

The Contractor shall keep and maintain all Quality System records in a Quality Register as required by AS/NZS ISO 9001, AS/NZS 3905.2 and this sub-section. They shall be systematically recorded, indexed and filed so as to be retrievable and accessible to the Superintendent or an appointed Quality Auditor on a job basis within 1 working day of requisition.

Conformance records shall be stored and maintained such that they are readily retrievable and in facilities that provide a suitable environment to minimise deterioration or damage and to prevent loss.

The Contractor shall make the quality records available to the Superintendent at all reasonable times. If requested by the Superintendent, the Contractor shall provide copies of the records or test results at no cost to the developer.

Prior to achieving practical completion or the commencement of the defects liability period or prior to acceptance of work as “Finally Complete”, the Contractor shall provide council, through the Superintendent, a copy of the quality register and other required quality assurance documents as required in this section.

(G) Non-conformance

In circumstances where there is a concern about workmanship, construction methodology or materials (e.g. variation to the approved work specification), council’s representative and/or Superintendent may require the Consultant and/ or contractor respectively to provide a non-conformance certificate (NCC) (template provided at SC6.4.5.3 Attachment E Non-conformance certificate template). The NCC will be required to be endorsed by the relevant design Consultant. A non-conformance report (NCR) (template provided at SC6.4.5.3 Attachment F Non-conformance report template) is required to be issued by the Contractor addressing intended variations to approved specifications, work method statements or standards by providing proposed disposition.

In the event that the above has not been satisfied and to ensure compliance with the required standards, Superintendent and/or council may issue a Notice of Non-Conformance (NNC) (template provided at SC6.4.5.3 Attachment G Notice of non-conformance template) to the Contractor. The NCC shall be issued within 1 working day of the non-conformance being identified during an inspection or during scheduled audit inspections, i.e. hold points and witness points. Upon issuance of the NNC, the Contractor must not continue the particular work in question unless an appropriate disposition (to be provided within five working days from issuance of the corrective and preventive action request (CPAR)) has been provided and agreed in accordance with the CPAR (template provided on SC6.4.5.3 Attachment H ~~Corrosive~~ Corrective and preventative action request template). This is to be undertaken by the Contractor if the NNC identifies non-conforming work which has been provided by the relevant design or construction consultant (Superintendent). Similarly, for council initiated NNC, work shall commence upon council’s acceptance of the proposed disposition in accordance with the CPAR. To avoid recurrence of non-conformance issues, all CPARs shall require joint sign off by the Contractor and Superintendent, and council for a council issued NNC. This procedure will require the Contractor to record the CPAR on the relevant issued NNC. Under no circumstances will the deliberation on the disposition of a non- conformance issue be used to justify delays to the construction schedule/period.

The Contractor shall advise the Superintendent in the NCR of the proposed disposition of the particular non-conformance. This proposed disposition will constitute corrective action for the lot or lots referred to in the NCR and may comprise one of the following:

- propose additional works to bring the lot up to the specified standard; or
- replace all or part of the lot to bring it up to the specified standard; or
- request utilisation of a lot for a reduced level of service if such a clause exists in the relevant technical specification; or
- for incidental defects, request that the Superintendent accept the lot without alteration as an exception with or without alteration to the respective unit rates.

Any proposed disposition shall be subject to the approval of the Superintendent. Reworked/replaced lots shall be verified to conform to the specified requirements.

The contractor shall establish a suitable numbering and registration system for all NCRs and NNCs. All non-conformance reports and relevant documentation are required to be submitted to council prior acceptance of development works, to ensure that all departure from the originally accepted requirement and appropriate disposition has been done in accordance with the agreed CPAR.

A process flow diagram of the above processes is shown on Figure SC6.4.5.3.2.

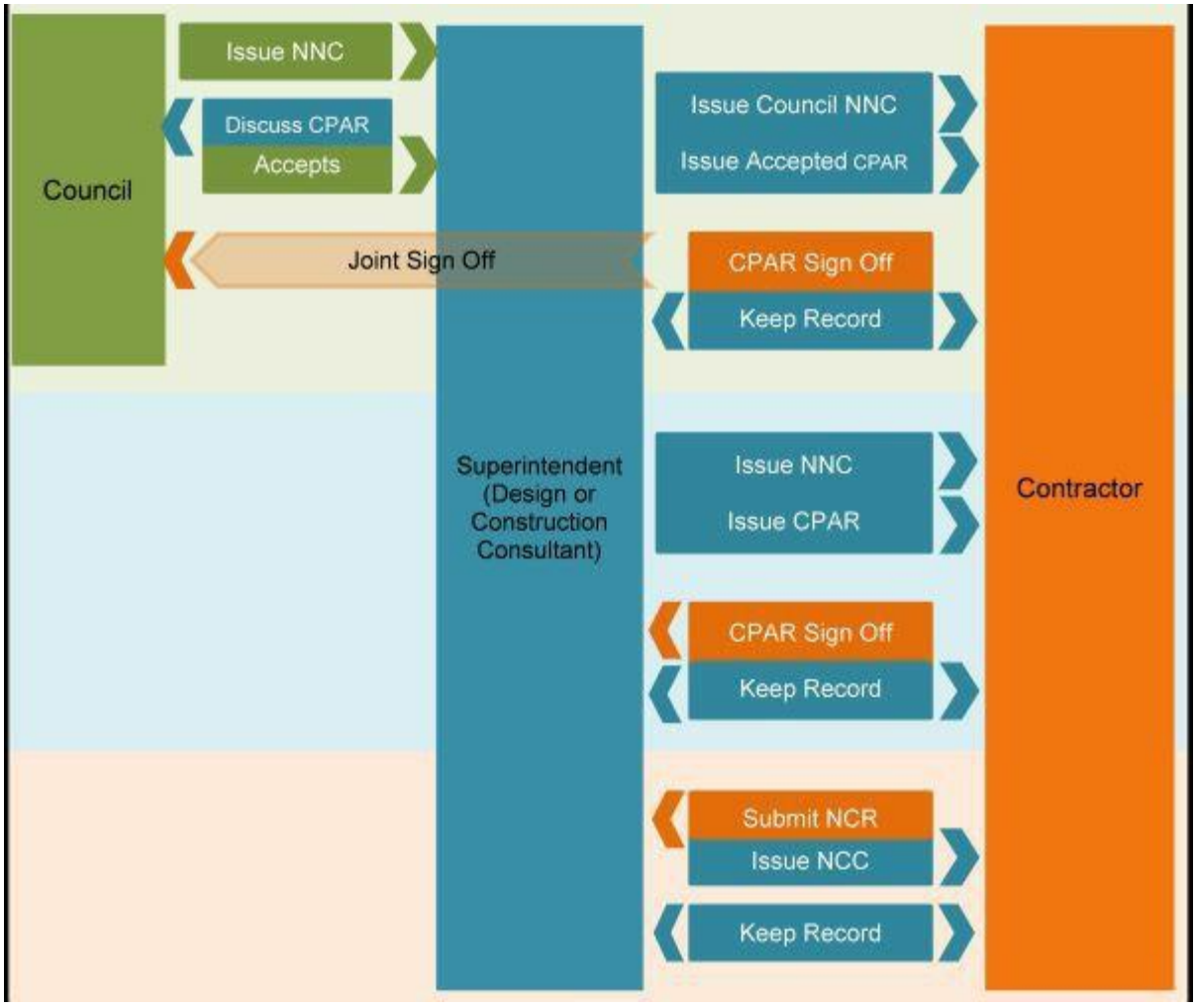


Figure SC6.4.5.3.2 Non-conformance flow diagram

(H) Inspection fees

A works inspection fee (at the rate applicable at the time of payment) must be paid prior to the development works being accepted by council at on maintenance or final completion.

SC6.4.5.3 Attachment A Maximum lot sizes and minimum test frequencies

General

Where material/product quality certification can be obtained from the supplier, tests listed per contract/separable part need not be repeated and where no Queensland Department of Transport and Main Roads (DTMR) Test Methods are available, Australian Standards or NSW Roads and Traffic Authority (RTA) Test Methods are specified.

Table SC6.4.5.3.1 Earthworks (SC6.4.6.10)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Stripping Topsoil	Surface Levels	10,000m^2	1 Cross Section per 25m	Survey
Excavation	Geometry	10,000m^2	1 Cross Section per 25m	Survey
Floor of Cuttings	Material Quality—CBR	5,000m^2	1 per 1,000m^2* or Material Type	AS1289.6.1.1 DTMR Materials Testing Manual
	Compaction	10,000m^2	1 per 500m^2	AS1289.5.4.1
Deflection Control	Benkelman Beam Deflection or Equivalent	Per days production	4 per 1000 m^2 or minimum 10 per lot	DTMR Materials Testing Manual
	No visible vertical movement under proof roll	One layer 5,000m^2 or max 1 day's placement	Whole area	Visual
Foundation for Embankments	Compaction	5,000m^2	1 per 500m^2	AS1289.5.4.1
Embankments				
General	Geometry	One layer 10,000m^2	1 Cross Section per 25m	Survey
	Material Quality - CBR	One layer 5,000m^2	1 per 800m^3 or Material Type	AS1289.6.1.1
	Compaction/Moisture Content	One layer 5,000m^2	1 per 250m^3	AS1289.5.1.1 AS1289.5.4.1 AS1289.5.7.1
Road Carriageway Embankments				
Select Zone	Geometry	One layer 10,000m^2	1 Cross Section per 25m	Survey
	Material Quality			
	Maximum Particle Size	10,000m^2	1 per 1,000m^3*	AS1289.6.1.1
	CBR	10,000m^2	1 per 500m^3* or Material Type	
	Compaction/Moisture Content	One layer 5,000m^2	1 per 500m^2	AS1289.5.1.1, AS1289.5.4.1 AS1289.5.7.1

Fill Adjacent to Structures: Bridges, Retaining Walls and Cast-in-Situ Culverts	Material Quality			
	Maximum Particle Size	1 Structure	1 per 200m3	AS1289.3.3.1
	Plasticity Index	1 Structure	1 per 200m3	
	Compaction/Moisture Content	1 Structure	2 per lot	AS1289.5.1.1, AS1289.5.4.1 AS1289.5.7.1

* **Note**—or part thereof, per lot.

Table SC6.4.5.3.2 Stormwater drainage (SC6.4.6.4), Drainage structures (SC6.4.6.5), Pipe drainage (SC6.4.6.6), Precast box culverts (SC6.4.6.7) and Open drains (SC6.4.6.9)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Supply of Precast Units	Precast Quality— Suppliers documentary evidence and certification	1 batch	1 per type/size/class per batch	
Siting and Excavation	Geometry	1 drainage line/structure	1 per drainage line/structure	Survey
Foundation	Compaction	1 drainage line/structure	1 per 40 lin m*	AS1289.5.4.1 Visual
Material surrounding Steel Structures	Material Quality pH/Electrical Resistivity	1 drainage line/structure	1 per material	AS1289.4.3.1 AS1289.4.4.1
Bedding *(Bed, haunch, sides and overlay for HS type support)*	Material Quality Particle Size Distribution Compaction/Moisture Content	 1 contract 1 drainage line/structure	 1 per 200m3* 1 per layer, per 40 lin m	 AS1141.11 AS1289.5.7.1, AS1289.5.4.1
Concrete Bedding or Lining	Geometry		1 Cross Section per 25m	Survey and 3m Straight Edge
Installation of Precast Units	Geometry	1 drainage line/structure	1 per drainage line/structure	Survey
Selected Backfill *(Backfill, sides and overlay for non HS type support)*	Material Quality Maximum Particle Size Plasticity Index Compaction/Moisture Content	 1 contract 1 contract 1 drainage line/structure	 1 per 500m3* 1 per 500m3* 2 per lot	 AS1289.3.3.1 AS1289.5.7.1, AS1289.5.4.1
Rock Fill for Gabions/ Wire Mattresses	Material Quality: Wet Strength Wet/Dry Strength Variation	 1 contract 1 contract	 1 per contract 1 per contract	 AS1141.22 AS1141.22
Kerb and Gutter	Geometry	1,000 lin m	1 Cross Section per 25m and change of direction	Survey and 3m Straight Edge

* **Note**—or part thereof, per lot.

Table SC6.4.5.3.3 Subsoil, foundation and pavement drains (SC6.4.6.20), Subsurface drainage (SC6.4.6.21), Drainage mats (SC6.4.6.8)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Material Supply	Material Quality—Supplier's documentary evidence and certification of:			
	Pipe	1 contract/size	1 per type/size	
	Filter Material			
	Grading (Type A, B, C, D)	1 contract/size	1 per type	AS1141.11
	Coefficient of Permeability (Type B)	1 contract/size	1 per type	AS1289.5.5.1 ASTM-D2434-68
	Grading Variation after Treatment (Type B)	1 contract/size	1 per type	AS1141.11
	Wet Strength (Type C, D)	1 contract/size	1 per type	AS1141.22
	10% Fines Wet/Dry (Type C, D)	1 contract/size	1 per type	AS1141.22
	Geotextile	1 contract	1 per type	
Excavation - Trench Base	Line and Grade	1 drainage line	1 per drainage line	Survey
Bedding and Backfill				
Filter Material	Geometry	1 drainage line	Visual	Survey
Selected Backfill	Geometry	1 drainage line	Visual	Survey
Earth Backfill	Geometry	1 drainage line	Visual	Survey
Drainage Mat	Geometry	2000m^2	1 Cross Section per 25m	Survey

Table SC6.4.5.3.4 Stabilisation (SC6.4.6.19)

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Material Supply	Material Quality - Supplier's documentary evidence and certification of:			
	• Cement	1 contract	Type	AS3972
	• Quicklime			
	• Available Lime (CaO content)	1 contract	Type	AS3588.12
	• Slaking Rate	1 contract	1 per contract	T432
	• Particle Size Dist'n	1 contract	1 per contract	AS1141.11
	• Hydrated Lime			
	• Available Lime ($CaOH_2$)	1 contract	1 per contract	AS3583.12
	• Residue on Sieving	1 contract	1 per contract	AS3583.14
	• Ground Blast Furnace Slag	1 contract	1 per contract	AS3583.2
	• Flyash	1 contract	1 per contract	AS3583.1
	• Blended Stabilising Agent	1 contract	1 per contract	
	• Water			
	• Chloride ion content	1 contract	1 per contract	AS3583.13
	• Sulphate ion content	1 contract	1 per contract	AS1289.4.2.1
	• Undissolved solids	1 contract	1 per contract	
Mix Design	NATA certification - Supplier's documentary evidence and certification	1 mix	1 per mix	
Stationary Mixing Plant	Application rate of stabilising agent	1 day's production	1 per 100t	
	Unconfined Compressive strength of product	1 day's production	1 per 400t	AS5101.4
In-Situ Spreading	Spread rate	1 layer 1,000m^2	1 per lot or 1 per 500m^2	DTMR Materials Testing Manual
	Mix uniformity	1 layer 1,000m^2	1 per 500m^2	Visual
	Unconfined Compressive Strength of product	1 day's production	1 per 100t	AS5101.4

Trimming and Compaction	Geometry	1 layer 3,000m², or 1day's placement	One cross section per 25m	Survey
	Surface Quality	"	10 per 200m lane length*	3m Straight Edge
	Average Layer thickness	"	1 per lot	
	Average Width	"	1 per lot	Measure/Survey

Note— or part thereof, per lot.

Table SC6.4.5.3.5 Flexible pavements (SC6.4.6.12)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Pavement Materials Supply	Material Quality - Supplier's documentary evidence and certification to meet MRTS05 unbound requirements - Type 2.1 for base, Type 2.3 for subbase and Type 2.4 for lower subbase.	1 contract		
	Particle Size Distribution		1 per 1,000t	Q103A, AS1289.3.6.1
	Fine and Particle Size Distribution Ratio			
	Liquid Limit		1 per 1,000t	Q104A, Q104D
	Plastic Limit		1 per 1,000t	Q105, AS1289.3.2.1
	Plasticity Index		1 per 1,000t	Q105, AS1289.3.2.1
	California Bearing Ration (soaked)		1 per 5,000t	Q113A
	Particle Shape		1 per 1,000t	Q201, AS1141.15
	Ten Percent Fines Value (Wet)		1 per 5,000t	Q205B, AS1141.22
	Wet/Dry Strength Variation		1 per 5,000t	Q205C, AS1141.22
	Degradation Factor (Source Rock)		1 per contract	Q208A, AS1141.25.1
	Unconfined Compressive Strength (Standard Compaction)		1 per 5,000t	TCC-001, Q115, AS5101.4
	Unconfined Compressive Strength (Bound)	1 contract	1 per mix design	Q115
Compaction Assessment	Geometry: Alignment and Level	One layer 2,000m² or	1 Cross Section per 15m	Survey
	Width and Surface Trim	max 1 day's placement	10 per selected 200 lin m*	Measure and 3m Straight Edge

	Compaction/Moisture Content/ Dry Density Testing	One layer 5,000m² or max 1 day's placement	10 per 5,000m² layer or 3 per lot if less	AS1289.5.21.1, Q142A, AS1289.5.4.1 AS1289.5.8.1
Deflection Control	Benkelman Beam Deflection or Equivalent No visible vertical movement under proof roll	Per days production One layer 5,000m² or max 1 day's placement	4 per 1000 m² or minimum 10 per lot Whole area	Q701 Visual

* **Note**—or part thereof, per lot.

Table SC6.4.5.3.6 Sprayed bituminous surfacing (SC6.4.6.17)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality - Suppliers documentary evidence and certification of:			
	Class 170 Bitumen	1 contract	1 per contract	MRTS.17
	Refinery Cutback Bitumen	1 contract	1 per contract	MRTS.17
	Polymer Modified Binder	1 contract	1 per contract	MRTS.18
	Bitumen Adhesion Agent	1 contract	1 per contract	
	Cutback Oils	1 contract	1 per contract	
	Aggregate Precoating Agent	1 contract	1 per contract	
	Aggregate	1 contract	1 per contract	MRTS.22
Application Rates	Binder	1 day's operation	Calculate per spray run	As per spray sheet
	Aggregate	1 day's operation	Calculate per spray run	As per spray sheet

Note— one per contract or change in material.

Table SC6.4.5.3.7 Asphaltic concrete (SC6.4.6.13)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality - Supplier's documentary evidence and certification of:			
	Coarse and Fine Aggregates			MRTS 30
	Grading	1 wk's prod'n	1 per contract or material change	MRTS 30
	- Moisture Content	1 wk's prod'n	1 per contract or material change	MRTS 30
	- Wet Strength	1 contract	1 per contract or material change	MRTS 30
	- Wet/Dry Strength Variation	1 contract	1 per contract or material change	MRTS 30
	- Particle Shape	1 contract	1 per contract or material change	MRTS 30
	- Fractured Faces	1 contract	1 per contract or material change	MRTS 30
	Polishing Agg Friction Value	1 contract	1 per contract or material change	MRTS 30
	- Mineral Filler	1 contract or 1 month's production	1 per contract or material change	MRTS 30
	- Bitumen Binder	1 refinery batching	1 per contract or material change	MRTS 17
	Polymer Modified Bitumen			MRTS 18
	Elasticity Recovery at 60ºC	1 production batch by supplier	1 per contract or material change	MRTS 30
	Viscosity on ER at 60ºC			MRTS 30
	Torsional Recovery at 25ºC			MRTS 30
	Viscosity at 180ºC - Bitumen Adhesion Agent	1 contract	1 per contract or material change	MRTS 30
	Resistance to Stripping			
	Reclaimed Asphalt Pavement (RAP)	1 stockpile	1 per contract or material change	MRTS 30
	Bitumen Emulsion	1 contract	1 per contract or material change	MRTS 21

Mix Design-Nominated Mix	Approval of mix and NATA certification. Supplier's documentary evidence and certification	1 mix per contract	1 per mix	
Production Mix	Temperature Moisture Content Grading Binder Content	1 per truck load SC6.4.6.13 Asphaltic concrete as included as separate table below. Additionally, max lot size one 12 hr shift's production.		Measure MRTS 30 MRTS 30 MRTS 30
Laying and Compaction	Temperature	1 day's laying per site	1 per truck load	Measure
	Levels	1 day's laying per site	1 cross section per 25m	Survey
	Shape	1 day's laying	10 per 200m* lane	3m Straight Edge
	Relative Compaction/Layer Thickness	1 day's laying	6 cores per lot or 10 nuclear density tests per lot	AS2891.9.3 or Nuclear Density Meter

Note—* or part thereof, per lot.

Table SC6.4.5.3.8 Minimum testing frequencies for asphalt production

Quantity of Asphalt in production lot	Minimum Frequency of Testing
Less than 100 tonnes	MRTS 30
101 to 300 tonnes	MRTS 30
301 to 600 tonnes	MRTS 30
Over 600 tonnes	MRTS 30

Table SC6.4.5.3.9 Ready-mixed concrete production and supply (SC6.4.6.14 and SC6.4.6.15)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Raw Materials Supply	Material Quality—Supplier's documentary evidence and certification of:	1 contract	1 per contract or material change	
	Cement	1 contract	1 per contract or material change	AS 3972
	Flyash	1 contract	1 per contract or material change	AS 3582.1
	Water	1 contract	1 per contract or material change	AS3583.13, AS1289.4.2.1
	Admixtures	1 contract	1 per contract or material change	AS 1478
	Fine Aggregates (SC6.4.615 only)	1 contract	1 per contract or material change	
	Grading	1 contract	1 per contract or material change	AS1141.11
	Moisture Content	1 contract	1 per contract or material change	
	Sulphate Soundness	1 contract	1 per contract or material change	AS1141.24
	Bulk Density	1 contract	1 per contract or material change	AS 2758.1
	Unit Mass (particle density)	1 contract	1 per contract or material change	AS 2758.1
	Water Absorption	1 contract	1 per contract or material change	AS 2758.1
	Material Finer 2µm	1 contract	1 per contract or material change	AS 2758.1
	Deleterious Material (Impurities/Reactive)	1 contract	1 per contract or material change	AS 2758.1
	Combined Aggregates (SC6.4.6.14 and SC6.4.6.15)	1 contract	1 per contract or material change	
	Grading	1 contract	1 per contract or material change	AS1141.11
	Moisture Content	1 contract	1 per contract or material change	

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	Wet Strength	1 contract	1 per contract or material change	AS1141.22
	Wet/Dry Strength Variations	1 contract	1 per contract or material change	AS1141.22
	Sulphate Soundness	1 contract	1 per contract or material change	AS1141.24
	Particle Shape	1 contract	1 per contract or material change	AS1141.14
	Fractured Faces	1 contract	1 per contract or material change	AS1141.18
	Bulk Density	1 contract	1 per contract or material change	AS 2758.1
	Unit Mass (particle density)	1 contract	1 per contract or material change	AS 2758.1
	Water Absorption	1 contract	1 per contract or material change	AS 2758.1
	Material Finer 75µm	1 contract	1 per contract or material change	AS 2758.1
Raw Materials Supply	Weak Particles	1 contract	1 per contract	AS 2758.1
	Light Particles	1 contract	1 per contract	AS 2758.1
	Deleterious Materials (Impurities/Reactive)	1 contract	1 per contract	AS 2758.1
	Iron Unsoundness	1 contract	1 per contract	AS 2758.1
	Falling/Dusting Unsoundness	1 contract	1 per contract	AS 2758.1
Mix Design (kerb mix)	Compressive Strength	1 contract mix	1 per mix per contract	AS1012.9
	Aggregate Moisture Content	1 contract mix	1 per mix per contract	
	Consistency - Slump	1 contract mix	1 per mix per contract	AS1012.3.1
	Air Content	1 contract mix	1 per mix per contract	AS1012.4 Method 2
	Shrinkage	1 contract mix	1 per mix per contract	AS1012.13

Table SC6.4.5.3.10 Mass concrete subbase (SC6.4.6.14)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Concrete Supply	Refer to Table SC6.4.3.30			
	Concrete/Air Temperature	50m^3	1 per 50m^3	Measure
	Air Content	50m^3	1 per 50m^3	AS1012.4 Method 2
	Consistency - Slump	50m^3	1 per load	AS1012.3.1
	Compressive Strength (7 day)	50m^3	1 pair per 50m^3	AS1012.1 AS1012.8 AS1012.9
	Compressive Strength (28 day)	50m^3	1 pair per 50m^3	AS1012.1 AS1012.8 AS1012.9
Placement	Thickness	50m^3	5m grid on plan area	Survey and check with subgrade survey
	Geometry	50m^3	1 cross section per 15m	Survey and 3m Straight Edge
Curing	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per production batch	AS3799 AS1160
	Application Rate	1 day's work	1 per 1000m^2*	
Joints	Geometry	50m^3	All joints	Survey

* **Note**—or part thereof, per lot

Table SC6.4.5.3.11 Plain or reinforced concrete base (SC6.4.6.15)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Concrete Supply	Refer to Table 6.4.3.30			
	Concrete/Air Temperature	50m^3	1 per 50m^3	Measure
	Air Content	50m^3	1 per 50m^3	AS1012.4 Method 2
	Consistency - Slump	50m^3	1 per load	AS1012.3.1
	Compressive Strength (7 day)	50m^3	1 pair per 50m^3*	AS1012.1 AS1012.8 AS1012.9
	Compressive Strength (28 day)	50m^3	1 pair per 50m^3*	AS1012.1 AS1012.8 AS1012.9
Placement	Relative Compaction			
	Machine Placed	50m^3	1 per 50m^3*	AS1012.14
	Hand Placed	Area between 2 consecutive const. joints or 50m^3 (whichever is the lesser)	2 per lot	AS1012.14
	Thickness	50m^3	5m grid on plan area	Survey
	Geometry	50m^3	1 cross section per 15m	Survey and 3m Straight Edge
Ride Quality	Profile Factor	1000m^2	10/lane/lot	3m Straight Edge
Surface Texture	Texture Depth	1000m^2	2 per lot	Survey
Curing	Material Quality—Supplier's documentary evidence and certification	1 contract	1 per production batch	AS3799 AS1160
	Application Rate	1 day's work	1 per 1000m^2*	
Joints	Sealant Material Quality Supplier's documentary evidence and certification	1 contract	1 per prod'n batch	
	Geometry	50m^3	All joints	Survey

*** Note—**or part thereof, per lot

Table SC6.4.5.3.12 Bituminous microsurfacing (SC6.4.6.17)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	Bitumen (prior to emulsification)	1 contract	1 per contract or change in material	AS2008
	Bitumen Emulsion - Residual Binder Content (Residue from Evaporation)	1 contract	2 per bulk delivery	AS1160, App.D
	Mineral Aggregates - Degradation Factor	1 contract	1 per contract or 6 month period	AS1141.25
	- Los Angeles Value	1 contract	"	AS1141.23
	- Aggregate Wet Strength	1 contract	"	AS1141.22
	- Wet/Dry Strength Variation	1 contract	"	AS1141.22
	- Polished Aggregate Friction Value	1 contract	"	AS1141.42
	- Sand Equivalent	1 contract	"	AS1289.3.7.1
	Mineral Filler	1 month's prod'n	"	AS2357
	Combined Aggregate Grading	1 contract	"	AS1141.11 AS1141.12
Mix Design—Nominated Mix	Approval of mix and NATA certification—Supplier's documentary evidence and certification	1 contract	1 per mix	
Production Mix	Grading	1 day's prod'n or 50m^3 (whichever is the lesser)	2 per 50m^3*	AS2891.3.1
	Residual Binder Content		2 per 50m^3*	AS2891.3.1
Laying	Levels	1 layer, max 200m^3	1 cross section per 15m	Survey
	Surface Quality	1 layer, max 200m^3	10 per 100m* lane length	3m Straight Edge

*** Note—**or part thereof, per lot

Table SC6.4.5.3.13 Segmental paving (SC6.4.6.18)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	Concrete Segmental Paving Units	1 contract	1 per contract	AS/NZS 4455
	Clay Segmental Paving Units	1 contract	1 per contract	AS/NZS 4455
	Bedding Sand - Grading	1 contract	1 per contract or change in material	AS1141.11
	Joint Filling Sand - Grading	1 contract	1 per contract or change in material	AS1141.11
Base	Geometry	One layer 5000m², max 1 day's placement	One cross section per 25m	Survey
	Surface Quality	"	10 per 200m² or lot	3m Straight Edge
Edge Restraints	Refer SC6.4.6.28 Minor Concrete Work	1 day's placement	1 per 10 lin m	Measure/Survey
Laying Paver Units	Joint Width	1 day's placement	All joints	Measure
	Geometry	1 day's placement	One cross section per 15m	Survey
	Surface Quality	1 day's placement	10 per 200m² or lot	3m Straight Edge

Table SC6.4.5.3.14 Minor concrete works (SC6.4.6.28)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Subgrade	Compaction	1000 lin m or 1000m^2	1 per 200 lin m or 200m^2	AS1289.5.4.1
Gravel Subbase Construction	Compaction	1 days placement	1 per 100 lin m or 100m^2	AS1289.5.4.1
	Subbase Geometry	1 days placement	1 per 25 lin m	3m Straight Edge
Steel Supply	Material Quality—Suppliers documentary evidence and certification	1 delivery	1 per production batch	
Ready-Mixed Concrete Supply	Material Quality—Suppliers documentary evidence and certification	1 contract	1 per mix type	
	Consistency - Slump	15m^3	1 per load	AS1012.3 Method 1
	Compressive Strength (7 and 28 day)	15m^3	2 pairs per 15m^3	AS1012.1, AS1012.8, AS1012.9
	ALL TESTING—MINIMUM LOT SIZE 3m^3. No testing on loads less than 3m^3 if supplier can provide documentation of in production testing.			
Concrete Placement	Finished Levels	15m^3	1 cross section per 15m	Survey and 3m Straight Edge
	Surface Dimensions	Single fabrication	As required to confirm design dimensions	measure
Backfilling	Material Quality			
	Maximum particle size	1 contract/ material type	1 per 200m^3	Q103
	Plasticity Index	1 contract/ material type	1 per 200m^3	AS1289.3.3.1
	Compaction	1 days work or max 200m^2	1 per 200m^2	AS1289.5.4.1
Sprayed Concrete	Test Panels and Cores	1 contract	3 test panels and 4 cores per mix design	AS1012.4, AS1012.9 AS1012.14
	Compressive Strength Cores	15m^3	2 per 15m^3	AS1012.4 AS1012.9 AS1012.14

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	Curing Material Quality— Supplier's documentary evidence and certification	1 contract	1 per production batch	

Table SC6.4.5.3.15 Pavement markings (SC6.4.6.22)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality - Supplier's documentary evidence and certification of:			
	Paint	1 contract	1 per contract or change in material	
	Glass Beads	1 contract	"	
	Thermoplastic Material	1 contract	"	
	Raised Pavement Markers	1 contract	"	
Paint Application	Wet Film Thickness	1 contract	1 per site visit	AS 1580.107.3
	Application Rate of Glass Beads	1 contract	1 per contract	SC6.4.6.22 Attachment A
Thermoplastic Application	Cold Film Thickness	1 contract	1 per site visit	Measure by micrometer
	Application Rate of Glass Beads	1 contract	1 per contract	SC6.4.6.22 Attachment A

Table SC6.4.5.3.16 Signposting (SC6.4.6.24)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	Sign Blanks	1 contract	1 per contract, or change in material	
	Aluminium Extrusion Backing	1 contract	"	
	Retro-reflective Material	1 contract	"	
	Non-reflective Paint	1 contract	"	
	Non-reflective Sheet Material	1 contract	"	
	Steel Sign Support Structures	1 contract	"	
Concrete Foundations	Refer SC6.4.6.28			

Table SC6.4.5.3.17 Water reticulation (SC6.4.6.2)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	uPVC Pipes	1 contract	1 per contract	AS2977
	Ductile Iron Pipes	1 contract	1 per contract	AS2280 and AS2129
	Copper Pipe	1 contract	1 per contract	AS1432
	Polyethylene Pipe	1 contract	1 per contract	AS1159
	Stop Valves Material	1 contract	1 per contract	AS2638 and AS2129
	Non Return Valves	1 contract	1 per contract	AS3578
	Spring Hydrants	1 contract	1 per contract	AS2544 or AS3952
Siting and Excavation	Geometry	1 line	1 per line	Survey
Bedding	Material Quality			
	Grading	1 contract	1 per contract per source	AS2032
Thrust and Anchor Blocks	Refer to Table SC6.4.5.3.14			
Chamber Covers and Frames	Geometry	1 cover/frame	1 per cover/frame	survey
Testing of Pipelines	Pressure testing	1 line	1 per line	As specified in SC6.4.6.2.5
Backfill and Compaction	Compaction	1 line	1 per 2 layers max 100m^2	AS1289.5.7.1
Switchgear and Control gear Assembly	Electrical function	each installation	1 factory test per installation	AS3439
Commissioning of Pumping Station	Certification testing of electrical installation in accordance with relevant Australian Standards	1 installation	1 per installation	

Table SC6.4.5.3.18 Sewerage system (Construction specification SC6.4.6.3)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	uPVC Pipes	1 contract	1 per contract	AS1477
	Ductile Iron Pipes	1 contract	1 per contract	AS2280 and AS2129
	Vitrified Clay Pipes	1 contract	1 per contract	AS1741
	Precast Access Chambers	1 contract	1 per contract	AS4198
Siting and Excavation	Geometry	1 line/ structure	1 per line/ structure	Survey
Bedding	Material Quality	1 contract	1 per contract per source	Q103
	Grading			
Concrete Bedding	Refer Table SC6.4.5.3.14			
Laying and Jointing of Pipes, Access Chambers, Structures	Geometry	1 line	1 per line	Survey
Thrust and Anchor Blocks	Table SC6.4.5.3.14			
Cast-in-situ Access Chambers	Material Quality			
	Tri-Calcium Aluminate Content	1 contract	1 per contract per source	AS3972
	Fineness Index	1 contract	"	AS3972
	Minimum Cement Content	1 contract	"	AS3972
Acceptance Test of Gravitation Mains and Access Chambers	Compressed Air Testing	1 line	1 per line	As specified SC6.4.6.3.4
Backfill and Compaction	Compaction	1 line	1 per 2 layers max 100m^2	AS1289.5.7.1
Switchgear and Control gear Assembly	Electrical Compliance	each installation	1 factory test per installation	AS3439
Commissioning of Pumping Station	Certification testing of electrical installation in accordance with relevant Australian Standards	1 installation	1 per installation	

SC6.4.5.3 Attachment B Random sampling

(1) General

Random sampling of test locations shall be used to control relative compaction of each layer of (which are generally rectangular in area):

(a) earthworks;

(b) selected material zone;

(c) flexible pavement

(d) asphalt; and

(e) stormwater drainage

The number of samples (n) per lot shall be as indicated in the specific sub-sections which are summarised in SC6.4.5.3 Attachment A.

(2) Locations

Sampling locations within a lot for the control of relative compaction shall be determined as follows:

(a) representing the lot as a rectangle, sub-divide the lot lengthwise into equi-area sub-lots in accordance with the number of samples selected (n) in accordance with Table SC6.4.5.3.19;

(b) establish six grid lines within the lot, as illustrated in Figure SC6.4.5.3.3;

(c) throw a die to select a number between 1 and 6. This determines which grid line to use for the sample location in sub-lot 1;

(d) throw die to select a group (1-6) in Table SC6.4.5.3.19;

(e) throw die twice to select two random numbers (between 1 and 6) for row and column in Table SC6.4.5.3.19 and obtain random fraction R;

(f) length co-ordinate for sample location in Sub-lot 1 = RL/n; and

(g) for sample location in next sub-lot:

(i) add L/n to previous length co-ordinate; and

(ii) add 1 (on a cycle of 6) to previous grid line.

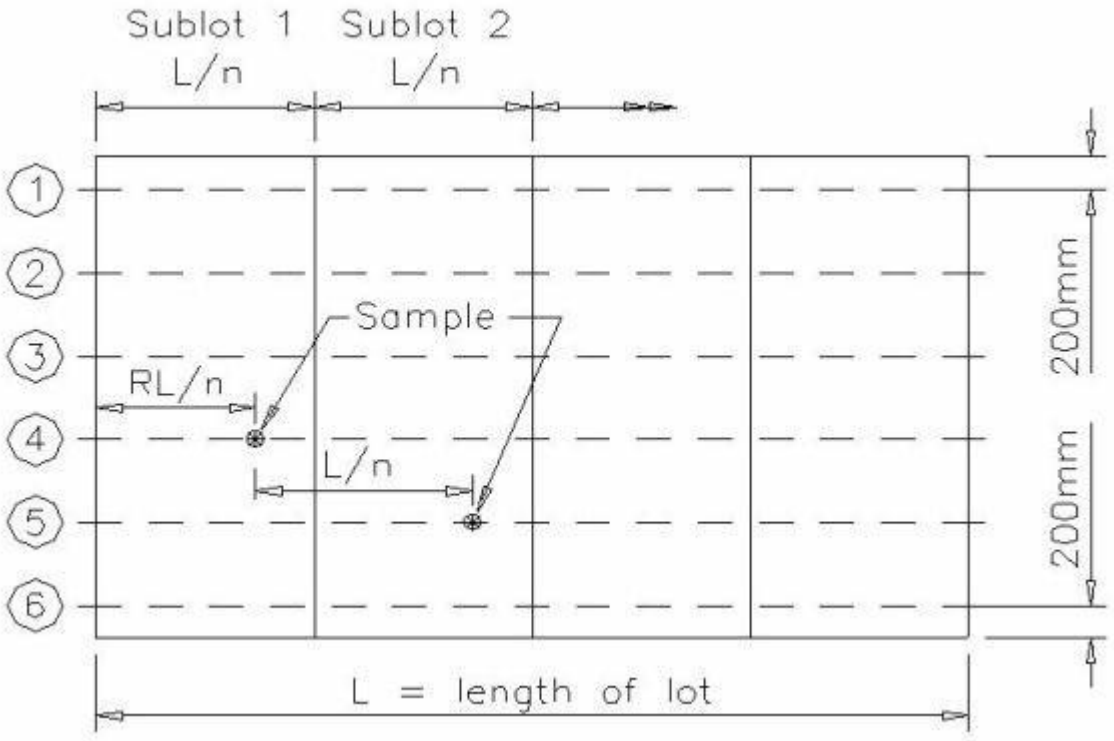


Figure SC6.4.5.3.3 Sampling locations for rectangular lot

Table SC6.4.5.3.19 Table of random fractions

GROUP	ROW	COLUMN					
		(1)	(2)	(3)	(4)	(5)	(6)
(1)	(1)	0.78178	0.45467	0.00347	0.27296	0.00020	0.36517
	(2)	0.59678	0.67931	0.25434	0.59054	0.32444	0.41504
	(3)	0.14464	0.17269	0.61154	0.18291	0.83242	0.50776
	(4)	0.89010	0.44764	0.07451	0.20428	0.49513	0.91440
	(5)	0.91941	0.47726	0.33160	0.30670	0.65114	0.36852
	(6)	0.51085	0.38148	0.22169	0.66578	0.67050	0.69559
(2)	(1)	0.81891	0.48626	0.88892	0.82994	0.16941	0.81528
	(2)	0.37410	0.60232	0.12070	0.79017	0.32981	0.34908
	(3)	0.45921	0.15648	0.58052	0.37413	0.08124	0.97145
	(4)	0.86614	0.94719	0.78872	0.91972	0.45149	0.15107
	(5)	0.26590	0.41140	0.95477	0.81267	0.24018	0.07324
	(6)	0.95205	0.39438	0.73697	0.59427	0.71146	0.00575
(3)	(1)	0.18694	0.36502	0.17828	0.84312	0.57003	0.58583
	(2)	0.91211	0.86936	0.43030	0.27672	0.47393	0.10342
	(3)	0.80714	0.34295	0.00775	0.90855	0.33368	0.21842
	(4)	0.67579	0.92686	0.18005	0.00645	0.11256	0.05278
	(5)	0.03184	0.69876	0.16676	0.43346	0.86992	0.03275
	(6)	0.15623	0.02905	0.72763	0.19095	0.80847	0.39729
(4)	(1)	0.72109	0.17970	0.22505	0.35561	0.98935	0.27818
	(2)	0.37348	0.19381	0.43331	0.75033	0.99963	0.42232
	(3)	0.12129	0.32386	0.56705	0.87165	0.84460	0.92955
	(4)	0.54948	0.08844	0.47061	0.78419	0.18731	0.93485
	(5)	0.15097	0.44967	0.48759	0.84161	0.19212	0.05146
	(6)	0.32360	0.66850	0.99382	0.94050	0.96449	0.96217
(5)	(1)	0.68091	0.54191	0.10910	0.94237	0.23161	0.15167
	(2)	0.97121	0.83626	0.70896	0.45296	0.69475	0.11264
	(3)	0.19723	0.98260	0.57429	0.94789	0.64457	0.20809
	(4)	0.84036	0.14095	0.29451	0.40256	0.34521	0.64924
	(5)	0.97500	0.98056	0.82276	0.97130	0.77329	0.89855
	(6)	0.83244	0.30828	0.06882	0.68471	0.71081	0.91649
(6)	(1)	0.75892	0.29685	0.70044	0.91238	0.53356	0.45239
	(2)	0.13229	0.19701	0.36074	0.32254	0.62045	0.26691
	(3)	0.34789	0.22179	0.91891	0.87651	0.91011	0.97469
	(4)	0.97211	0.68943	0.12831	0.50006	0.20793	0.61151
	(5)	0.24954	0.17809	0.56093	0.51524	0.69135	0.68967
	(6)	0.10062	0.11852	0.47089	0.64765	0.44644	0.35548

SC6.4.5.3 Attachment C Method statement requirements

General

(1) Method statements are required to describe the key steps and sequence in the construction activities, how and by whom each step shall be undertaken and what materials and equipment shall be used. Method statements may include a flow chart to clarify the sequence of key steps. One or more method statements may address a construction activity.

(2) Each method statement will be supported by a check list which shall identify relevant inspections, test points, materials requirements and hold points. Each requirement on the check list will have an officer responsible

identified and will require the nominated officer to sign off the requirement so indicating its satisfactory execution.

(3) Method statements and check lists shall be compatible with the appropriate Inspection and test plan. Check lists will be completed for each lot of work during construction and compiled with other documents to comprise the quality register.

(4) The Contractor shall submit method statements and check lists to describe the key steps in those construction activities listed below that are identified with a preceding asterisk (*).

Item	Enter * here if required	Activity	Sub-section Number
1		Control of Traffic	SC6.4.6.30
2		Temporary Roadways and Detours	SC6.4.6.30
4		Clearing and Grubbing	SC6.4.6.11
5		Earthworks - Cut	SC6.4.6.10
6		Earthworks - Unsuitable Material	SC6.4.6.10
7		Earthworks - Embankment	SC6.4.6.10
8		Compaction and Quality Control	SC6.4.6.10
9		Siting, Excavation, Bedding, Backfilling and Compaction of Stormwater Drainage	SC6.4.6.4
10		Installation of Pipe Drainage	SC6.4.6.6
11		Installation of Precast Box Culverts	SC6.4.6.7
12		Siting and Installation of Drainage Structures	SC6.4.6.5
13		Construction of Lined Open Drains including Kerb and Gutter	SC6.4.6.9
14		Stabilisation of Pavement or Subgrade Materials	SC6.4.6.19
15		Provision of Subsurface Drainage as subsoil drains, pavement drains or free draining layer	SC6.4.6.20-21, SC6.4.6.8
16		Construction of Flexible Pavement Layers	SC6.4.6.12
17		Construction of Concrete Pavement Layers	SC6.4.6.14-15
18		Construction of Asphaltic Concrete Pavement Layers	SC6.4.6.13
19		Sprayed Bituminous Surfacing	SC6.4.6.16
20		Bituminous Microsurfacing	SC6.4.6.17
21		Construction of Segmental Paving	SC6.4.6.18
22		Pavement Marking	SC6.4.6.22
23		Minor Concrete Works	SC6.4.6.28
24		Landscaping	SC6.4.6.28

SC6.4.5.3 Attachment D Minimum inspection and test plan

Table SC6.4.5.3.20 Water supply-hold points

Clause title/ Item	Requirement	Notice for inspection	Release by
Materials			
General	Submit alternative products and materials for approval.	2 weeks before ordering	Council (Water Authority)
Pipeline construction			
General–Work accreditation	Provide proof of accreditation for approval.	1 week prior commencement of work	Superintendent
General–Change of Pipeline Alignment	Approval of the proposed alignment from the Water Authority.	1 week	Council (Water Authority)
Earthworks–Excavation near existing services	Approval from relevant Authority for the excavation.	1 week	Superintendent

Clause title/ Item	Requirement	Notice for inspection	Release by
Minimum Trench Width for Pipelines–Excavation across paved or improved surfaces	Approval from the Authority or Owner prior to commencing any excavation across paved or improved surfaces.	1 week	Superintendent
Pipe Bedding–Trench completed	Present the completed excavated trench prior to pipe laying, jointing and bedding.	2 working days	Superintendent
Laying and Jointing of Pipes–Existing asbestos cement pipe cutting and disposal	Submit method statement for approval.	2 working days	Superintendent
Pipe testing and restoration			
Testing of Pipelines	Conduct pressure testing.	7 days	Superintendent and Council
Testing of Pipelines– unsatisfactory test results, defects and leakage	Conduct pressure testing upon completion of rectification work.	3 days	Superintendent and Council
Backfill and Compaction– Completion of work	Present the laid and jointed pipes for approval prior to the commencement of trench backfilling.	2 working days	Superintendent
Restoration of Surfaces	Restore progressively and as soon as possible after the section of works is completed.	2 working days	Superintendent
Pump stations			
Pumps	Provide written warranty from the manufacturer for approval.	2 weeks before ordering	Superintendent
Electrical Compliance– ompliance with required standard	Supply a proof of compliance**–**Test certificate.	1 week	Superintendent
Electrical Installation–oute of underground cabling	Submit underground cabling requirements and route for approval.	2 weeks	Superintendent
Testing and Commissioning of Pump Station–Compliance with the Specification Requirements	Submit required test results.	1 week	Water Authority and Superintendent
Testing and Commissioning of Pump Station–Commissioning	Give notice of intention to undertake commissioning. Provide pre-commissioning record sheets.	2 weeks	Water Authority and Superintendent
Construction compliance			
Works–as–executed details and Operation and Maintenance Manuals	Submit work-as executed drawing and Operating and Maintenance Manuals.	2 weeks before operating	Water Authority and Superintendent

Table SC6.4.5.3.21 Water supply-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/ Item	Requirement	Notice for inspection
Materials		
General–Compliance with manufacturers recommendations	Contractor to inspect material and products at time of delivery for compliance.	2 working days
General–Certification	Provide product or material certification prior to delivery to the works.	3 working days (Pipes and Fittings) 1 week (Valves and Hydrants)
Pipeline construction		
Location–Set out	Confirm the set out locations prior to construction.	3 working days
Crossings–Crossings authority approvals	Approval from relevant Authority and payment of fees.	2 weeks
Earthworks–Open excavation	Contractor to provide appropriate safety measures for open excavation.	Progressive
Laying and Jointing of Pipes–Inspection prior laying	Contractor to present to the Superintendent materials prior laying (if required).	Progressive
Pipe testing and restoration		
Disinfection and Flushing of Pipelines	Provide evidence of compliance with this requirement.	2 working days upon completion of activity.
Restoration of Surfaces–Disposal of surplus material	Superintendent approval is required prior spreading/disposal.	2 working days progressive

Table SC6.4.5.3.22 Sewerage systems-hold points

Clause title/ Item	Requirement	Notice for inspection	Release by
Materials			
General	Submit alternative products and materials for approval.	2 weeks before ordering	Superintendent
Pipeline construction			
General–Work accreditation	Provide proof of accreditation for approval.	1 week prior commencement of work	Superintendent
General–Change of Pipeline Alignment	Approval of the proposed alignment from the Sewer Authority.	1 week	Superintendent and Council (Sewer Authority)
Earthworks–Prior Excavation	Approval from relevant Authority for the excavation.	1 week	Superintendent
Excavation near underground services–Protection of other services	Submit for approval give notice of any interference to the works caused by an existing service and submit a proposed work method statement.	1 week	Superintendent
Pipe Bedding–Foundation Condition/Water Charged Ground	Notify Superintendent and confirm method of foundation support from the designer.	Progressive	Superintendent

Clause title/ Item	Requirement	Notice for inspection	Release by
Wrapping Pipelines– Damage to sleeving	Rectify any damage to sleeving before backfilling trench.	Progressive	Superintendent
Bedding and Backfill Compaction Requirements–Notification of pipeline laid and jointed.	Present the laid and jointed pipes for approval before the trench backfilling.	Progressive	Superintendent
Bedding and Backfill Compaction Requirements–Embankment	Submit proposal for construction of embankments.	1 week	Superintendent
Pipeline testing and restoration			
Acceptance Test of Gravitation Sewers and Maintenance Holes– acceptance Testing	Present all sewers and maintenance holes for acceptance testing.	1 week	Superintendent and Sewer Authority
Acceptance Test of Gravitation Sewers and Maintenance Holes–Hydrostatic testing	Submit proposed alternative testing regime for approval.	1 week	Superintendent and Sewer Authority
Connection to Existing Sewers	Submit request to connect to the existing sewer and give notice of works including any affected occupants.	3 weeks before connection	Superintendent and Sewer Authority
Testing of Rising Mains–Pressure Test	Present rising main for acceptance testing.	1 week	Superintendent and Sewer Authority
Restoration of Surfaces– Original condition requirement	Restore progressively and as soon as possible after the section of works is completed.	2 working days	Superintendent
Pump stations			
General–Authorised products and materials	Submit alternative products and materials for approval.	2 weeks before ordering	Superintendent
Pumps	Provide written warranty of the equipment.	Upon delivery on site	Superintendent
Electrical Compliance– Compliance with required standard	Supply a proof of compliance – Test certificate.	1 week	Superintendent
Electrical Installation– Route of underground cabling	Submit underground cabling requirements and route for approval.	2 weeks	Superintendent
Testing and Commissioning of Pump Station–Compliance with the Specification Requirements	Submit required test results.	1 week	Sewer Authority and Superintendent
Testing and Commissioning of Pump Station–Commissioning	Give notice of intention to undertake commissioning. Provide pre-commissioning record sheets.	2 weeks	Sewer Authority and Superintendent
Practical Completion of Pump Station	Fulfil all the requirements for issuance of Certificate of Practical Completion.	2 weeks	Superintendent
Construction compliance			

Clause title/ Item	Requirement	Notice for inspection	Release by
Works–as–executed details and Operation and Maintenance Manuals	Submit work-as executed drawing and Operating and Maintenance Manuals.	1 week before operating	Sewer Authority and Superintendent

Table SC6.4.5.3.23 Sewerage systems-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/item	Requirement	Notice for inspection
Materials		
General–Compliance with Manufacturer's recommendations	Contractor to Inspect material and products at time of delivery for compliance.	2 working days
General–Certification	Provide product or material certification prior to delivery to the works.	3 working days (Pipes and Fittings) 1 week (Valves)
Pipeline construction		
Crossings–Crossings Authority approvals	Approval from relevant Authority and payment of fees.	2 weeks
Earthworks–Open excavation	Contractor to provide appropriate safety measures for open excavation	Progressive
Bedding and Backfill Compaction Requirements–NATA	Provide NATA certified test results for all testing.	2 working days progressive
Thrust and Anchor Blocks for Rising Main–Verification of Bearing Pressures	Give notice if the allowable bearing pressure of the ground and the design pressure of the pipeline differ from actual pressures on site.	1 week
Pipeline testing and restoration		
General–Initial Tests (Sewers and Maintenance Holes)	Give notice prior commencement of initial testing.	2 days progressive
Ovality Test and CCTV Inspection– Deflection testing and pipeline verification	Submit proposal for deflection testing (Ovality Test). Submit CCTV Results.	1 week (Ovality Test) 2 days upon completion of inspection
Acceptance Test of Gravitation Sewers and Maintenance Holes	Submit acceptance test results.	Progressive
Visual Inspection and Measurement of Infiltration– Infiltration testing	Submit method of infiltration testing.	1 week
Testing of Rising Main	Submit acceptance test results.	Progressive
Restoration of Surfaces–Disposal of surplus material	Superintendent approval is required prior to spreading/disposal.	2 working days progressive
Pump stations		
General - Conformance with manufacturers recommendations	Inspect material and products at time of delivery.	2 working days
Electrical Compliance–approval of all design and materials	Submit all design drawings and materials to each Authority having jurisdiction for approval.	2 weeks before ordering

Table SC6.4.5.3.24 Stormwater drainage-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Construction			
Temporary drainage–Erosion and Sediment Control	Confirmation of accepted project ESCP and completion of erosion and sedimentation control measures.	1 week prior to site commencement	Superintendent and Council
Siting of Culverts–Survey set-out	Submit survey set-out of culvert inlets and outlets for approval.	1 week prior to proceeding	Superintendent
Siting of Culverts–Changes by Contractor	Submit proposed changes for approval.	1 week prior to proceeding	Superintendent
Excavation–Public utilities	Obtain approval for adjacent excavation with relevant authorities.	1 week prior to proceeding	Superintendent
Construction traffic– Protection measures	Submit certification and verification of protection measures.	3 working days	Superintendent

Table SC6.4.5.3.25 Stormwater drainage-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Construction		
Excavation–Notice	Identify unsuitable materials and inadequate support material for removal and disposal at the foundation level of the structure.	progressive
Backfilling–In situ concrete structures	Do not backfill against in situ concrete structures within 14 days of concrete placement.	progressive
Backfilling–Tolerance	Check shape of culvert during backfilling.	progressive
Compaction adjacent to culverts or drainage structures	Inform the Superintendent prior rectification any damage.	2 working days before proceeding

Table SC6.4.5.3.26 Drainage structures-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Construction			
Precast Units–Product drawings and Quality	Submit details of precast or proprietary items for approval and Submit quality test results.	1 working day and 3 working days before delivery respectively	Superintendent
Excavation	Excavation and compaction of foundation as documented.	1 working day	Superintendent
Backfill–Commencement	Obtain approval for commencement.	1 workday day	Superintendent

Table SC6.4.5.3.27 Drainage structures-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Construction		
Headwalls and Wingwalls – Batter retention	If dimensions on drawings are unable to satisfy batter retention, notify the Superintendent.	3 working days
Precast units	Give notice of installation of precast pits and junction boxes.	1 week
Construction	Submit for approval part omission of concrete lining.	3 working days

Table SC6.4.5.3.28 Pipe drainage-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Common requirements			
General–Material Certification	Submit conformance certificate and other relevant manufacturer quality documentation.	24 hours in advance of dispatch to site	Superintendent
General–Alternative materials	Submit full product details in accordance with AS/NZS 2566.1.	4 weeks prior to commencing work	Superintendent and Council
General–Backfilling	Present the completed installation and jointed pipes for inspection.	Progressive before backfilling	Superintendent and Council
General–Protection of structures	Submit design proposal for protective measures for approval.	3 days prior	Superintendent and Council
Steel pipes and pipe arches			
Materials and Surface Treatment	Engineer's certification for the pipe materials and surface treatments.	Prior to practical completion	Superintendent
UPVC pipes			
Materials–Proprietary product with external diameter of ≥450mm	Submit for approval prior to construction.	4 weeks	Superintendent and Council

Table SC6.4.5.3.29 Pipe drainage-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Precast reinforced concrete and fibre reinforced concrete pipes		
Excavation–Wide Trench Condition	If deemed as a wide trench, confirm appropriate pipe strength/trench support.	Progressive
Bedding	Source of bedding material -advise Superintendent.	Progressive
Bedding–Cementitious stabilisation	Provide if erosion of bedding material may occur.	1 week

Table SC6.4.5.3.30 Precast box culverts-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Materials			
Culvert Units, Link and Base Slabs	Submit certificate of conformance.	3 working days prior to dispatch	Superintendent
Proof load testing	Submit certificate and test results.	3 working days prior to dispatch	Superintendent
Construction			
Construction of coffer dams	Submit construction details for approval.	1 week prior to construction	Superintendent
Prior placement of bedding	Inspection of foundation and approval of proposed bedding.	2 days before placing material	Superintendent
Backfill—Inspection of seals	Present joints and seals for before backfilling.	1 working day	Superintendent
Construction loading on culvert —Constraint	Do not load base slab until strength has reached ~~32~~20 MPa.	~~28 days~~1 working day	Superintendent

Table SC6.4.5.3.31 Precast box culverts-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Materials		
Handling, Delivery and Storage	Inspect box culvert units for conformance.	1 week prior to installation
Construction		
Coffer Dams—Timber or bracing removal	Inspect removal of bracing materials.	1 working day
Installation of Precast in situ base slabs	Attainment of concrete minimum compressive strength.	1 working day

Table SC6.4.5.3.32 Drainage mats-hold points

Item/Clause title	Requirement	Notice for inspection	Release by
Type A mats / Type B mats			
Geotextile, Damaged geotextile	Approval of condition or repair of geotextile.	1 working day before next activity	Superintendent
Filter material, Thickness	Approval of thickness and layers of filter material.	3 working days before placing filters	Superintendent

Table SC6.4.5.3.33 Drainage mats-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Type A mats /Type B mats		
Filter material, Protective layer	Inspection of placement of protective layer over mat extension.	3 working days before placing materials
Discharge, Outlets	Inspection of outlet proposals.	7 days before set-out of layers

Table SC6.4.5.3.34 Open drains-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Pre-construction planning			
Provision for traffic	Submit Traffic Guidance Scheme for approval.	2 weeks prior to site commencement	Superintendent
Temporary drainage	Submit details of procedures/devices for approval.	2 weeks prior to site commencement	Superintendent
Materials			
Proprietary Products	Submit proprietary products and manufacturer's instructions.	7 days prior to commencement on site	Superintendent
Gabions/Wire mattresses	NATA compliance certificates for proposed Gabions.	7 days prior to commencement on site	Superintendent
Rock fill material	NATA compliance certificates for proposed rock fill material.	7 days prior to commencement on site	Superintendent
Geotextile	NATA compliance certificates for proposed Geotextile material.	7 days prior to commencement on site	Superintendent
Open drains			
Excavation	Approval to divert drain to avoid trees and/or rocks.	1 working day before set-out.	Superintendent.
Excavation	Location and construction of drains to prevent salination.	1 working day before set-out.	Superintendent.
Kerb and channel (gutter)			
Foundation	Approval for shape and compaction of foundation material.	1 working day before forming	Superintendent

Table SC6.4.5.3.35 Open drains-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Open drains		
Excavation	Unsuitable material removal and disposal.	Progressive
Excavation	Spoil site locations.	Prior to placement
Embankment	Embankment compaction and revegetation.	Progressive
Construction	Grade and compaction of open drains.	Progressive
Construction	Proprietary items installed to manufacturers recommendations.	Progressive
Types	Maintain catch drains.	Progressive
Types	Construct minor diversion and contour drains, table drains, swales and depressed medians.	Progressive
Types	Channels preserving the existing stream bed.	Progressive
Lining		
Concrete lining	Instruction on weephole location.	1 working day before concreting.
Concrete lining	Joints and tolerances.	1 working day before concreting.
Stone pitching	Bedding material and placement.	1 working day before concreting.
Kerb and channel (gutter)		
Stormwater outlets	Positive drainage to channel.	Progressive
Vehicular or pedestrian access	Siting, location and bedding compaction.	Progressive
Backfilling and reinstatement		
Backfill behind kerbs	Backfilling timing, material and compaction.	1 working day prior to backfilling
Pavement backfill	Backfill adjacent new gutter material and location.	1 working day prior to backfilling
Rock filled wire mattresses and gabion– Completion	Inspection of rockfill material and filling method.	On completion of works

Table SC6.4.5.3.36 Earthworks-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Stockpile Sites	Approval to use any stockpile site not shown on the Drawings.	3 working days before stockpiling	Superintendent
Treatment of Floors of Cuttings–Prior ripping floors of cuttings	Present in situ material for inspection to determine suitability of pavement support.	Before ripping commences	Superintendent
Treatment of Floors of Cuttings–Compacting floors of cuttings	Inspection of compacted cutting floor.	Prior to placing any subsequent layers over the completed cutting floor	Superintendent and Council
Unsuitable material–Floor inspection	Re-present the floor of the excavation after the removal of unsuitable material.	Prior to backfilling with replacement material	Superintendent

Clause/subclause	Requirement	Notice for inspection	Release by
Foundations for Embankments	Inspection of the embankment foundation area.	1 working day prior to next activity	Superintendent
Foundation for Embankments–Other Embankments (Bridging layer)	Inspection and direction for bridging layer where required	3 working days before proceeding	Superintendent
Trimming tops of embankments	Inspection of the completed surface to receive subsequent pavement layers.	Prior to placing any subsequent pavement layers	Superintendent
Selected material zone	Inspection of the completed select material zone surface prior to placing any subsequent pavement layers.	1 working day before proceeding	Superintendent
Fill adjacent to structures–General	Concrete strength required for early filling to structures.	3 working days prior to fill placement	Superintendent
Deflection monitoring or proof rolling	Present the completed work for deflection monitoring or proof rolling.	2 working days before next activity	Superintendent and Council

Table SC6.4.5.3.37 Earthworks-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Natural Surface and Earthworks Materials	Survey method and results, including any discrepancies.	At least 7 days notice
Cuttings–Floors of cuttings	Floors to be no more than 50 mm above or below the designed floor and provide suitable support.	1 working day before next activity
Batters–Excavation beyond the batter line	Minor change in the general slope of the batter to suit the site conditions.	1 working day before next activity
Transition from cut to fill–Terrace	Excavate a terrace for the width of the selected material zone to a depth of 900 mm below and parallel to the cutting floor.	1 working day before excavating terrace
Unsuitable Material	Material deemed unsuitable for embankment or pavement support in its present position.	Progressive
Placing Fill for Embankment Construction–Rock material	Modify grading of fill material to achieve compaction.	Progressive
Fill adjacent to structures–Treatment at weepholes	Proposal to use synthetic membrane geotextile.	3 working days before proposed use
Spoil–Haulage disposal	Obtain planning approval and any permits.	3 working days before commencing activity
Borrow–Requirement	Obtain planning approval and any permits.	3 working days before commencing activity

Table SC6.4.5.3.38 Clearing and grubbing-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Limits of clearing			
Survey	Decision on the removal of miscellaneous items.	7 days before proposed removal	Superintendent
Extent of clearing	Submit peg out and extent of clearing survey.	7 days before proposed commencement of clearing	Superintendent and Council
Clearing Operations			
Tagging	Confirm clearing perimeters and mark trees to be preserved.	7 days before proposed site clearing	Superintendent and Authorised Council Officer
Work near trees noted for protection	Work method statement for works within the exclusion zone.	7 days before proposed works	Superintendent
Excavation within 4m of tree trunks	Develop appropriate work methods to avoid damage to the tree for approval.	7 days before proposed excavation	Superintendent
Trees within proposed embankment areas	Direction to remove or protect trees within proposed embankments.	7 days before proposed site clearing	Superintendent
Unsound trees in road reserve	Direction on removal of trees or branches not within the clearing limits.	7 days before proposed site clearing	Superintendent
Timber falling on private property	Written consent of owner to leave in place or to enter property to remove.	Prior to carrying out works	Superintendent
Damage	Approval for any rehabilitation of vegetation or fauna habitat.	3 working days prior to carrying out works	Superintendent and Authorised Council Officer
Grubbing			
Blasting	Explosives not permitted without prior approval.	Progressive	Superintendent
Disposal of materials			
Burning of material	Approval prior to disposal of timber and other combustible materials by burning.	Prior to burning	Superintendent

Table SC6.4.5.3.39 Clearing and grubbing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Existing Utility services–Marking	Locate all underground pipe and cables.	Before commencing any earthworks
Trees to be preserved–Work near trees noted for protection	Exclusion zone around protected trees.	Progressive
Trees to be preserved–Tree protection	Trees and roots not to be cut or damaged.	Progressive
Grubbing–Backfill	Backfill and compact grub holes.	Progressive
Chipping of cleared vegetation–Stockpiling	Stockpile location approval.	Prior to stockpiling

Table SC6.4.5.3.40 Flexible pavements-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Activity plan			
Pavement construction plan	Prepare and submit pavement plan.	4 weeks before commencing site work	Superintendent
Inspection, sampling and testing			
Notification	Written notice for testing times and provide test results.	3 working days prior to testing or inspection	Superintendent
Materials			
Proposed materials	Prepare and submit schedule detailing material properties including NATA test results and certificate.	2 weeks before ordering materials	Superintendent
Bound or modified materials	Complete and submit (SC6.4.6.19 Attachment A).	2 weeks before ordering materials	Superintendent
Variations to approved materials	Submit details of changes to approved materials.	1 week before use in works	Superintendent
Lime modified base and subbase materials			
Lime modification	Submit proposals to modify materials.	2 weeks before placing	Superintendent
Stationary Plant or In-situ lime modification	Submit proposals for the in-situ use of hydrated lime or quicklime.	2 weeks before activity	Superintendent
Spreading			
Underlying layer	Inspection to determine suitability of underlying layer.	1 working day before placing next layer	Superintendent
Temperature	Submit proposal to proceed outside allowable conditions.	1 working day before placement	Superintendent
Trimming, compaction and curing			
Plant	Submit details of proposed hand operated plant.	1 week before use	Superintendent
Subsequent layers	Submit completed test results of previous layer.	1 working day before placing next layer	Superintendent
Acceptance of compaction			
Lots for acceptance	Submit compaction test results.	1 working day after testing	Superintendent
Compaction requirements and acceptance	Submit evidence that compaction is within tolerances.	1 working day after test results	Superintendent
Tolerances			
General	Submit lot survey reports.	1 working day before next activity	Superintendent
Action on rejection			
Corrective action–rejected unbound layers	Submit proposal for corrective action.	1 working day before next activity	Superintendent
Corrective action–rejected bound layers	Submit proposal for corrective action.	3 working days before next activity	Superintendent
Removal and replacement of rejected course			
Extent of removal	Submit proposal to remove less than full width.	1 working day before next activity	Superintendent

Clause title/Item	Requirement	Notice for inspection	Release by
Prior to replacement	Give notice for inspection of underlying material.	1 working day before next activity	Superintendent
Replacement	Submit proposed methods to make good.	1 working day before next activity	Superintendent
Maintenance before completion of wearing course			
Pavement condition before primerseal	Dry-back, re-prepare and give notice for inspection.	3 working days before next activity	Superintendent and Council
Opening bound pavement to traffic	Give notice of proposed opening to traffic.	3 working days before proposed opening	Superintendent

Table SC6.4.5.3.41 Flexible pavements-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Delivery to site		
Delivered materials	Give notice for inspection.	Progressive
Delivery of modified or bound materials		
Delivery of materials	Provide delivery dockets at point of delivery.	Progressive
Stockpiling of unbound materials		
Location	Give notice of proposed alternative locations.	2 weeks before stockpiling
Trimming, compaction and curing		
Compaction	Give notice of proposal to use alternative layer thickness.	2 weeks before activity
Rework	Give notice for inspection of reworked wetted up layer.	Progressive
Curing of bound materials	Give notice of water curing activities.	Progressive
Acceptance of compaction		
Nuclear density Meter testing	Give notice of proposal to use Nuclear density meter.	1 working day before use
Tolerances		
Layer width	Give notice of completion of layer width.	Progressive
Levels and Surface Trims	Give notice of completed surface layer.	Progressive

Table SC6.4.5.3.42 Asphaltic concrete-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Plant	Evidence that plant is registered and insured.	2 weeks before using plant	Superintendent
Delivery—work records	Submission for counter signing.	Each day for daily completion	Superintendent
Asphalt mix design			
Approved Mix	Submit approved mix design for Superintendent confirmation.	7 days before using mix	Superintendent
Production Mix— Production Sampling and Testing	Submission of all documented test results.	Within 7 days of delivery of material	Superintendent

Clause/subclause	Requirement	Notice for inspection	Release by
Asphalt mixes incorporating RAP	Mixes containing more than 20% RAP to be submitted for assessment.	7 days before using mix	Superintendent
Placing	Present surface prior spreading.		Superintendent
Joints—General	Submit plan of joints location for approval.	7 days before commencing	Superintendent
Preparation of Pavement — Rectification of Pavement Surface	Prepare surface to the satisfaction of the Superintendent.		Superintendent
Laying—Paver	Provide notice of proposed pavers.		Superintendent
Removal and Replacement of Rejected Material	Present surface after removal of the rejected material.		Superintendent

Table SC6.4.5.3.43 Asphaltic concrete-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Plant	Superintendent to assess faulty plant.	Progressive
Production	Superintendent to access the mixing plant to verify production procedures and the supplier's compliance with the Contractor's Project Quality Manual and Quality Plan.	Progressive
Aggregate—General	Source subject to inspection and approval of Superintendent.	3 weeks before importing aggregate

Table SC6.4.5.3.44 Mass concrete subbase-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Materials for concrete			
Materials	Submit details of concrete mix and materials.	Submit as part of confirmation of nominated mix	Superintendent
Design and control of concrete mixes			
Nominated mix	Submit details of concrete mix and materials including NATA certificates and test results.	21 working days before using the nominated mix (Progressive)	Superintendent and Council
Variations to nominated mix and materials	Submit details of any change to nominated mix and materials.	21 working days before implementing change	Superintendent
Conformance for concrete strength and thickness			
Sampling, curing and testing of fresh concrete	Inspection of sampling procedure.	Progressive	Superintendent
Acceptance criteria	Submit test results.	Progressive	Superintendent
Acceptance criteria for cored concrete (non-conformance)	Submit test results.	Progressive	Superintendent
Production, transport and consistency of concrete			
Concrete production and transport	Submit proposed work methods.	At least 21 working days before starting	Superintendent
Placing and finishing concrete subbase			
Subbase Paving plan	Submit as part of Quality plan.	21 working days before starting	Superintendent
Construction—Placing	Written notice to commence (including trial section).	7 days before starting	Superintendent
Trial Concrete Subbase —Construction	Inspection of the trial concrete subbase.	1 working day after placing trial section	Superintendent
Trial Concrete Subbase —Deficient trial section	Provide justification of the methods used in producing deficient work for assessment.	1 working day after deficiency identified	Superintendent

Table SC6.4.5.3.45 Mass concrete subbase-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Conformance for concrete strength and thickness		
Testing by specimens cut from the work	Coring witnessed by Superintendent	3 working days
Restoration after coring	Inspection of restoration work	3 working days after cutting
Placing and finishing concrete subbase		
Curing – Efficiency Index	Submit certificate of compliance for the curing compound	Progressive
Average application rate	Average rate checked by the Contractor and certified by the Superintendent	Progressive
Bond breaker and spall treatment		
Treatment of Unplanned Cracks	Check for cracks and repair/reject	Progressive

Table SC6.4.5.3.46 Plain and reinforced concrete base-hold points

Clause title / Item	Requirement	Notice of inspection	Release by
Design and control of concrete mix			
Nominated mix	Submit details and certificates for nominated concrete mix and material constituents including NATA certificates and test results	21 working days before using the nominated mix	Superintendent
Variations to nominated mix and materials	Submit details of any change to nominated mix and materials	21 working days before implementing change	Superintendent
Steel reinforcement			
Placing and cover requirements	Approval of placement and fastening of reinforcing steel	4 working hours before concrete placement	Superintendent
Production, transport and consistency of concrete			
Concrete production and transport	Submit proposed methods and equipment	4 weeks before starting	Superintendent
Placing and finishing concrete base			
Subbase survey	Work-as-executed survey of the subbase.	7 days before starting any works	Superintendent
Surface texture	Submit details of proposed texturing device and method of texturing	Before texturing	Superintendent
Trial of Concrete Base Construction	Obtain approval for the trial section	5 working days before main works	Superintendent
Trial of Concrete Base—Deficient trial section	Provide justification of the methods used in producing deficient work for assessment	2 working days after construction	Superintendent
Joints			
Permanent sealing—General	Submit proposed method for permanent joint sealing	4 weeks before installation	Superintendent
Slab anchors			
Excavation	Submit compacted excavated surface	1 working day before concreting	Superintendent
Testing of concrete for compressive strength			
Sampling	Inspection of sampling procedure	Progressive	Superintendent
Acceptance criteria	Submit test results	Progressive	Superintendent
Acceptance criteria for cored concrete	Submit test results	Progressive	Superintendent
Removal and replacement of base			
General	Submit proposed method of removal to preserve adjoining base and underlying subbase	7 working days before replacement works	Superintendent

Table SC6.4.5.3.47 Plain and reinforced concrete base-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Witness Points Off Site		
Clause/ subclause	**Requirement**	**Notice of inspection**
Materials for concrete		
Aggregates - Storage	Storage and handling to preserve quality of aggregate	Progressive
Steel reinforcement		
General	Provide NATA certificates and manufacturer's information.	Before delivering to site
Bar chairs	Demonstrate load bearing capacity	Before delivering to site
Joints		
Silicone Sealant	Provide NATA certificate and manufacturer's information	4 weeks before joint work
Witness Points On Site		
Joints		
Permanent Sealant	Locations as shown on drawings and change to spacing	Progressive
Placing and finishing concrete base		
Consistency	Provide slump check test results	Progressive
Protection of Work - Ambient conditions	Provide details of protection methods for cold or hot weather and rain	Progressive
Traffic considerations	Provide traffic management measures	Progressive
Rate of Evaporation and moisture loss	Provide details of precautionary measures to prevent moisture loss when evaporation rate exceeds prescribed limits	Progressive
Paving (Mechanical and Hand Paving)	Construction joint if hand or mechanical paving is disrupted	Progressive
Alignment and Surface Tolerances - Assessment of base thickness	Survey of base surface, edge alignment and thickness	Progressive
Curing – Efficiency Index	Submit certificate of compliance for the curing compound	Progressive
Testing of concrete for compressive strength		
Testing of specimens cut from the work	Carry out coring in presence of the Superintendent	
Repair and Restore work after coring	Restore holes with non-shrink cementitious concrete	After coring
Conformance of concrete strength, compaction and thickness		
Relative Compaction	Testing conformance of required relative compaction	Progressive

Table SC6.4.5.3.48 Sprayed bitumen surfacing-hold points

Clause title/Item	**Requirement**	**Notice for inspection**	**Release by**
Design of bituminous surfacing			
Confirmation of Design and Materials Compliance	Submit the sprayed seal design and additional details for approval	2 weeks before commencing work	Superintendent
Plant	Evidence that plant is registered and insured	2 weeks before using plant	Superintendent

Table SC6.4.5.3.49 Sprayed bitumen surfacing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Application and rolling of aggregate		
Removal of loose aggregate, Loose aggregate particles	Completion within specified time	Various to allow inspection of performance in conformance with Tables of time limits
Removal of surplus and waste material	Demonstrate that materials are properly disposed	Progressive
Protection - New work	Demonstrate that line marking and warning signs are in place to protect new work	Progressive

Table SC6.4.5.3.50 Bituminous microsurfacing-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Mix design			
Nominated Mix—Design and control of bituminous mix	Submit details of nominated mix with NATA Certification	7 days before commencing	Superintendent
Production and paving			
Production mix Bituminous —microsurfacing	Target application rate and nominal layer thickness for approval	7 days before commencing	Superintendent
Sampling and testing of production mix	Compliance with maximum permitted variations from approved mix	During mixing	Superintendent
Weather limitations	Cease works if weather conditions are not appropriate	Progressive	Superintendent
Paving unit calibration	Documentation for detailed calibration	7 days before using paving unit	Superintendent
Preparation of Pavement	Provide cleaned surface for inspection	1 working day prior to spreading works	Superintendent
Spreading—Traffic	Capable of carring traffic in short period after slurry surfacing to the approval of Superintendent	One hour after spreading	Superintendent
Surface texture—Test run	Demonstrate surface texture	1 working day before commencing	Superintendent
Non-conformance—Materials and finished surfacing	Approval for correction or replacement	1 working day before corrective action	Superintendent

Table SC6.4.5.3.51 Bituminous microsurfacing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Witness Points Off Site		
Materials		
Binder—Compliance	Submit NATA test results for the nominated binder	7 days prior to commencing works
Mineral Aggregates—Quality	Submit NATA test results for the nominated mineral aggregates	7 days prior to commencing works
Mineral Filler—Quality Compliance	Submit NATA test results for the nominated binder	7 days prior to commencing works
Witness Point On Site		
Spreading—Clean up	Leave road fixtures in clean and satisfactory condition	Progressive

Table SC6.4.5.3.52 Segmental paving-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Materials			
General—Nominated materials	Submit segmental paving materials and supplier.	2 weeks before ordering	Superintendent
Construction			
Subgrade Preparation—Dimensions and specification	Present the finished subgrade for approval	1 working day before proceeding	Superintendent
Subbase—Dimensions and specification	Present finished subbase for approval	1 working day before proceeding	Superintendent
Base—Dimensions and specification	Present the finished base for approval	2 working days before proceeding	Superintendent

Table SC6.4.5.3.53 Segmental paving-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Construction		
Opening to Traffic—Inspection	Regularly inspect joints after completion	Progressive

Table SC6.4.5.3.54 Stabilisation-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Materials proposed for use in the work	Submit NATA certificate of compliance	14 days prior to commencement of works	Superintendent
Field Working Period—Laboratory	Nominate the specific field working period specified in the Stabilisation Mix Design	14 days prior to commencement of works	Superintendent
Materials			
Cement—Storage	Re-test cement stored in excess of 3 months	2 working days prior to usage	Superintendent
Stabilisation Process—Proposed equipment and procedures	Submit a Work Plan nominating proposed plant and work sequence	14 days prior to commencement	Superintendent
Application of stabilising agent—In situ application	Proposals for special processes of supply of stabilising agent into the mixing bowl	7 days prior to mixing	Superintendent
Mixing—In situ mixing process	Demonstration of equipment mixing efficiency in trial section	7 days prior to production stabilisation	Superintendent
Trimming and Compaction—Trimming	Work methods to exclude laminations and slurrying	3 working days prior to production stabilisation	Superintendent
Trimming and Compaction—Survey control methods	Use of trimmed material as fill or spoil	3 working days prior to disposition	Superintendent
Curing—Method statement	Submit details of proposed curing method	As directed	Superintendent
Trial section of stabilised earthworks			
General	Submit a trial section of stabilised earthworks	5 working days prior to commencement of works	Superintendent and Council
General	Any deficient sections will require to be investigated and may be directed to remove	Progressive	Superintendent and Council

Table SC6.4.5.3.55 Stabilisation-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Witness Points Off Site		
Materials		
Cement	Proof of quality and source	Progressive
Quicklime	Proof of quality and source	Progressive
Hydrated lime	Proof of quality and source	Progressive
Ground granulated blast furnace slag	Proof of quality and source	Progressive
Flyash	Proof of quality and source	Progressive
Blended stabilising agent		
Blended stabilising agent —Standard	Proof of quality and source	Progressive
Blended stabilising agent —Handling and storage	Comply with supplier's handling and storage requirements and arrange sampling of agent	Progressive
Witness Points On Site		
Quality Requirements— Compaction	Adjustment of Field Working Period for site conditions	Progressive
Application of stabilising agent —Stationary mixing plant	Monitoring application of stabilising agent at the plant	Progressive
Application of stabilising agent —Stationary mixing plant	Removal of spilled stabilising agent	Immediately upon spillage event
Application of stabilising agent —Spreading out	Actual spread to be recorded and checked	Progressive
Application of stabilising agent —Spreading out	Record average spreading rate using load cells	Progressive
Mixing—Stationary mixing plant	Test unconfined compressive strength	Progressive
Mixing—In situ mixing process	Visual inspection to ensure uniform mixing and record	Progressive
Mixing—In situ mixing process	Additional passes of mixing equipment to improve uniformity	Progressive
Trimming and Compaction—Survey control methods	Survey to confirm pavement layer thickness remains within tolerances after trimming	Progressive
Trimming and Compaction —Straight edge test	Conform to surface tolerances prior to sealing or practical completion of work component	As directed by Superintendent
Dimensions—Width	Random measurement of stabilised layer width	As directed by Superintendent

Table SC6.4.5.3.56 Subsoil, foundation and pavement drains-hold points

Item/Clause title	Requirement	Notice for inspection	Release by
Construction			
Subsoil and Sub-Pavement Drains / Foundation drains —Excavation	Inspect excavated trench	1 working day prior to filling	Superintendent
Subsoil and Sub-Pavement Drains / Foundation drains—Laying of Pipes	Present bedding of compacted filter material laid to line and grade	3 working days before next activity	Superintendent
General—Filter material	Type of filter material	3 working days before ordering material	Superintendent
Intra-pavement drains —Laying of pipe	Provide certification that drain has adequate crushing strength	3 working days before ordering	Superintendent
Intra-pavement drains —Laying of pipe	Submit details of proposed method of securing pipes	7 days before pipe laying	Superintendent
Edge drains—Laying of pipe	Submit details of proposed method of securing pipes	7 days before pipe laying	Superintendent

Table SC6.4.5.3.57 Subsoil, foundation and pavement drains-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item/Clause title	Requirement	Notice for inspection
Construction		
Subsoil and Sub-Pavement Drains / Foundation drains—Pipes	Lay on compacted bed to documented line and level	1 working day before filling
Subsoil and Sub-Pavement Drains —Backfilling	Backfilling to documented level and relative compaction	1 working day before covering with geotextile
Foundation drains—Backfilling	Backfilling to documented level and relative compaction	1 working day before covering with geotextile
Geotextile—Installation	Placement of fabric conformance	1 working day before filling
Geotextile—Installation	Ensure exposure periods are within the constraints	Progressive
Cleanouts—Field testing	Perform flushing test	Progressive (timing depending on the construction of pavement layers)

Table SC6.4.5.3.58 Subsurface drainage-witness points

Item/Clause title	Requirement	Notice for inspection	Release by
General			
Siting of Work	Submit the proposed set-out in addition to the designed set-out	7 days before planned execution	Superintendent
Siting of Work—Proposed changes	Present the proposed new set-out for approval	3 days before planned execution	Superintendent
Excavation—Existing underground services	Submit evidence of approval of the relevant authorities.	14 days before planned excavation	Superintendent
Excavation—Trenches	Approval of completed trenches required prior to installation of drainage work	1 working day prior to installation of drainage work	Superintendent
Materials			
Subsurface drainage pipes—General	Submit compliance certificates	7 days before proceeding to provide pipes	Superintendent
Other subsurface drainage pipes	Submit details of proposed alternative pipes and evidence of conformity for approval.	7 days before proceeding to provide pipes	Superintendent
Geotextile—General	Provide documentation of conformity of geotextile and installation process	14 days before proceeding to provide geotextile	Superintendent
Recording of drainage			
Recording of subsurface drainage Information	Progressive supply of subsurface drainage details	5 working days after completion of each drain or drainage system	Superintendent

Table SC6.4.5.3.59 Subsurface drainage-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item/Clause title	Requirement	Notice for inspection
General		
Temporary drainage during construction	Locate materials and equipment clear of water courses	7 days prior to positioning

Table SC6.4.5.3.60 Pavement markings-hold points

Clause title/subclause	Requirement	Notice for inspection	Release by
General			
Material Quality	Submit NATA Test Reports on materials	7 days before work is scheduled to commence	Superintendent
Surface preparation—Wet Weather	Superintendent direction on suspension of work	Progressive	Superintendent
Removal of pavement markings			
General—Removal of redundant markings	Submit method for approval	1 working day before commencement of activity	Superintendent

Table SC6.4.5.3.61 Pavement markings-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/subclause	Requirement	Notice for inspection
General		
Setting Out—Net	Set out in accordance with the drawings	Progressive
Pavement marking paint		
Application of Paint Beads—Glass beads applied to other paint markings	Application method to be approved by Superintendent	Progressive
Field testing—Application Rate	Application to be checked for quality	Progressive
Thermoplastic pavement marking material		
Field testing—Application Rate	Application to be checked for quality	Progressive
Pavement marking tape		
Removal of Pavement Marking Tape	Direction to remove pavement marking tape	Progressive
Raised pavement markers		
Installation of Raised Pavement Markers	Installation to be checked for quality (allow adhesive to set)	Progressive

Table SC6.4.5.3.62 Guide posts-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
General			
Materials—Proprietary posts—Proposed supplier	Supply details of the proposed guide posts	Two weeks before manufacture	Superintendent
Construction			
Erection of Guide Posts —Proprietary guideposts	Provide manufacturers anchorage instructions	5 working days	Superintendent
Erection of Guide Posts —Guide posts on concrete pavements	Provide fixing details	5 working days	Superintendent

Table SC6.4.5.3.63 Guide posts-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/ subclause	Requirement	Notice for inspection
Construction		
General—Location of guide posts and proximity to underground services	Locations shown on drawings or as specified Check for existing underground services	Two weeks before installation
Erection of Guide Posts—Backfilling	Firm embedment in ground	Progressive
Delineators—Fixing	Arrangement of delineators relative to traffic direction	Progressive

Table SC6.4.5.3.64 Signposting-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Materials			
General—Approved Supplier	Details of proposed suppliers provided to the Superintendent including documentary evidence	1 week prior to ordering	Superintendent
General—Documentary Evidence	Evidence that materials and parts proposed comply with the requirements of this specification	1 week prior to engaging supplier	Superintendent
Retro-Reflective Material for Background and Legend	Details of material and compatibility in application and durability	1 week prior to ordering	Superintendent
Sign Support Structures —Attachment of signs	Details of proposed attachment systems	2 weeks prior to fabricating attachment systems	Superintendent
Erection of new signs			
Setting Out	Approval of the location and alignment of the sign support structure	1 week prior to erection	Superintendent
Setting Out—Existing underground services	Locate services and protect against damage	1 week prior to erection	Superintendent
Special requirements			
Street Name, Service and Tourist Signs	Submit details of manufacturer for approval by council	1 week prior to ordering	Council

Table SC6.4.5.3.65 Signposting-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Erection of new signs		
Setting Out	Submit details of and set out for each support structure	1 week before installing signs
Clearing	Clear vegetation after set-out on advice from council	3 working days before clearing
Sign Structure Footings —Excavation	Excavation as shown on drawings and as directed, including disposal of material	1 working day before next activity
Erection—Sign Damage	Repair or replace damaged signs	1 week before installing signs
Adjustment of existing signs and support structures		
General	Conform to Drawings and Superintendent direction	1 week before adjusting signs

Table SC6.4.5.3.66 Non rigid road safety barrier system-hold points

Item/Clause title	Requirement	Notice for inspection	Release by
Materials			
Certification—Evidence of Conformance	Provide documentary evidence of conformity of steel components	1 week prior to erection	Superintendent
Construction			
General— Set Out	Set out to drawings or as directed	2 working days prior to erection	Superintendent
End Treatment of Road Safety Barriers—MELT	Submit alternative MELT locations	1 week prior to ordering	Superintendent

Table SC6.4.5.3.67 Non rigid road safety barrier system-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Construction		
General—Sequence of Construction (pavements)	Erection after pavement activities	1 week before installation – progressive
General—Underground Obstruction	Alternative method due to obstructions	1 week before setting posts
Erection of Steel Posts—Damage to posts	Assessment by Superintendent for replacement	3 working days before removal of damaged post
Erection of Road Safety Barrier Rails—Excessive damage to rails	Assessment and rejection by Superintendent	1 working day after perceived damage

Table SC6.4.5.3.68 Minor concrete works-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
General			
Excavation and Foundation General—Ground preparation—Base preparation	Inspect prepared surface or sand underlay	1 working day prior to covering	Superintendent
Excavation and Foundation General—Ground preparation—Polymeric film underlay installation	Inspect membrane or film underlay installed	1 working days prior to covering	Superintendent
Approval of Formworks Design	Formwork design certificates	3 working days	Superintendent
Erection—Formwork	Certification of installed formwork and inspection	1 working day prior to covering	Superintendent
Materials for concrete			
Nominated Mix	Submit details of nominated mix for approval	7 working days	Superintendent
Reinforcement for concrete			
Steel reinforcement placement—Approval of reinforcement before concrete placement	Inspect reinforcement placement	1 working day prior to covering	Superintendent
Cores, fixings and embedded items—General	Shop drawings for cores, fixings and embedded items	7 working days prior to commencing works	Superintendent

Clause/subclause	Requirement	Notice for inspection	Release by
Loads on minor concrete structures	Approval for early loading of the structure by design strength in situ tests	3 working days	Superintendent
Sprayed concrete general—Method statement	Submit proposal for spraying	14 days prior	Superintendent

Table SC6.4.5.3.69 Minor concrete works-witness points

Clause title/Item	Requirement	Notice for inspection
General		
Ground preparation—Mass concrete bedding on earth foundations	Inspect concrete blinding slab prior to placing forms or materials	1 working day prior to covering
Concrete quality requirements —Formwork	Check erection tolerances	1 working day
Materials for concrete		
Certificate of compliance	NATA certificates for all materials	7 days prior to commencing on site
Handling and treatment of concrete		
Mixing of concrete—Hand Mix On Site	Submit proposal for use	7 days prior
Mixing of concrete—Pre-mixed supply	Submit delivery dockets and subcontractors details	Progressive
Concrete quality requirements —Flatness	Confirm unformed surfaces	1 working day
Concrete quality requirements —Surface quality	Confirm surface quality	1 working day
Concrete curing	Certified test results for curing compound	7 days prior
Joints	Submit proposal for sawn joints	7 days prior
Concrete placing and compaction —Testing	Certified test results for compressive strength	Progressive
Reinforcement for concrete		
Steel reinforcement placement —Delivery and receipt of reinforcement	Submit notice for test inspection	7 days
Steel reinforcement placement —Placing	Submit proposed changes to reinforcement	2 days prior to commencing on site
Steel reinforcement placement —Damaged galvanising	Submit proposed repair method	2 working days prior
Steel reinforcement placement —Provision for concrete placement	Submit proposed changes to spacing, cover, splicing or welding or reinforcement	2 working days prior
Cores, fixings and embedded items—Cutting or coring	Approval for cutting or coring hardened concrete	2 working days prior
Sprayed concrete—Sprayed concrete test panel	Approval of sample panels	7 days

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Table SC6.4.5.3.70 Boundary fencing-hold points

Clause title / item	Requirement	Notice for inspection	Release by
Materials			
General—Material approval	Submit source, type, Certificate of compliance and manufacturer for each type of material	One week before ordering each type	Superintendent
Construction			
General—Clearing and grubbing	Confirm approval for tree removal	One week before next activity	Superintendent
Erection of posts			
Depth of posts	Method of installing and proposed type of posts to be used	One week before manufacture or order	Superintendent
Erection of wires—General	Approval for any proprietary fasteners	One week before manufacture or order	Superintendent
Flood gates—General	Approval to proceed with flood gates and type	One week before fabricating flood gates	Superintendent
Removal and disposal of surplus material and rubbish	Approval required for burn off for combustible materials	Prior to burning	Superintendent
Bedding—Cattle Grids	Approval for bedding requirements	One week before fabricating flood gate	Superintendent

Table SC6.4.5.3.71 Boundary fencing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Materials		
Galvanised Posts, Braces and Rails —Welded Joints	Welding sites to be cleaned and painted	Progressive
Gates—Dimensions and Fittings	Fitting alternatives	3 working days before fabrication
Construction		
Stock-Proof Fencing—Erection of posts—Depth of posts	Posts sunk to the required depths	Progressive
Crossing of Watercourses and Depressions	Secure by installing longer posts as directed	Progressive
Flood gates—Small water courses	Provide required waterway area	Progressive
Erection of Gates	Double gates to be directed	One week before ordering
Removal and disposal of surplus material and rubbish	All surplus material to be removed	Progressive

Table SC6.4.5.3.72 Control of traffic-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
General			
Traffic guidance scheme (TGS)—Approval	Approval of Traffic guidance scheme	2 weeks before proposed commencement on site	Superintendent.
Traffic guidance scheme (TGS)—Relevant Authority Approval	Provide evidence of approvals from Council and other Authorities	4 weeks before proposed commencement on site	Superintendent
Traffic Guidance Scheme (TGS)—Non-complex TGS	Carry out a risk assessment for works not involving complex TGS or staged works	4 weeks before proposed commencement on site	Superintendent.
Side Roads and Property Accesses—Proposed access	Provide Proposal for access	5 working days prior to carrying out works	Superintendent.
Side Roads and Property Accesses—Notice to property owners	Approval to deny vehicular access and provide notice to property owners	3 working days prior to carrying out works	Superintendent.
Temporary roadways and detours			
Approval	Submit design of all proposed temporary roadways and detours	5 working days prior to carrying out works	Superintendent.
Opening to Traffic	Present completed temporary roadways and detours to the Superintendent for approval prior allowing traffic	5 working days prior to carrying out works	Superintendent.
Arrangements for traffic			
Construction Under Traffic—Approval	Approval required to construct under traffic	3 working days prior to carrying out works	Superintendent.
Construction Under Traffic—Details	Submit full details of temporary signposting, traffic control devices and traffic control methods for approval	5 working days prior to carrying out works	Superintendent.
Opening Completed Work—Written Notice	Provide written notice to the Superintendent confirming date of opening of completed works.	5 working days prior to opening of completed works	Superintendent.
Traffic control devices			
Adequate Traffic Control Devices—Default by Contractor	Rectify inadequate traffic control devices	1 working day of notice	Superintendent.

Table SC6.4.5.3.73 Control of traffic-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/Item	Requirement	Notice for inspection by the Superintendent
General		
Traffic Guidance Scheme (TGS)—Site Copy	A copy of the approved Traffic Guidance Scheme must be kept on site	Progressive
Traffic Guidance Scheme—Safety Audit	For complex traffic arrangements and staged works carry out safety audits	Progressive
Traffic Controllers—Personnel	Submit names and declaration of proposed traffic controllers	Prior to commencing work
Temporary Speed Zoning—Record	Diary and method of works	Progressive
Temporary roadways and detours		
Drainage—Pavements	Pavement designed and constructed not to pond water	Progressive
Surfacing—Extent	Width of wearing surface and position of finish tying into existing works	3 working days prior to carrying out works
Traffic control devices		
Arrangement of traffic control devices	Arrangement and placement as per the approved TGS	Progressive
Temporary markings—Line Marking	Ineffective line marking, remark within 48 hours.	Progressive
Temporary markings—Old Markings Removed	Obliterate or remove old markings.	Progressive
Raised Pavement Markers—Ineffective Markers	Replace ineffective markers within 24 hours.	Progressive

SC6.4.5.3 Attachment E Non conformance Certificate (NCC) - Template

Click here to obtain a copy of the following form.

SC6.4.5.3 Attachment F Non Conformance Report (NCR) - Template

Click here to obtain a copy of the following form.

SC6.4.5.3 Attachment G Notice of Non Conformance Report (NNC) - Template

Click here to obtain a copy of the following form.

SC6.4.5.3 Attachment H Corrective and Preventive Action Request (CPAR) - Template

Click here to obtain a copy of the following form.

SC6.4.6.2 Water supply

SC6.4.6.2.1 Introduction

(1) Scope

This policy sub-section provides standards, advice and guidelines for the construction of water supply infrastructure including:

(a) mains up to DN600 nominal size; and

(b) small pump stations.

This sub-section excludes the construction of:

(c) reservoirs, including repainting of reservoirs;

(d) treatment plants;

(e) dams;

(f) headworks, including bores and weirs;

(g) dosing plant; and

(h) larger pump stations.

The Contractor shall carry out the work, and supply materials meeting the requirements of the reference documents, and, in particular, in accordance with the requirements of the *Water Supply Code of Australia* except as otherwise specified herein.

(2) Reference and source documents

Documents referenced in this sub-section are listed below whilst being cited in the text in the abbreviated form or code indicated. The Contractor shall possess, or have access to, the documents required to comply with this sub-section.

References to the *Water Supply Code of Australia* are made where there are parallel sections or equivalent clauses to those in this sub-section. Where not called up as part of this sub section, these references are identified by part and section numbers and enclosed in brackets thus (WSA Part, Section).

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.3.21 Townsville Water and Waste planning and design guidelines
SC6.4.4.8 Standard drawings
SC6.4.6.28 Minor concrete works

Note—SC6.4.4.8 Standard drawings shall take precedence over the WSAA standard drawings. Where any standard drawing used in conjunction with this sub-section includes technical requirements that conflict with this sub-section, the requirements of this sub-section shall take precedence.

(b) Australian Standards

Note—references in this sub-section or on the drawings to Australian Standards are noted by their prefix AS or AS/NZS. Where not otherwise specified in this sub-section or the drawings, the Contractor shall use the latest Australian Standard, including amendments and supplements, available within two weeks of close of tenders.

AS/NZS1111	*ISO metric hexagon commercial bolts and screws*
AS/NZS1112	*ISO metric hexagon nuts*
AS1152	*Specification for test sieves*
AS/NZS1260	*PVC-U pipes and fittings for drain, waste and vent applications*
AS1272	*Unsintered PTFE tape for thread sealing applications*
AS1289.5.4.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Dry density ratio, moisture variation and moisture ratio*

AS1289.5.6.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Density index method for a cohesionless material*
AS1289.5.7.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Hilf density ratio and Hilf moisture variation (Rapid method)*
AS1349	*Bourdon tube pressure and vacuum gauges*
AS1432	*Copper tubes for plumbing, gasfitting and drainage applications*
AS1444	*Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties*
AS1449	*Wrought alloy steels – Stainless and heat-resisting steel plate, sheet and strip*
AS/NZS1477	*PVC pipes and fittings for pressure applications*
AS1565	*Copper and copper alloys – Ingots and castings*
AS1579	*Arc welded steel pipes and fittings for water and waste water*
AS/NZS1594	*Hot-rolled steel flat products*
AS1627.4	*Metal finishing – Preparation and pre-treatment of surfaces - Abrasive blast cleaning of steel*
AS1646	*Elastomeric seals for waterworks purposes*
AS1657	*Fixed Platforms, walkways, stairways and ladders – Design, construction and installation*
AS1830	*Grey cast iron*
AS60529	*Degrees of protection provided by enclosures (IP Code)*
AS/NZS2032	*Installation of PVC pipe systems*
AS2033	*Installation of polyethylene pipe systems*
AS2129	*Flanges for pipes, valves and fittings*
AS/NZS2280	*Ductile iron pipes and fittings*
AS2419.2	*Fire hydrant installations – fire hydrant valves*
AS2528	*Bolts, studbolts and nuts for flanges and other high and low temperature applications*
AS/NZS2566.1	*Buried flexible pipelines – Structural design*
AS/NZS2566.2	*Buried flexible pipelines – Installation*
AS2638	*Gate valves for waterworks purposes – Metal and resilient seated*
AS2837	*Wrought alloy steels – Stainless steel bars and semi- finished products*
AS/NZS3000	*Electrical installations (Wiring rules)*
AS/NZS3008	*Electrical installations – selection of cable*
AS3439	*Low voltage switchgear and control gear assemblies*
AS/NZS3518	*Acrylonitrile butadine styrene (ABS) compounds, pipes and fittings for pressure applications*
AS3571	*Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin – Pressure and non-pressure drainage and sewerage*
AS3681	*Application of polyethylene sleeving for ductile iron piping*
AS3690	*Installation of ABS pipe systems*
AS3879	*Solvent cement and priming fluids for PVC (PVC-U and PVC-M) and ABS pipes and fittings*
AS3862	*External fusion-bonded epoxy coating for steel pipes*
AS3952	*Water supply –Spring hydrant valve for waterworks purposes*
AS3996	*Access covers and grates*
AS/NZS4087	*Metallic flanges for waterworks purposes*
AS/NZS4129	*Fittings for polyethylene (PE) pipes for pressure applications*
AS/NZS4130	*Polyethylene (PE) pipes for pressure applications*
AS/NZS4158	*Thermal-bonded polymeric coatings on valves and fittings for water industry purposes*
AS/NZS4321	*Fusion bonded medium density polyethylene coating and lining for pipes and fittings*
AS/NZS4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*
AS/NZS4765	*Modified PVC (PVC-M) pipes for pressure applications*
AS4794	*Non-return valves – Swing check and tilting disc*

(c) Other

Department of Energy and Water Supply, *Planning Guidelines for Water Supply and Sewerage*, April 2010

Water Services Association of Australia (WSAA) - *WSA 03 – 2011 - Water Supply Code of Australia*

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control, 2008*

British Standard - *BS 410 - Specification for test sieves*

SC6.4.6.2.2 Materials

(1) General

The Contractor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this sub-section.

Prior to the delivery of products and materials, the contractor is expected to obtain relevant product or material certification from the manufacturer which shall be presented to the Superintendent if requested.

The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

If the Contractor proposes to use alternative products and materials other than the products and materials authorised by Townsville Water and Waste, the design drawings and this sub-section, an approval from Townsville Water and Waste is required prior to delivery and use of alternative products or materials.

(2) Unplasticised and modified PVC (uPVC and PVC-M)

Unplasticised PVC (uPVC) and modified PVC (PVC-M) pipes and fittings for mains and suction pipes shall comply with AS/NZS1477 and AS/NZS4765, shall be suitable for use with rubber ring (elastomeric) seals complying with AS1646 joints and shall be of the class and size as shown on the Design drawings. (WSA 03 – 2011, Part 1, Section 4.)

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS/NZS2032 and AS/NZS2566.1.

Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of shelter.

(3) Acrylonitrile butadine styrene (ABS)

ABS pipes and fittings shall comply with AS/NZS3518 to the class, size, use, shape and colour as shown on the Design drawings and installed in accordance with AS/NZS2566.2 and AS3690.

ABS pipes and fittings shall be joined in accordance with the manufacturer's instructions using solvent cement to AS3691.

(4) Glass reinforced plastic (GRP)

The use of this material is not permitted by council.

(5) Ductile iron (~~di~~DI) pipe and fittings

Ductile iron (DI) pipes and fittings shall comply with AS/NZS2280 and shall be of the class, size and lining, as shown on the Design drawings, and installed in accordance with AS/NZS2566.2. Jointing shall be with rubber rings (elastomeric), complying with AS1646, to the class and type as shown on the design drawings.

Flanges shall be to the table shown on the design drawings. Bolts and nuts for flanged joints shall be galvanised, or stainless steel as for the pumps specified herein, unless shown otherwise on the design drawings.

All pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS3681 unless specified otherwise to be coated and lined. All fittings shall be fusion-bonded coated, in accordance with AS/NZS4321, or wrapped. The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

(6) Steel pipeline and fittings

Steel pipelines and fittings shall comply with AS1579 and AS/NZS1594 and shall be of the class, size, lining and coating as shown on the design drawings. (WSA 03 – 2011, Part 1, Section 4).

The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

The jointing system shall be rubber ring (elastomeric), complying with AS1646, unless shown otherwise on the design drawings.

The Contractor shall not lay continuously welded steel pipelines parallel to, when in close proximity, high voltage power lines.

(7) Copper pipe and fittings

Copper tube and fittings shall comply with AS1432 and shall be of the size and type as shown on the design drawings.

The Contractor shall install copper tube, capillary and compression fittings, insulated from ferrous mains, as shown on the design drawings (WSA 03).

(8) Polyethylene (PE)

Polyethylene pipe shall comply with AS/NZS4129 and AS/NZS4130 and shall be of the class and size as shown on the design drawings and installed in accordance with AS2033 (WSA 03 – 2011, Part 1, Section 4).

Jointing shall be by butt thermal fusion or by electrofusion couplings, or with compression fittings.

Fittings up to 110mm shall comply with AS/NZS4129. Fittings from 110mm to 600mm shall be ductile iron in accordance with AS/NZS2280 and coated internally and externally in polyethylene in accordance with AS/NZS4129.

The Contractor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the design drawings.

(9) Steelwork

Structural steelwork, including ladders, brackets, and covers, complying with AS1657, shall be abrasive blast cleaned to AS1627.4 Class 2.5 and hot dip galvanised to AS/NZS4680. (WSA 03 – 2011, Part 1, Section 4.)

SC6.4.6.2.3 Valves and hydrants

(1) General

The Contractor shall ensure that the valves and hydrants supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve. The concrete lining in pipework shall not be chipped away or reduced to provide clearance from the working parts of valves.

The Contractor shall ensure that the valves and hydrants are installed so as to facilitate maintenance. The Contractor shall take into account the manufacturer’s recommendations, the requirements shown on the design drawings, the type of connection, lubrication of connecting bolts, and the location of valves within valve chambers or type of backfill material. (WSA 03 – 2011, Part 2, Section 15.13.)

The type of external corrosion protection of buried valves and hydrants shall be fusion-bonded medium density polyethylene coating to AS3862 and AS/NZS4321 or thermal-bonded polymeric coating to AS/NZS4158.

Flanges shall comply with AS2129 and AS4087 and shall be of the class and size shown on the design drawings.

(2) Stop valves

Sluice valves shall be resilient seated valves manufactured in accordance with AS2638. The valves shall be flanged where permitted by Townsville Water and Waste unless shown otherwise on the Drawings (WSA 03 - 2011 Part 1, Section 8.2).

Ball valves shall be flanged where permitted by Townsville Water and Waste unless shown otherwise on the Design drawings (WSA 03 - 2011 Part 1, Section 8.2).

Butterfly valves shall be flanged where permitted by Townsville Water and Waste unless shown otherwise on the Design drawings (WSA 03 - 2011 Part 1, Section 8.2).

Knife Gate valves shall be flanged where permitted by Townsville Water and Waste unless shown otherwise on the Design drawings (WSA 03 - 2011 Part 1, Section 8.2).

Scour valve assemblies shall be as shown on the Design drawings.

Valves shall be operated by a removable key. The Contractor shall size “Tee Key” valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel.

Hand wheels, where specified, shall display an embossed or engraved arrow, together with “open” and/or “close” corresponding to the valve operation.

(3) Air valves

Air valves shall be of the double air valve type with integral isolating valve of minimum size DN80, and shall be installed as shown in the Design drawings (WSA 03 – 2011 Part 1, Section 8.4).

Air valves shall be installed such that they can be maintained without affecting supply.

The Contractor shall obtain the consent of Water Authority for the use of other types of air valves.

(4) Non-return valves

Non-return valves shall be of the swing check type to AS3578 or AS4794 of cast iron or steel body, cover and disc with bronze body and disc seat rings. The leaf shall swing clear and provide an unobstructed waterway (WSA 03 – 2011 Part 1, Section 8.5). Wafer style non-return valves shall not be used.

The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve body.

Where shown on the design drawings, non-return valves shall have an extended spindle, minimum grade 316 stainless steel complying with AS1449, fitted with an adjustable counterweight, together with a proximity switch to indicate a no-flow condition.

No flow switches shall have the following features:

(a) be of the eccentric cam operated limit switch type.

(b) have a minimum rating of 10 amps, 240 V AC, 50- Hz.

(c) be oil tight and dust proof to IP 65.

(d) be suitable for 25mm conduit entry.

(e) be mounted on rigid stainless steel complying with AS1449 adjustable brackets. The brackets shall be free of sharp edges and exposed corners.

(5) Spring hydrants

Spring hydrant bodies shall be manufactured in accordance with AS3952 and installed in accordance with AS2419.2 except as varied below (WSA 03 - 2011 Part 1, Section 8.8).

The top of spring hydrants shall be between 100mm and 300mm below finished surface level as detailed in SC6.4.4.8 Standard drawings SD-350. If necessary, this shall be achieved by the use of hydrant risers of various heights.

Spring hydrants shall be protected internally and externally with fusion-bonded coating in accordance with AS4158, or equivalent protection approved by the Superintendent.

(6) Pressure reducing valves

Pressure reducing valves shall be of the type as shown on the design drawings.

Pressure reducing valves shall be installed with isolating valves to facilitate maintenance.

SC6.4.6.2.4 Pipeline construction

(1) General

The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work. Proof of accreditation must be provided to the Superintendent for approval prior to the release of the hold point.

The Contractor shall not change the pipeline alignment without prior concurrence of Townsville Water and Waste. The Contractor shall provide full details, of any proposed changes to the pipeline alignment, to the Superintendent for submission to Townsville Water and Waste. The Superintendent shall obtain the decision of Townsville Water and Waste prior to the release of the hold point.

(2) Location

The location of the mains and pump stations, sizes of mains, types of chambers and covers and the classes of pipes shall be as shown on the design drawings. The pipelines shall be laid to grades and locations shown on the design drawings and to tolerances in the Water Supply Code unless directed otherwise by the Superintendent (WSA 03 – 2011, Part 2, Section 21). The Contractor shall confirm the locations immediately prior to construction (WSA 03 – 2011, Part 2, Section 11).

(3) Cover over pipelines

The minimum depth of cover to be provided for mains, measured vertically from the finished ground level to the top of any socket, shall be ~~as follows (refer to~~in accordance with SC6.4.4.8 Standard drawings SD-325~~):~~

~~(a) 750mm in embankments;~~

~~(b) 600mm in roadways and commercial areas; and~~

~~(c) 450mm elsewhere.~~

Lesser cover may be provided where special protection of the pipelines has been shown on the design drawings or directed by the Superintendent.

The maximum cover shall be 1200mm, however, greater cover may be provided where special situations occur, where there is conflict with other services or to meet grading requirements.

(4) Crossings

Where a pipeline crosses a road, creek or involves features shown on the design drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority. The Contractor shall provide written notification to the Authority of the intention to carry out the work, and pay the appropriate fees. (WSA 03 - 2011 Part 2, Section 15.16.) The Contractor shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to the Superintendent if requested. The Superintendent shall advise at the time of notification by the Contractor whether the option to request the written approval is to be exercised.

Where shown on the design drawings, the Contractor shall use trenchless methods for the installation of the mains. The installation of the main by open trenching shall not be permitted over the lengths designated for trenchless installation (WSA 03 – 2011 - Part 2, section 15.15).

The Contractor shall address, in its method statement for trenchless conduit installation, the following:

(a) general description of method and sequence of operation;

(b) size, depth and position of temporary pits required;

(c) use of specialist subcontractors;

(d) specialist equipment to be used; and

(e) grout type and method of injection.

The encasement pipe shall be as detailed on the design drawings. The encasement pipe shall extend 1m behind the back of kerb on either side of the carriageway.

The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe.

After installation and pressure testing of the carrier pipe, the Contractor shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler.

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.

(5) Earthworks

The Contractor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the design drawings or as directed by the Superintendent within the specified tolerances.

With excavation near existing underground services and structures, the Contractor shall be responsible in obtaining approval of the appropriate Authority and comply with all the requirements of the approval including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners (WSA 03- 2011, Part 2, Section 13). The Contractor shall locate, protect and repair, as necessary, all services affected by the Works at the Contractor's expense.

The Contractor shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of stockpiles. No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling.

At the completion of work each day, the Contractor shall install safety fencing to statutory requirements along the edges of open excavations to isolate them from the public. The Contractor shall provide fenced walkways and vehicular crossings across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advise all affected residents beforehand. All installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

The Contractor shall carry out erosion and sedimentation control at all construction sites in accordance with *Best Practice Erosion and Sediment Control.*

The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open. (WSA 03 - 2011 Part 2, Sections 13.1 and 13.2.)

(6) Minimum trench width for pipelines

The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150mm above the top of the pipe shall be as shown in Table SC6.4.6.2.1.

Table SC6.4.6.2.1 Minimum trench widths

NOMINAL SIZE OF PIPE (DN)	Minimum clear width of trench(mm) (inside timbering or sheet piling, if any)	
	Pipe other than PVC/PE	PVC/PE Pipe
100	450	450
150	450	450
200	500	450
225	550	500
250	550	500
300	600	550
375	700	650
400	700	650
450	750	700
500	850	800
525	850	800
600	950	900

Where the design drawings provide for a trench to be excavated across a paved or improved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by sawcutting or other means approved by the Superintendent, so as to provide a neat straight line free from broken ragged edges. The Contractor is responsible in obtaining approval from the relevant Authority and/or owner before starting any excavation across paved or improved surface.

The Contractor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

(7) Excavation depth

The Contractor shall excavate trenches to 75mm below the underside of the pipe barrel and socket or coupling except for mains to be laid on other than rock foundations or as otherwise shown on the design drawings.

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of barrel with chases provided for joints and wrapping.

(8) Support of excavation

The Contractor shall adequately support all excavations to statutory requirements as the Works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls (WSA 03 – 2011 Part 2, Section 13.5).

The Contractor shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation.

(9) Pipe bedding

When excavation of the trench has been completed the Contractor shall obtain the Superintendent's approval prior to commencing pipe laying, jointing and bedding. The Superintendent’s approval of the excavated trench is required prior to the release of the hold point.

Crusher screenings shall only be used for pipe bedding where sand or other non-cohesive material is not readily available locally or where the Contractor can demonstrate that its use will not impede repair operations. (WSA 03 – 2011 Part 2, Section 14.)

Pipes (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Contractor shall provide non-cohesive granular bedding, having a minimum thickness of 100mm below the barrel and socket of the pipe, where rock or other hard material occurs in the bottom of the trench. The bedding material shall conform to the sands classification described in SC6.4.4.8 Standard drawings SD-370, either loose clean sand and /or medium dense clean sand.

For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 75mm below the underside of the pipe barrel and socket, side support and overlay to a depth of 150mm above the top of the pipe) as shown in Figure 5.1 in AS2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within the limits in Table SC6.4.6.2.2, except that where the materials cannot be reasonably sourced from within the vicinity, the Contractor may use materials satisfying the classification in the second paragraph above provided also that the material meets the requirements for passing sieve sizes 9.5mm and 6.7mm shown in Table SC6.4.6.2.2:

Table SC6.4.6.2.2 Grading of bedding material for PVC and PE pipes

Sieve size aperture width (AS1152)	Equivalent BS sieve size (BS410)	Percentage passing
9.5mm	3/8 inch	100
6.7mm	1/4 inch	90 - 100
425µm	No. 36	40 - 90
150µm	No. 100	0 - 10

All mains laid on grades steeper than 50% shall be encased in concrete as detailed on the design drawings.

(10) Laying and jointing of pipes

Unless detailed otherwise in this sub-section, the Contractor shall install pipes in accordance with AS/NZS2032, AS2033, AS/NZS2566.1 or AS3690 as appropriate (WSA 03 - 2011 Part 2, Sections 15, SC6.4.4.8 Standard drawings SD- 315 and SD-320).

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Contractor and, if required by the Superintendent, the Contractor shall suspend each one in a sling to enable the Superintendent to inspect it. If directed by the Superintendent, the Contractor shall oil valves and repack valve glands.

The Contractor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight.

The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports shall be removed prior to completion of backfilling.

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be flexible, rubber ring (elastomeric) joints, either roll-on or skid type or, where shown on the Design drawings, mechanical joints, either fixed flange or bolted gland type.

For pipes with rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Contractor shall make the joint such that the witness mark shall, at no point, be more than 1mm from the end of the socket.

Pipes may be cut as needed or directed by the Superintendent to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting.

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine toothed hand saw and mitre box. For field cuts of ductile iron or steel, the Contractor shall ensure that fire fighting equipment, in working order, is on the site prior to the field cuts being made. If the Contractor proposes to use a petrol engined pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times.

The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer’s written instructions, or as directed by the Superintendent.

Where pipes are cut in the field, the Contractor shall make a witness mark on the pipe using a felt-tip marking pen at the length specified by the manufacturer from the end of the pipe. The Contractor shall not use PVC/PE

pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Contractor shall refer to the socket manufacturer for the correct marking depth.

Where PVC/PE pipes are to be joined to ductile iron pipes, the joints shall be made by inserting a PVC/PE spigot into a ductile iron socket. Ductile iron spigots shall not be joined to PVC/PE sockets. Alternatively, multi-fit mechanical couplings or flanged adaptor couplings may be used to join pipes of different materials.

The Contractor shall conform to the relevant statutory and work, health and safety requirements when cutting and disposing of asbestos cement pipes and submit a method statement for approval of the Superintendent.

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Contractor shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

The maximum angle of deflection between adjacent pipes shall be limited to 2^{o} or 0.035 radian in areas subject to mine subsidence or slippage.

Unless otherwise directed by the Superintendent, the Contractor shall lay pipes on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface. Detectable identification tape shall be laid along the line of non-metallic mains within 150mm of the finished surface (SC6.4.4.8 Standard drawings SD-325).

(11) Trench stops

Where a pipe is laid on bedding at a grade of 5% to 14%, the Contractor shall construct, as below, trench stops consisting of bags filled with clay, or sand or cement stabilised sand and sealed: (SC6.4.4.8 Standard drawings SD-374)

(a) at the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300mm below finished surface level; and

(b) the bags shall be placed around and above the pipe, as in (a) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.

The distance between trench stops shall be determined by the following formula:

$$D = \frac{100}{G}$$, whereby

D = Distance between stops in m

G = Grade of pipe expressed in %.

(12) Concrete bulkheads

Where a pipe is installed at a grade of 15% to 29%, the Contractor shall construct concrete bulkheads. Where a pipe is installed at a grade 30% to 50%, the Contractor shall construct concrete bulkheads integral with concrete encasement. Where a pipe is to be installed at a grade of 50% or more the Contractor shall provide a site specific design. Bulkheads shall be of 25MPa concrete complying with SC6.4.6.28 Minor concrete works, 150mm minimum thickness as follows: (SC6.4.4.8 Standard drawings SD-374 and WSA 03 – Part 2, Section 15.10)

(a) Where concrete bedding or encasement to pipe is required, the 150mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150mm. The bulkhead shall extend to 300mm below finished surface level or such other level as directed by the Superintendent.

(b) Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150mm for the full width of trench.

(c) A 75mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the

upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20mm in size within 150mm in all directions upstream and above the invert of the drain hole beyond which another 150mm thick surround of gravel 2 to 10mm in size shall be placed.

The distance between concrete bulkheads shall be determined by the following formula:

Concrete bulkhead (grade of 15% to 29%)

$$D = \frac{L}{G}$$

Concrete encasement (continuous) and concrete bulkhead (grade of 30% to 50%)

$D = \frac{100}{G}$, whereby

L = 80 X Pipe length, m

= 450m max

if L> 100m use intermediate trench stops at spacing < 100/G

D = Distance between bulkheads in m

G = Grade of pipe expressed in %

(13) Valve and hydrant chambers

The Contractor shall construct around each valve and hydrant a chamber of the type and to the details shown on the Design drawings (WSA 03 – 2011, Part 2, Section 15.13).

The concrete shall comply with SC6.4.6.28 Minor concrete works.

Valve chamber covers shall be painted with white pavement marking paint while hydrant chamber covers shall be painted with yellow pavement marking paint.

Where the type of valve chamber is such that the body, or part of the body, of the valve is to be backfilled before the valve chamber is constructed, the Contractor shall either wrap the valve using a tape consisting of synthetic fibre open weave cloth impregnated with saturated hydro-carbons, applied in accordance with the valve manufacturer's written instructions, or apply at least one coat of corrosion preventing material to the valve body after the valve has been installed but before backfilling. The coating material shall be compatible with the coating material which has been applied to the valve prior to delivery.

(14) Chamber covers and frames

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4mm radius.

Tolerances for the dimensions on the COVER shall be - 3mm + NIL.

Tolerances for the dimensions on the FRAME shall be - 3mm + 3mm.

Covers shall be seated as shown on the design drawings or as directed by the Superintendent.

Covers shall be finished flush with the surface in road pavements, footpaths and other paved surfaces. Elsewhere, covers shall be finished 25mm above the surface of the ground, or such other level as directed by the Superintendent, in a manner designed to avoid as far as possible, the entry of surface water.

Cast iron covers and frames shall be manufactured in accordance with AS3996 and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.

The Contractor shall take care to avoid lateral movement, cracking and subsidence when installing plastic covers and frames.

(15) Service connections

Not applicable.

(16) Thrust and anchor blocks

Thrust and anchor blocks shall be constructed where shown on the design drawings to the dimensions depicted therein or as otherwise directed by the Superintendent. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur (SC6.4.4.8 Standard drawings SD-371 and WSA 03 – 2011, Part 2, Section 15.7).

The Contractor shall provide permanent thrust blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that directed by the Superintendent.

The Contractor shall provide permanent anchor blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, of a volume not less than that directed by the Superintendent.

The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test.

The Contractor shall obtain the consent of Townsville Water and Waste for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

(17) Concrete encasement

The use of Concrete encasement shall not be permitted unless otherwise approved by Townsville Water and Waste.

(18) Wrapping of pipelines

Where shown on the design drawings, the Contractor shall enclose a pipeline or a section thereof, in lay-flat polyethylene sleeving (WSA 03 – 2011, Part 2, Section 15.11).

The materials to be used shall be high impact resistance polyethylene sleeving, of minimum thickness 0.2mm polyethylene film approved by the Superintendent and 50mm wide plastic adhesive tape.

The width of the sleeving when flat shall be in accordance with the manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

For dual trenching, pipelines shall be identified by colour sleeving, blue stripe for potable water and lilac for recycled water, or an appropriate identification tape.

Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Superintendent. The Contractor shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving overlapped for a minimum of 250mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three circumferential turns of adhesive tape. As the polyethylene sleeving material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately 1 metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Contractor shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving.

The Contractor shall rectify any damage done to the polyethylene sleeving before, during or after backfilling of the trench.

(19) Corrosion protection of steel bolts and nuts

The Contractor shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape, approved by the Superintendent, consisting of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the

manufacturer's recommendations or as directed by the Superintendent. Bolts and nuts shall be dry, clean and free from rust immediately before wrapping.

SC6.4.6.2.5 Pipeline testing and restoration

(1) Testing of pipelines

The hydrostatic pressure testing shall be conducted in accordance with Section 6 and Appendix M of AS/NZS2566.2.

The Contractor shall pressure test mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. Pipelines shall be tested in sections approved by the Superintendent as soon as practicable after each section has been laid, jointed and backfilled provided that:

(a) if so specified, or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Superintendent; and

(b) the pressure testing shall not be commenced earlier than seven days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves.

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Superintendent.

During pressure testing, all field joints, which have not been backfilled, shall be clean, dry and accessible for inspection.

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, the Contractor shall flush and clean it to the satisfaction of the Superintendent and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

The hydrostatic test pressure, which shall be applied to each section of the pipeline, shall be 1200 kPa.

The Contractor shall maintain the specified test pressure as long as required by the Superintendent while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 4 hours. For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

The pressure testing of a section shall be considered to be satisfactory if:

(a) there is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;

(b) there is no visible leakage; ~~and~~

(c) the measured leakage rate for pipes other than PE does not exceed the permissible leakage rate as determined by the following formula:

$Q_1 = 0.14DLH$

where:

Q_1 = permissible leakage rate (litres per hour)

D = nominal diameter of pipe (m)

L = length of section tested (km)

H = average test head (m); and

(d) for PE pipes:

$V_2 \leq 0.55V_1 + 0.14DLH$

where:

V_1 = water volume (litres) added between Hour 2 and Hour 3 to maintain test pressure

V_2 = water volume (litres) added between Hour 4 and Hour 5 to maintain test pressure

D = nominal diameter of pipe (m)
L = length of section tested (km)
H = average test head (m)

Any failure, defect, or visible leakage which is detected during the pressure testing of the pipeline or during the defects liability period shall be made good by the Contractor at the Contractor's expense. This constitutes a hold point.

Unless directed by the Superintendent, the maximum test length shall be 1000m. ~~The hydrostatic pressure testing shall be conducted in accordance with Section 6 and Appendix M of AS/NZS2566.2.~~

(2) Connection to existing pipes

Connections to existing pipes carrying water shall be made at such times as will cause the least interference with the supply. The Contractor shall make arrangements with Townsville Water and Waste or other Authority concerned for the timing of the work including the need to isolate the existing mains and notification of affected dwelling occupants. The Superintendent shall be given 5 working days notice of such arrangements. (WSA 03 – 2011 Part 2, Section 22.)

(3) Disinfection and flushing of pipelines

The Contractor shall disinfect all water mains after satisfactory testing in accordance with this sub-section (WSA 03 – 2011 Part 2, Section 20). The Contractor shall adopt procedures for the disinfection of the mains with the concurrence of Townsville Water and Waste. All test results submitted are required to be NATA certified.

After disinfection and testing is completed, the Contractor shall flush all water mains to ensure that the disinfected water used in the process do not enter sections of the system already in service. Flushing and disposal of disinfected water shall be in accordance with WSA 03 – 2011 Part 2, Section 20.2.

(4) Bacteriological testing

(a) General

Disinfection of a water main may be required to ensure suitable water quality parameters are maintained. When disinfection of a main is required, bacteriological testing of the disinfected water must be undertaken.

Disinfection may also be required where there is a likelihood of contamination. A bacteriological test must also be undertaken on all new disinfected mains following satisfactory completion of swabbing/flushing and pressure testing of the water main.

(b) Test procedure

Water mains shall be tested as follows:

(i) scour past the sampling point;

(ii) engage a NATA registered laboratory to collect representative water samples from the test section of the water main; and

(iii) dispose of testing water in accordance with the relevant environmental Regulator and/or Water Agency requirements.

(c) Satisfactory bacteriological test

The water main will be deemed compliant if:

(i) the test results fall within the water quality parameter limits specified in the Table SC6.4.6.2.3; or

(ii) the water quality parameter test results in the test section of water main are no worse than the water quality parameter test results measured by testing an influent sample of existing mains water, provided that the influent sample was collected by the NATA registered laboratory at the same time as water sample from the test section of water main was collected.

Table SC6.4.6.2.3 Water quality parameter limits

Water quality parameter	Unit	Acceptable range
pH	-	6.8–8.5*
Chlorine (free)	mg/L	0.5–2.0
Total Coliform count	cfu/100mL	0
Faecal Coliform count or E.Coli count	cfu/100mL	0
Heterotrophic Plate count	cfu/mL	0–10

* for cement mortar lined mains an upper level pH of 9.2 is acceptable

For failed tests, the water main shall be swabbed, flushed and/or disinfected and then re-tested. This shall be undertaken until all test results are satisfactory.

(5) Backfill and compaction

After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to the commencement of trench backfilling. The Superintendent's approval to the laid and jointed pipes is required prior to the release of the hold point. Backfill shall not be placed until the Superintendent has given approval.

Material for the side support and overlay of the pipe shall comply with the requirements for pipe bedding specified SC6.4.6.2.4(9) Pipe bedding. The material shall be compacted in layers of not more than 150mm to a Density Index of 70 as determined in accordance with AS1289.5.6.1 and with reference to WSA 03 – 2011, Part 2, Section 16.3.

The Contractor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150mm thick as follows: (WSA 03 – 2011, Part 2, Section 17).

(a) Where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be (WSA 03 – 2011, Part 2, Section 17):

(i) backfilled with a non-cohesive granular material, with a grading falling generally within the limits detailed herein for pipe bedding, and compacted to Density Index of 70 when determined in accordance with AS1289.5.6.1 for cohesionless materials:

(A) below 0.3m of the subgrade road surface; and

(B) in the road reserve, up to top of overlay zone;

(ii) backfilled with selected material, and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS1289.5.4.1, to top of subgrade level of the road surface, but excluding the pavement layers;

(iii) backfilled with selected material, and compacted to 95% of the standard maximum dry density of the material when determined in accordance with AS1289.5.4.1, to finish surface level of the areas of trench outside of roadways;

(iv) backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS1289.5.4.1.

(b) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS1289.5.6.1 for cohesionless materials or 98% of the standard maximum dry density of the material when determined in accordance with AS1289.5.7.1 for cohesive materials.

The Contractor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

The Contractor shall carry out compaction tests 75mm to 100mm below the level being tested.

Where a roadway is to be sited over existing infrastructure, excavation of trench material down to overlay zone and subsequent backfilling with appropriate select material to the underside of sub-base to the compaction requirements stated above.

The Contractor may compact backfill by trench flooding only where:

(i) the ground and backfill material is cohesionless sand;

(ii) water for flooding has been sourced at the site;

(iii) the process will not create mud which would be moved off site by vehicles or construction plant. The process is closely monitored to ensure adequate volumes are added to sufficiently compact the materials to achieve the compaction requirements as specified in WSA 03 – 2011, Part 2 –

Table 19.1; and

(iv) additives are not used.

(6) Valve and hydrant marking

The Contractor shall clearly mark the position of each stop valve, scour valve, air valve and hydrant on completion of backfilling in a manner and position in accordance with SC6.4.4.8 Standard drawings SD-345 and/or shall be consistent with the method(s) in use by Townsville Water and Waste.

Where, in the opinion of the Superintendent, a valve or hydrant is at too great a distance from any existing wall, fence, kerb face, or post, the Contractor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the valve or hydrant in metres, to an accuracy of 0.1m, shall be permanently marked on the plate with legible numbers a minimum 80mm high. Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.

The post shall conform to the following requirements:

(a) the post shall be of sufficient length to be set firmly in place under saturated ground conditions;

(b) when installed, the post shall project 1000mm above the ground, provided that where tall grass or crops are likely to obscure the post, its height above the ground shall be increased to 1500mm; and

(c) the post shall be painted with 2 coats of white enamel for exterior use.

The Contractor shall fix marking plates as soon as practicable after each valve or hydrant is installed. However, the Contractor shall temporarily cover marking plates for hydrants using masking tape or other approved cover which the Contractor shall remove on satisfactory completion of the pressure testing of the pipeline.

For hydrants, the Contractor shall affix blue two-way reflective raised pavement markers to the road pavement in accordance withSC6.4.4.8 Standard drawings SD-345.

(7) Restoration of surfaces

The Contractor shall clean pavements, lawns and other improved areas and leave them in the same order as they were at the commencement of the Works. The Contractor shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with turf imported from a source approved by the Superintendent (WSA 03 – 2011, Part 2, Section 23). The restoration works shall be done progressively and as soon as possible after the section of works is completed.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects liability period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects liability period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel, asphaltic concrete or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement. Final restoration may include, if required by the Superintendent, the removal of temporary restoration.

In other than roadways, the Contractor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the defects liability period in order that the surface of the completed trench may then conform to the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor. Where dry weather conditions have persisted after the original backfilling, including during the defects liability period, the Contractor

shall take all necessary steps to consolidate the trench before removing surplus materials from the site.

In locations where, in the opinion of the Superintendent, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Superintendent in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the expiry of the defects liability period.

Where, within public or private property, the reasonable convenience of persons will require such, the Contractor shall level trenches at the time of backfilling or otherwise as directed by the Superintendent. The Contractor shall make good any subsequent settlement, as required by placing additional fill.

The Contractor shall immediately restore any damaged or disturbed private property and services.

Should the Contractor elect to tunnel under paving, kerb and channel or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the defects liability period.

The Contractor shall provide notice to affected property owners of any pending works.

SC6.4.6.2.6 Pump stations

(1) Pumps

Pump construction materials for centrifugal end suction pumps shall comply with the following:

DESCRIPTION	MATERIAL
PUMP	
Casing and suction bend	Cast iron AS1830 Gr T200
Wear rings	Cast iron AS1830 Gr T200
Impeller	316 Stainless steel AS1449
Impeller nut	Gunmetal AS1565-905C
Shaft	316 Stainless steel AS2837
Shaft sleeve	Phosphor bronze AS1565-9060/316
Neck bush, lantern ring	Phosphor bronze AS1565-9060
Gland	Cast Iron AS1830 Gr T200
Gland studs	316 Stainless steel AS2837
Gland nuts	316 Stainless steel AS2837
Fixing nuts and bolts handhold	316 Stainless steel AS2837
Covers	316 Stainless steel AS1449
Fitted bolts and nuts, casing and dowels	316 Stainless steel AS2837
Forcing screws	316 Stainless steel AS2837
Water thrower and drip tray	316 Stainless steel AS1449
Pump set base plate	Cast iron AS1830 Gr T200/Fabricated steel
MOTOR	
Motor frame and end shield	Cast iron/Mild steel
Motor terminal box	Cast iron/Mild steel
Motor fan cover	Mild steel
Motor fan	Metal
HOLDING DOWN BOLTS	316 Stainless steel AS2837
MECHANICAL SEALS	
Seal faces	Tungsten carbide or equal
Springs	Nickel chrome steel
Secondary seal	Fluoro carbon or nitrile rubber

The Contractor shall provide a written warranty from the Manufacturer of the equipment. This action constitutes

a hold point. The Superintendent's approval of the warranty is required prior to the release of the hold point.

The Manufacturer's warranty shall require the Manufacturer to accept liability for any defect in materials or workmanship which becomes apparent at any time within two years after the date of delivery of any piece of equipment used in Work under the Contract.

All nuts and bolts shall be manufactured in accordance with AS/NZS1111 and AS/NZS1112 150 metric series and fitted with washers beneath bolts heads and nuts. Requirements are:

(a) all bolts, nuts and washers shall be stainless steel to AS1449 and AS2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated;

(b) all threads are to be rolled;

(c) all bolt heads and nuts shall be hexagonal;

(d) all bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS2528;

(e) all nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts;

(f) all concrete anchor bolts, nuts, locking nuts and large series washers required for the bolting down of pump set discharge bends shall be provided. These anchor bolts shall be as recommended by the equipment designer with a minimum diameter of 16mm; and

(g) concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.

Bolts on all flanges will protrude no more than 10mm past the nut when tightened.

The Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluoroethylene (PTFE), either tape to AS1272, dipped or sprayed, or molybdenum disulphide.

(2) Pressure gauges

The Contractor shall install one diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS1349 per centrifugal pump installation. Cases shall be fabricated from stainless steel complying with AS1449 or bronze. The protective diaphragm shall be suitable for dismantling for cleaning without affecting the accuracy of the gauge.

The gauge face shall be 100mm in diameter and calibrated in metres head of water. The gauge shall accurately indicate the pump operating head and the pump no-flow head.

Each gauge shall be supplied with the nominally sized metric equivalent of three of the following bronze fittings: gate valve, union, nipple and reducing nipple.

Gauges and fittings shall be screwed into the pipe wall of ductile iron pipes, or pipe fittings, 150mm and larger. In pipework less than 150mm, gauges and fittings shall be screwed into a tapping band. Where shown on the design drawings, the Contractor shall install a ball valve to allow removal of the gauge.

The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps.

(3) Electrical compliance

The Works shall be in accordance with the requirements specified in SC6.4.3.21.4 Electrical and mechanical except where this sub-section or the Design drawings indicate otherwise. The technical requirements detailed on the Design drawings shall take precedence over the requirements of this sub-section should clauses be in disagreement.

Except where SC6.4.3.21.4 Electrical and mechanical requires a higher standard, works shall be carried out in accordance with AS/NZS3000, the service rules of the supply authority and all relevant statutory authorities.

The Contractor shall supply the Superintendent a proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority.

The Contractor shall submit all designs and material to each Authority having jurisdiction for approval. The Contractor shall arrange for each Authority having jurisdiction to inspect the works. The Superintendent shall be advised a minimum of 7 working days in advance of the date of any inspection by an Authority. The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the inspections is to be exercised.

(4) Switchgear and control gear assembly (SCA)

The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Superintendent.

The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 60529.

All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A hot dipped galvanised steel channel base shall be provided.

Starter contactors shall have the appropriate rating for the proposed pumps to AC3.

All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the Design drawings.

The Contractor shall liaise with the electricity supply authority to supply pad locks for the metering equipment, at the Contractor’s expense. The Superintendent shall supply pad locks for use on the SCA at no cost to the Contractor.

The electrical characteristics of the SCA shall be:

Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire.
Motor Control Circuit: 240 V, 50 Hz.
Common Control Circuit: 240 & 24 V, A.C.
Prospective short-circuit current: 14kA for 1 second.
Peak Factor: 2.2
Power Factor Correction (Determined in consultation with Townsville Water and Waste)
Earthing (M.E.N. system)

All cables shall enter the SCA from below.

The Contractor shall supply data from the switchgear supplier confirming Type “2” co ordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent.

Refer to standard specification TCC24 clause 18 for starter selection requirements and functional specification for the project.

The Contractor shall carry out factory tests in the presence of the Superintendent's Representative and in accordance with the requirements stipulated in SC6.4.3.21.4 Electrical and mechanical and the results shall comprise all routine Tests specified in AS3439.

Inspections and functional tests shall be in accordance with TCC24 clause 21.

The Contractor shall ensure, after approval has been given by the Superintendent, that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided.

The Contractor shall be responsible for any damage that may occur during transit and unloading at site.

The Contractor shall ensure that spare parts, tools etc., are packed separately from the main plant and shall be marked “Spare Parts”, “Tools” etc., as applicable.

The Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent.

The Contractor shall supply and install control equipment that is compatible with the existing equipment.

(5) Electrical installation

The Contractor shall liaise with the Supply Authority for the electricity supply to the pump station site.

The Contractor shall be responsible for all facilities required by the Supply Authority for revenue metering equipment and the payment of all associated connection, inspection fees and capacity charges.

The Contractor shall supply and install all cabling including consumer mains, motor, control and instrumentation cables, conduits and electrical pits.

The Contractor shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority’s requirements, with a minimum 500mm below the finished ground level in non-trafficable areas and 600mm below the finished ground level in trafficable areas. The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.

The Contractor shall run electrical marker tape 150mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150mm wide and stamped with the words “DANGER – ELECTRIC CABLES BELOW” or similar.

The Contractor shall route all underground cabling with the approval of the Superintendent. Brass marking plates shall be positioned on a concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read “DANGER – ELECTRICAL CABLES BELOW”. The Superintendent’s approval of the route of all underground cabling is required prior to the release of the hold point.

The Contractor shall determine the points of attachment on site and the Contractor shall supply and install any consumer’s connection poles for the consumer mains required by the Supply Authority.

The consumer mains shall be generally run underground and commence at the point of attachment on a steel consumers pole (if applicable), installed near the property boundary and run in conduit to the switchboard.

No aerial conductors are to be installed over structures, access road or vehicle manoeuvring areas.

The minimum size of the consumers’ mains shall be sized to satisfy the following requirements:

(a) current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum;

(b) be sized for a voltage drop less than 1.5% to the maximum demand as calculated; be

(c) single core PVC/PVC cables. XLPE insulated cable may also be used;

(d) comply with the requirements of the Supply Authority; and

(e) AS/NZS3000 and AS/NZS3008.

In addition to the requirements of the Supply Authority and as specified in SC6.4.3.21.4 Electrical and mechanical (Townsville Water planning and design guidelines) the main earthing conductor shall be run in conduit to the main earthing electrode. The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50mm^2 cable and a Type 4 pit for larger cable.

Earth electrode shall be bonded and suitably labelled with an engraved brass label.

Surge diverters shall be earthed in accordance with manufacturer's instructions.

The Contractor shall bond the pump station metallic pipework to the main earth.

Refer also to TCC24 clause 28.1 for installation instruction requirements.

Metering equipment and installation shall comply with the Queensland Electricity Connections and Metering Manual.

The Contractor shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals. Cables shall not be jointed.

The Contractor shall seal, at the completion of commissioning tests, all conduits into the outdoor SCA with a non-setting sealing compound to prevent the ingress of vermin.

(6) Testing and commissioning of pump station

The Contractor shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the sub-section requirements. The submission to the Superintendent of satisfactory test results constitutes a hold point. The approval of the Superintendent is required prior to the release of the hold point.

Tests and inspections shall comply with relevant Australian Standards.

Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.

Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation.

The Contractor shall conduct pre-commissioning in a logical sequence in accordance with the programme prepared by the Contractor and approved by the Superintendent.

The Contractor shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

Specific requirements for pre-commissioning shall include, but are not limited to:

(a) initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for "running in";

(b) physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc., depending on the type of equipment;

(c) electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary;

(d) tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms; and

(e) equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to the Superintendent prior to commissioning.

The Contractor shall carry out pre-commissioning tests to the satisfaction of the Superintendent and shall record the results of the tests on the appropriate Pre-commissioning Record Sheet.

Refer to TCC24 clause 28.1.11 for electrical test documentation requirements.

The Contractor shall furnish the Superintendent with one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Superintendent's Representative who witnessed the test.

Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions.

The Contractor shall give the Superintendent 5 working days notice of the Contractor’s intention to undertake commissioning and supply to the Superintendent the copies of each of the pre-commissioning record sheets and three copies of the operational and maintenance manuals at the time that notice of commissioning is given.

The Contractor shall conduct commissioning in a logical sequence in accordance with a programme prepared by the Contractor and approved by the Superintendent.

Throughout commissioning the Contractor shall be responsible for the test programme.

The Contractor shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests.

The Contractor shall prepare schedules, test record sheets and programmes for approval by the Superintendent prior to each stage of the overall commissioning.

The Contractor shall carry out final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc.) including setting and adjustment of equipment in accordance with the requirements in SC6.4.3.21.4 Electrical and mechanical (Townsville Water planning and design guidelines).

The Contractor shall arrange for all testing, commissioning and any adjustments to be carried out by qualified personnel.

(7) Practical completion of pump station

The Contractor shall fulfil the following requirements before the Certificate of Practical Completion is issued:

(a) receipt by the Superintendent of a certificate of approval from the relevant statutory authorities;

(b) pump station is in working order as demonstrated by the testing and commissioning;

(c) approval by the Superintendent of Operating and maintenance manuals; and

(d) receipt by the Superintendent of as-built drawings of the pump station.

(8) Telemetry

The Contractor shall make provision for equipment to link the pump station to the existing telemetry network to be provided by Townsville Water and Waste at the Contractor's expense. Refer to TCC24 clause 17.1, 28.2, Appendix B2 and Appendix C.

The pump station shall operate automatically by control signals from the telemetry system. In addition, either one or any combination of pumps may operate at any one time by control signals from the telemetry system.

(9) Operation and maintenance manuals

(a) Manuals shall contain the following information:

(i) contractor's name, address and telephone number;

(ii) client's contract number, job name; and

(iii) pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and electrical installation.

(b) Manuals for pumps shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing of pump and motor;

(v) sectional arrangement drawing with parts and list;

(vi) dimensioned sectional arrangements detailing:

(A) maximum and minimum shaft/bearing clearance (radial);

(B) maximum and minimum impeller/bowl clearance (radial);

(C) maximum and minimum impeller/bowl clearance (axial);

(D) impeller/bowl wear rings;

(E) motor/pump coupling - type, make and model number; and

(F) mechanical seals where applicable.

(c) Manual for motors shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing;

(v) sectional arrangement drawing for submersible motor power cabling where applicable;

(vi) gland sealing arrangement drawing for submersible motor power cabling where applicable;

(vii) cables where applicable; and

(viii) terminal block arrangement drawing where applicable.

(d) Manuals for electrical equipment shall comply with TCC24 clause 23 and requirements for electrical drawings are described in TCC24 clause 22.

(e) Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves.

(f) Manuals shall contain the following test curves:

(i) pump witnessed test curves;

(ii) motor test curves; and

(iii) motor torque/speed/efficiency characteristic curves.

(g) The operating and maintenance manual shall include:

(i) safe working procedures: for switching and isolating the supply and distribution system;

(ii) description of operation;

(iii) maintenance procedures: recommended maintenance periods and procedures;

(iv) tools: particulars of maintenance equipment and tools provided, with instructions for their use.

(v) equipment: a technical description of the equipment supplied, with diagrams and illustrations where appropriate;

(vi) dismantling: where necessary, procedures for dismantling and reassembling equipment; and

(vii) spare parts: a list of the spare parts provided.

(10) Trouble shooting instructions shall be included for pumps, motors, valves and SCA.

(11) Step by step procedures for dismantling and reassembly of pumps, motors and valves using any special tools

shall be detailed together with step by step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc.

SC6.4.6.2.7 Construction compliance

(1) Work-as-executed details and operation and maintenance manual

The Contractor shall submit to the Superintendent work-as-executed drawings showing the actual location and alignment of pipelines, and all pump station details together with operating and maintenance manuals.

Details shall include the size, type, levels of pipelines, valve and hydrant chamber types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details.

The Contractor shall ensure that a Registered Surveyor certifies the plans showing location and alignment.

The Contractor shall provide records, for Townsville Water and Waste's Asset Register, to the Superintendent at the time of practical completion of the Contract. The records are to be in a form consistent for inputting into the Asset Register as directed by the Superintendent.

SC6.4.6.3 Sewerage system

SC6.4.6.3.1 Introduction

(1) Scope

This sub-section is for the construction of the following:

(a) gravitation sewers up to DN600 nominal size;

(b) common effluent sewers, both gravity and pressurised;

(c) vacuum sewerage systems;

(d) rising mains up to DN600 nominal size;

(e) standard appurtenances such as maintenance holes, maintenance shafts and property connection sewers; and

(f) small pump stations, usually limited to single wells with submersible pumps.

This sub-section excludes the construction activities for:

(g) treatment plants;

(h) headworks;

(i) dosing plant;

(j) larger pump stations; and

(k) works controlled by others, including overflow management

The Contractor shall carry out the work, and supply materials meeting the requirements of the reference documents and, in particular, in accordance with the requirements of the Water Services Association of Australia publications WSA 02~~-2002~~ 2014 – Gravity *Sewerage Code of Australia*, WSA 07 – 2005 - *Sewerage Pumping Station Code of Australia*, and WSA 07-2011 *Pressure Sewerage Code of Australia*, except as otherwise specified herein. Sewerage works should be designed in accordance with SC6.4.3.21 Townsville Water planning and design guidelines in conjunction with Department of Energy and Water Supply's *Planning Guidelines for Water Supply and Sewerage.*

For the purposes of this sub-section, "access chambers" are referred to as "maintenance holes".

(2) Reference and source documents to be read and applied in conjunction with this policy sub-section are as follows:

Documents referenced in this sub-section are listed below whilst being cited in the text in the abbreviated form or code indicated. The Contractor shall possess, or have access to, the documents required to comply with this sub-section.

References to the *Sewerage Code of Australia* are made where there are parallel sections or equivalent clauses to those in this sub-section. Where not called up as part of this sub-section, these references are identified by edition, part and section numbers and enclosed in brackets thus (WSA Edition, Part, Section).

(a) Development manual planning scheme policy sub-sections

SC6.4.3.21 Townsville Water and Waste planning and design guidelines
SC6.4.4.8 Standard drawings
SC6.4.6.28 Minor concrete works
SC6.4.6.30 Control of traffic

Note—where any standard drawing used in conjunction with this sub-section includes technical requirements that conflict with this sub-section, the requirements of this sub-section shall take precedence.

(b) Australian Standards

Note—references in this sub-section or on the design drawings to Australian Standards are noted by their prefix AS or

AS/NZS. Where not otherwise specified in this sub-section or the design drawings, the Contractor shall use the latest Australian Standard, including amendments and supplements, available within two weeks of close of tenders.

AS/NZS 1111	*ISO metric hexagon commercial bolts and screws*
AS/NZS 1112	*ISO metric hexagon nuts,*
AS 1152	*Specification for test sieves*
AS/NZS 1260	*PVC-U pipes and fittings for drain, waste and vent applications*
AS 1272	*Unsintered PTFE tape for thread sealing applications*
AS 1289.5.4.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.7.1	Methods of testing soils for engineering purposes – Soil compaction and density tests- *Compaction control test – Hilf density ratio and Hilf moisture variation (Rapid Method)*
AS 1349	*Bourdon tube pressure and vacuum gauges*
AS 1444	*Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties*
AS 1449	*Wrought alloy steels – Stainless and heat-resisting steel plate, sheet and strip*
AS/NZS 1477	*PVC pipes and fittings for pressure applications*
AS 1565	*Copper and copper alloys – Ingots and castings*
AS 1579	*Arc welded steel pipes and fittings for water and wastewater*
AS/NZS 1594	*Hot-rolled steel flat products*
AS 1627.4	*Metal finishing – Preparation and pre-treatment of surfaces- Abrasive blast cleaning of steel*
AS 1646	*Elastomeric seals for waterworks purposes*
AS 1657	*Fixed Platforms, walkways, stairways and ladders – Design, construction and installation*
AS 1741	*Vitrified clay pipes and fittings with flexible joints – sewer quality*
AS 1830	*Grey cast iron*
AS 60529	*Degrees of protection provided by enclosures (IP Code)*
AS/NZS 2032	*Installation of PVC pipe systems*.
AS 2033	*Installation of polyethylene pipe systems*
AS 2129	*Flanges for pipes, valves and fittings*
AS/NZS 2280	*Ductile iron pipes and fittings*
AS 2528	*Bolts, studbolts and nuts for flanges and other high and low temperature applications*
AS/NZS 2566.1	*Buried flexible pipelines – Structural design*
AS/NZS 2566.2	*Buried flexible pipelines – Installation*
AS 2837	*Wrought alloy steels – Stainless steel bars and semi-finished products*
AS/NZS 3000	*Electrical installations (Wiring Rules)*
AS/NZS 3008	*Electrical installations –Selection of cables*
AS 3439	*Low voltage switchgear and controlgear assemblies*
AS 3518	*Acrylonitrile butadine styrene (ABS) compounds pipes and fittings for pressure applications*
AS 3571	*Glass filament reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin – Pressure and non-pressure drainage and sewerage*
AS 3578	*Cast iron non-return valves for general purposes*
AS 3681	*Application of polyethylene sleeving for ductile iron pipelines and fittings*
AS 3690	*Installation of ABS pipe systems*
AS 3972	*General purpose and blended cements*
AS 3996	*Access covers and grates*
AS/NZS 4058	*Precast concrete pipes (pressure and non-pressure)*
AS 4060	*Loads on buried vitrified clay pipes*
AS/NZS 4087	*Metallic Flanges for waterworks purposes*
AS/NZS 4129	*Fittings for polyethylene (PE) pipes for pressure applications*
AS/NZS 4130	*Polyethylene (PE) pipes for pressure applications*
AS 4198	*Precast concrete access chambers for sewerage applications*

Note—read “maintenance hole” for “access chamber”

AS 4321	*Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings*
AS/NZS 4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*
AS/NZS 4765	*Modified PVC (PVC-M) pipes for pressure applications*
AS 4794	*Non return valves – Swing check and tilting disc*

(c) Other

Department of Energy and Water Supply, *Planning Guidelines for Water Supply and Sewerage*, April 2010

Water Services Association of Australia (WSAA)

WSA 02-~~2002~~ 2014 - Gravity *Sewerage Code of Australia*

WSA 04-2005 - *Sewerage Pumping Station Code of Australia*

WSA 05-2013 - *Conduit Inspection Reporting Code*

WSA 07-2007 - *Pressure Sewerage Code of Australia*

British Standard - BS 410 - *Specification for test sieves*

International Erosion Control Association (IECA) - *Best Practice Erosion and Sediment Control*.

SC6.4.6.3.2 Materials

(1) General

The Contractor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this sub section.

Prior to the delivery of products and materials, the contractor is expected to obtain relevant product or material certification from the manufacturer which shall be presented to the Superintendent if requested.

The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

All gravity reticulation pipes shall be rubber ring (elastomeric), complying with AS 1646, jointed to the type, size and class as shown on the design drawings.

If the Contractor proposes to use alternative products and materials other than the products and materials authorised by Townsville Water and Waste, the design drawings and this sub-section, an approval from Townsville Water and Waste is required prior to delivery and use of alternative products or materials.

(2) Unplasticised and modified PVC (uPVC and PVC-M) pipe and fittings

Unplasticised PVC (uPVC) pipes and fittings for gravity systems shall comply with AS/NZS 1260, shall be suitable for rubber rings (elastomeric) joints and shall be of the class and size as shown on the design drawings. (WSA 02- 2014~~02~~, Part 2~~4~~, Section ~~10~~13.)

Unplasticised PVC (uPVC) pipes and fittings for rising mains and suction pipes shall comply with AS/NZS 1477 and AS/NZS 4765, shall be suitable for rubber ring (elastomeric) joints and shall be of the class and size as shown on the design drawings. Modified PVC (PVC-M) pipes and fittings shall comply with AS/NZS 4765, shall be suitable for rubber ring (elastomeric) joints and shall be of the class and size as shown on the design drawings.

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS/NZS 2032 and AS/NZS 2566.1.

Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of shelter.

(3) Polyethylene (PE) pipe and fittings

Polyethylene pipe shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size shown on the design drawings and installed in accordance with AS 2033. (WSA 02-~~2002~~2014, Part ~~2~~2,Section ~~10~~13.)

Jointing shall be by butt thermal fusion or by electrofusion couplings, or with compression fittings.

The Contractor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the design drawings.

(4) Glass reinforced plastic (GRP) pipe and fittings

Glass filament reinforced thermosetting plastics (GRP) pipes shall comply with AS 3571 and shall be of the class and size as shown on the design drawings and installed in accordance with AS/NZS 2566.1. (WSA 02-~~2002~~2014, Part ~~2~~2, Section ~~10~~13.)

Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of cover.

(5) Ductile iron (DI) pipe and fittings

Ductile iron (DI) pipes and fittings shall comply with AS/NZS 2280 and shall be of the class, size and lining, as shown on the design drawings, and installed in accordance with AS/NZS 2566.1. Jointing shall be with rubber rings (elastomeric) to the class and type as shown on the design drawings and in accordance with ~~(~~WSA 02-~~2002~~2014, Part 2, Section 13~~0)~~.

Flanges shall be to the table shown on the design drawings. Bolts and nuts for flanged joints shall be galvanised, or stainless steel as for the pumps specified herein, unless shown otherwise on the design drawings.

All pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS 3681 unless specified otherwise to be coated and lined. All fittings shall be thermal bonded polymeric coated, in accordance with AS/NZS 4158, or wrapped. The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

(6) Steel pipeline

Steel pipelines and fittings shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining and coating as shown on the design drawings or as specified in ~~(~~WSA 02- ~~2002~~2014, Part 2, Section ~~10~~13~~)~~.

The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

The jointing system shall be rubber ring (elastomeric) unless shown otherwise on the design drawings.

(7) Vitrified clay

Vitrified clay (VC) pipes and fittings shall comply with AS 1741 and shall be of the class of pipe, complying with the loading requirements of AS 4060, and size as shown on the design drawings and suitable for rubber ring (elastomeric) joints (WSA 02-2002, Part 2, Section10).

(8) Precast maintenance holes (MH)

Precast maintenance hole components shall comply with AS/NZS 1477 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete (WSA 02-~~2002~~2014, ~~Part 1, Section 6 and~~ Part ~~3~~2, Section ~~18~~17.2).

If approved by the Superintendent, precast systems, complying with the drawings, may be used in lieu of cast in-situ systems (WSA 02-~~2002~~2014, Part ~~3~~2, Section1~~8.4~~7.2.2). Precast system components shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out.

(9) Preformed maintenance shafts (MS) and terminal maintenance shafts (TMS) including cover

Preformed maintenance shaft and terminal maintenance shaft components shall comply with AS/NZS 1477 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete (WSA 02-~~2002~~2014, Part ~~1~~2, Section ~~6~~ 17~~and Part 3, Section 19, SEW 1314 and SEW1316~~).

(10) Maintenance hole covers and frames

Cast iron maintenance hole covers and frames shall comply with AS 3996 and shall be of a type that is flush top cast cover, identifiable as SEWER, size, opening and class as shown on the design drawings. Covers and frames shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out.

(11) Steelwork

Structural steelwork, including ladders, brackets and covers, complying with AS 1657, shall be abrasive blast cleaned to AS 1627.4, Class 2.5 and hot dip galvanised to AS/NZS 4680.

SC6.4.6.3.3 Pipeline construction

(1) General

The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work. Proof of accreditation must be provided to the Superintendent prior to the release of the hold point (WSA 02-~~2002~~2014, Part ~~3~~2, Section1~~6~~2.2.)

The Contractor shall not change the pipeline alignment without the prior concurrence of Townsville Water and Waste. The Contractor shall provide full details, of any proposed changes to the pipeline alignment, to the Superintendent for submission to Townsville Water and Waste. The Superintendent shall obtain the decision of Townsville Water and Waste prior to the release of the hold point.

(2) Location

The location of the sewers, maintenance holes, rising mains and pump stations, sizes and grades of sewers and rising mains, the types of maintenance holes and maintenance hole covers and the classes of pipes shall be as shown on the design drawings. The Contractor shall commence laying of pipelines at the lower end of the line unless directed otherwise by the Superintendent. The Contractor shall lay pipelines to grades and locations shown on the design drawings unless directed otherwise by the Superintendent. (WSA 02-2014~~02~~, Part ~~3~~2, Section~~s~~ 1~~6~~3.1 and 13.2.)

(3) Cover over pipelines

The minimum depth of cover to be provided over pipelines shall be as follows: (WSA 02-2014~~02~~, Part 1, Section ~~5~~4.6.3 ~~and WSA 02-2002, Part 3, Section 15.2~~).

LOCATION	MINIMUM COVER (mm)
Private property non vehicular new developments	600
Private property non vehicular existing developments	450
Private residential property subject to vehicular loading	750
Footpaths, sealed roads (non arterial)	900
Unsealed roads	1200
Arterial roads	1200

Lesser covers may be permitted where special protection of the pipelines has been shown on the design drawings or directed by the Superintendent (WSA 02-~~2002~~2014, Part 1, Section ~~4~~5.6.3.)

(4) Crossings

Where a pipeline crosses a main or state road, creek or involves features shown on the design drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority. The Contractor shall provide written notification to the Authority of the intention to carry out the work,

and pay the appropriate fees ~~(WSA 02-2002, 3, 17.13)~~. The Contractor shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to the Superintendent if requested.

Where shown on the design drawings, the Contractor shall use trenchless methods for the installation of the sewer mains. The installation of the sewer main by open trenching shall not be permitted over the lengths designated for trenchless installation (WSA 02-~~2002~~2014, Part 2~~3~~, Section~~s 13.5.4~~14.12 ~~and 17.12~~).

The Contractor shall address, in its method statement for trenchless conduit installation, the following:

(a) general description of method and sequence of operation;

(b) size, depth and position of temporary pits required;

(c) use of specialist subcontractors;

(d) specialist equipment to be used; and

(e) grout type and method of injection.

The encasement pipe shall be as detailed on the design drawings. The encasement pipe shall extend 1.0 m behind the back of the kerb on either side of the carriageway.

The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe.

After installation and pressure testing of the carrier pipe, the Contractor shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler ~~(WSA 02-2002, Part 3, Section 17.12)~~.

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.

(5) Earthworks

The Contractor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the design drawings, or as directed by the Superintendent, within the specified tolerances.

Prior commencement of excavation, the Contractor shall be responsible in obtaining approval from the appropriate Authorities and shall comply with all requirements of the approval including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners ~~(WSA 02-2002, Part 3, Section 15)~~.

The Contractor shall leave a clear space of 600 mm minimum between the edge of any excavation and the inner toe of stockpiles. No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling ~~(WSA 02-2002, Part 3, Sections 14.7 and 15.9)~~.

At the completion of work each day, the Contractor shall install safety fencing to statutory requirements along the edges of open excavations to isolate them from the public. The Contractor shall provide fenced walkways and vehicular crossways across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advise beforehand all affected residents. All such installations shall be of adequate size and strength and shall be illuminated to prevent accidents ~~(WSA 02-2002, Part 3, Section 15.1)~~.

The Contractor shall locate, protect and repair, as necessary, all services affected by the Works at the Contractor's expense. The Contractor shall give notice of any interference to the works caused by an existing service and submit a proposed work method statement ~~(WSA 02-2002, Part 3, Sections 13.5.2 and 13.7)~~.

The Contractor shall carry out erosion and sedimentation control at all construction sites in accordance with *Best Practice Erosion and Sediment Control*.

The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open ~~(WSA 02-2002, Part 3, Section 15.7)~~.

(6) Minimum trench width for pipelines

The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150 mm above the top of the pipe shall be as shown in Table SC6.4.6.3.1 (~~WSA 02-2002, Part 3, Section 15.2 and~~ SC6.4.4.8 Standard drawings SD-460).

Table SC6.4.6.3.1 Minimum trench widths

Nominal size of PIPE (DN)	Minimum clear width of trench(mm) (inside timbering or sheet piling, if any)	
	Pipe other than PVC/PE	PVC/PE Pipe
80	400	350
100	400	350
150	450	400
200	500	450
225	550	500
250	550	500
300	600	550
375	700	650
400	700	650
450	750	700
500	850	800
525	850	800
600	950	900

Where the design drawings provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by sawcutting, or other means approved by the Superintendent, so as to provide a neat straight line free from broken ragged edges (WSA 02~~-2002~~2014, Part ~~3~~2, ~~Section15~~Section14.7~~.3~~).

The Contractor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

(7) Maximum trench width

For gravitation sewers or rising mains of pipe materials other than PVC or PE, no restriction shall be placed on the maximum width of trench due to the structural strength of the pipe provided the depth to invert of the pipe does not exceed the depths shown in column (ii) of Table SC6.4.6.3.2.

The Superintendent may, however, restrict the width of trench due to local conditions. The Superintendent shall not restrict the width of trench to less than as shown in column (iii) of Table SC6.4.6.3.2.

Where the depth to invert exceeds that shown in column (ii) of Table SC6.4.6.3.2 – Maximum trench widths, the maximum width of trench (outside timbering or sheet piling, if used) to a height of 150 mm above the top of the pipe shall be as shown in column (iii) of Table SC6.4.6.3.2.

Table SC6.4.6.3.2 Maximum trench widths

Nominal size of pipe (mm) (i)	Maximum depth to invert, unlimited width trench (m) (ii)	Maximum trench width, depths greater than in column (ii) (mm) (iii)
150	8.0	750
225	6.5	825
300	5.5	900
375	4.5	975
400	4.5	975
450	4.5	1050
525	4.0	1125
600	4.0	1200

For gravitation sewers or rising mains of PVC/PE pipe the maximum width of trench from the trench base to a height of 150 mm above the top of the pipe shall be the outside diameter of the pipe barrel plus 400 mm. However, in timbered or travelling box excavated trenches, the width of trench when measured to the outside of the support used may be increased to a maximum of 580 mm plus the outside diameter of the pipe barrel.

The Contractor shall supply a method statement of any special construction control, where shown on the design drawings, to the Superintendent's approval.

(8) Excavation depth

The Contractor shall excavate trenches to a minimum of 100 mm below the underside of the pipe barrel and socket or coupling except for rising mains to be laid on other than rock foundations or as otherwise shown on the design drawings (~~WSA 02-2002, Part 3, Section 15.8 and~~ SC6.4.4.8 Standard drawings SD 461).

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of the barrel with chases provided for joints and wrapping.

(9) Support of excavation

The Contractor shall adequately support all excavations to Statutory requirements as the Works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls. ~~(WSA 02-2002, Part 3, Section 15.6)~~.

The Contractor shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation.

(10) Pipe bedding

When excavation of the trench has been completed the Contractor shall obtain the Superintendent's approval prior to commencing pipe laying, jointing and bedding. The Superintendent's approval of the excavated trench is required prior to the release of the hold point ~~(WSA 02-2002 -2002, Part 3, Section 15.8)~~, or where sewers are to be located in water charged ground (present or predicted to occur) will require specialist geotechnical analysis and design. The contractor shall inform the Superintendent immediately upon encountering ground water and await further direction ~~(WSA 02-2002, Part 1, Sections 8.5 and 8.6.7)~~.

Crusher screenings may only be used for pipe bedding where sand or other non- cohesive material is not readily available locally or where the Contractor can demonstrate that its use will not impede repair operations ~~(WSA 02-2002, Part 3, Section 16)~~.

Pipes for gravitation sewers (excluding PVC/PE pipes), shall be bedded on sand or other non-cohesive material. Pipe bedding shall consist of a non-cohesive granular material, having a minimum thickness of 75 mm below the barrel and socket of the pipe, and its grading shall generally fall within the following limits shown in Table SC6.4.6.3.3.

Table SC6.4.6.3.3 Grading of bedding material for pipes other than PVC and PE

Sieve size aperture width (AS 1152)	Equivalent BS sieve size (BS410)	Percentage passing
22.4 mm	1 inch	100
6.7 mm	¼ inch	90 - 100
425 µm	No. 36	40 - 90
75 µm	No. 200	0 - 10

Pipes for rising mains (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Contractor shall provide non-cohesive granular bedding, having a minimum thickness of 100 mm below the barrel (SC6.4.4.8 Standard drawings SD-461) and socket of the pipe, where rock or other hard material occurs in the bottom of the trench or where specified or directed by the Superintendent. The bedding material shall be either loose clean sand and /or medium dense clean sand or as directed by the Superintendent.

For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 100 mm below the underside of the pipe barrel (SC6.4.4.8 Standard drawings SD-461) and socket, side support and overlay to a depth of 150 mm above the top of the pipe) as shown in Figure 5.1 in AS 2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within limits shown in Table SC6.4.6.3.4 Grading of bedding material for PVC and PE Pipes, except that where the materials cannot be reasonably sourced from within the vicinity, the Contractor may use materials satisfying the classification in the second paragraph above, provided also that the material meets the requirements for passing sieve sizes 9.5 mm and 6.7 mm as shown in Table SC6.4.6.3.4.

Table SC6.4.6.3.4 Grading of bedding material for PVC and PE Pipes

Sieve size aperture width (AS1152)	Equivalent BS sieve size (BS410)	Percentage passing
9.5mm	3/8 inch	100
6.7mm	1/4 inch	90 - 100
425µm	No. 36	40 - 90
150µm	No. 100	0 - 10

The Contractor shall bed all gravitation sewers laid on grades of 15 per cent to 50 per cent on 20 MPa concrete complying with sub-section SC6.4.6.28 Minor concrete works. Such concrete bedding shall have a thickness of at least 75 mm below the underside of the barrel and socket of the pipe and shall extend to a level above the bottom of the pipe of one quarter of the external diameter of the pipe and a width across the trench not less than the minimum width shown in Table SC6.4.6.3.1 Minimum trench widths.

The Contractor shall encase all gravitation pipelines and rising mains, laid on grades steeper than 50 per cent, in concrete as detailed on the design drawings.

(11) Laying and jointing of pipes

Unless detailed otherwise in this Specification, the Contractor shall install pipes in accordance with AS 2032, AS 2033, AS/NZS 2566.1 or AS 3690 as appropriate (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~17~~16).

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Contractor and, if required by the Superintendent, the Contractor shall suspend each one in a sling to enable the

Superintendent to inspect it. If directed by the Superintendent, the Contractor shall oil valves and repack valve glands.

The Contractor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight.

The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. The Contractor shall remove any temporary supports prior to completion of backfilling.

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be flexible, rubber ring (elastomeric) joints (either roll-on rubber ring (elastomeric) or skid type) or, where shown on the design drawings, mechanical joints (either fixed flange or bolted gland type). ~~(WSA 02-2002, Part 3, Section 17.1.)~~

For pipes with roll-on rubber ring (elastomeric) joints, spigots and sockets shall be clean and dry. The Contractor, after making the joint, shall check that the rubber ring (elastomeric) has rolled in evenly, and, if not, the Contractor shall withdraw the pipe and remake the joint.

For pipes with skid type rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Contractor shall make the joint such that the witness mark shall, at no point, be more than 1 mm from the end of the socket.

Pipes may be cut as needed, or directed by the Superintendent, to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting.

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine toothed handsaw and mitre box. For field cuts of ductile iron or steel, the Contractor shall ensure that fire fighting equipment, in working order, is on the site prior to the field cuts being made. If the Contractor proposes to use a petrol-engine pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times.

The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer's written instructions, or as directed by the Superintendent.

Where pipes are cut in the field, the Contractor shall make a witness mark on the pipe at the length specified by the manufacturer from the end of the pipe. The Contractor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Contractor shall refer to the socket manufacturer for the correct marking depth.

Where PVC pipes are to be joined to pipes of another material, the joints shall be made as follows:

(a) for jointing PVC/PE spigot to VC socket or PVC/PE socket to VC spigot, the Contractor shall use a PVC/PE adaptor shall be used. The joints in both instances shall be made using a ring conforming to AS 1646.

(b) for jointing PVC/PE to ductile iron, the Contractor shall use a rubber ring (elastomeric) joint with an adaptor coupling.

The Contractor shall conform with the relevant Statutory and work, health and safety requirements when cutting and disposing of asbestos cement pipes.

Gravitation pipelines shall be constructed to the following tolerances:

(c) the maximum horizontal deviations to either side from the design axis of a pipeline shall be 20mm for all sizes of pipes (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~23~~22.1); and

(d) the invert level shall not deviate from the design grade line by more than 10 mm (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~23~~22.2).

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Contractor shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

The maximum angle of deflection between adjacent pipes shall be limited to 2º or 0.035 radian in areas subject to mine subsidence or slippage.

Unless otherwise directed by the Superintendent, the Contractor shall lay pipes for rising mains on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.

Detectable identification tape to AS/NZS 2648.1 shall be laid along the line of the rising main within 150 mm of the finished surface or as otherwise directed by the Superintendent (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~17~~16.11.2 and SC6.4.4.8 Standard drawings SD-460).

(12) Connections to maintenance holes and structures

The Contractor shall connect pipelines to maintenance holes, structures or embedded concrete by means of 600 mm long pipes such that two flexible joints are provided, the first joint being at or within 150 mm of the face of the structure. The contractor shall not core any connections into wall sections of precast or cast insitu manholes <150 mm from any joint to the closest edge of core. Where flexible joints cannot be made with cut pipes, the Contractor shall select pipes from the various lengths provided in order to make the second joint within 300 mm of the position shown on the drawings (~~WSA-02-2002, Part 3, Section 18.10 and~~ SC6.4.4.8 Standard drawings SD-470 and SD484).

The Contractor may vary slightly the positions of maintenance holes shown on the design drawings, subject to final approval by the Superintendent immediately prior to construction, to suit changes, such as erection of structures, growth of flora and installation of services. The positioning of a maintenance hole shall be such as to comply with occupational health and safety requirements for access by maintenance staff, providing a proper working area around the top and access into the hole. Once the final position of a maintenance hole has been established, construction shall be subject to the following requirements:

(a) for deviations from the design levels of maintenance holes as shown on the design drawings or as directed by the Superintendent during construction, the following tolerances shall apply (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~23~~22):

(i) where the difference in levels between the inlet pipe and the outlet pipe in a maintenance hole is 100mm or less:

Pipe Tolerance
Inlet - nil; + 10 mm
Outlet - 10 mm; + nil; and

(ii) where the difference in levels, as above, is greater than 100 mm:

Pipe Tolerance
Inlet - 10 mm; + 10 mm
Outlet - 10 mm; + 10 mm; and

(b) allowable lateral deviations from the final design position of maintenance holes shall be +/- 300 mm.

(13) Junctions and property connection sewers

The Contractor shall provide junctions for dead ends and property connection sewers or risers to properties to serve existing and future dwellings in accordance with this sub-section and the design drawings. Such junctions shall be inserted along pipelines in locations shown on the design drawings or directed by the Superintendent, with the service connection, where not shown on the design drawings, provided at a depth no deeper than 1.5 m provided the property still has service to the sewer, as follows ~~(WSA-02-2002, Part 3, Sections 17.7 and 17.8)~~:

(a) for existing dwellings, at the most practical point not outside the property boundary to facilitate the connection, considering existing sewage outlets. Separate connections shall be provided for dual occupancies; and

(b) for vacant blocks, at the most practical point not outside the property boundary to facilitate the connection, considering topography and likely positioning of sewage outlets.

Where the sewer is intended to serve a large block and/or where the sewer line is located more than 75 m from the premises, the Contractor shall extend the property connection sewer onto that block such that the maximum horizontal measurement in a straight line between the sewer connection point and the premises on the block is not more than 75 m.

Concrete support shall be provided for the full trench width in accordance with SC6.4.4.8 Standard drawings SD-455 complying with sub-section SC6.4.6.28 Minor concrete works.

Except where concrete encasement is ordered by the Superintendent, the Contractor shall sand compact

backfill around risers to the top of the socket or coupling on the highest branch off the riser, for the full width of trench and for a minimum distance of 500 mm upstream and downstream of the riser. Compaction density shall be as for the requirements for the trench pipeline.

All property connection sewers and junctions shall have a minimum diameter of 150 mm and have a screwed access cap. Property connection sewers shall have a maximum length of 10 m.

(14) Marking of junctions and property connection sewers

The Contractor shall clearly mark the position of each riser, junction or end of a property connection sewer on completion of backfilling. The marking shall be made by one of the following methods but the location of the mark or peg shall be consistent with the method(s) in use by Townsville Water and Waste and to the approval of the Superintendent (WSA 02-~~2002~~2014, Part ~~3~~2, Section 1~~6~~7.9).

Where the position of a riser, junction or the end of a property connection sewer is at a substantial boundary fence or structure located on the boundary, a neatly stencilled letter "J" 50 mm high shall be painted thereon. An underground identification tape, as specified hereafter, shall finish flush with the existing ground surface as close to the boundary fence or structure as possible.

Elsewhere, the Contractor shall drive into the ground, a peg, 75 mm x 50 mm x 600 mm long at that position, and left flush with the surface of the surrounding ground. The Contractor shall connect the peg to an underground identification tape as specified hereafter.

The Contractor shall tie the identification tape to the junction or end of the property connection sewer, hold the tape in a vertical position during backfilling operations and finish tape flush with finished ground level.

The identification tape shall be 75 mm wide fawn coloured polyethylene tape with the inscription "Caution - buried sewer line", printed in heavy black letters every 200 mm.

(15) Trench stops

Where a sewer or rising main is laid on bedding at a grade of 5 per cent to 14 per cent, the Contractor shall construct, as below, trench stops consisting of bags filled with clay, or sand or cement stabilised sand and sealed. Reference shall be made to SC6.4.4.8 Standard drawings SD-482 and SD-483.

(a) At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100 mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300 mm below finished surface level.

(b) The bags shall be placed around and above the pipe, as in (a) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.

The distance between trench stops shall be determined by the following formula:

$$D = \frac{100}{G}$$, whereby

D = Distance between stops in m

G = Grade of pipe expressed in per centum.

(16) Concrete bulkheads

Where a gravitation sewer or rising main is installed at a grade of 15 per cent to 29 per cent, the Contractor shall construct concrete bulkheads. Where a gravitation sewer or rising main is installed at a grade 30 per cent to 50 per cent, the Contractor shall construct concrete bulkheads integral with concrete encasement. Where any sewer line is to be installed with a grade exceeding 50 per cent, the contractor must provide a site specific design to incorporate all aspects of the site conditions including soil conditions. Bulkheads shall be of 20 MPa concrete complying with sub-section SC6.4.6.28 Minor concrete works, 150 mm minimum thickness as follows: (SC6.4.4.8 Standard drawing SD-482, WSA 02-~~2002~~2014, Part 1, Section ~~8~~9.10 and WSA 02-~~2002~~2014, Part ~~3~~2,
Section ~~17~~16.6)

(a) where concrete bedding or encasement to pipe is required, the 150 mm thick bulkhead shall be cast

integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150 mm. The bulkhead shall extend to 150 mm below finished surface level or such other level as directed by the Superintendent;

(b) where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150 mm for the full width of trench; and

(c) a 75 mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20 mm in size within 150 mm in all directions upstream and above the invert of the drain hole beyond which another 150 mm thick surround of gravel 2 to 10 mm in size shall be placed.

The distance between concrete bulkheads shall be determined by the following formula: (WSA 02-~~2002~~2014, Part 1, Section ~~8~~9.10.)

Concrete bulkhead

$$S = \frac{L_P}{G}$$

Concrete encasement (continuous) and concrete bulkhead S = 100/G, whereby

L_P = 80 X Pipe length, m

= 450 m max

if L_P > 100 m use intermediate trench stops at spacing < 100/G

S = Distance between bulkheads in m

G = Grade of pipe expressed in per centum

(17) Thrust and anchor blocks for rising mains

The Contractor shall construct thrust and anchor blocks where shown on the design drawings to the dimensions depicted therein or as otherwise directed by the Superintendent where it is deemed that the allowable bearing pressure of the ground and the design pressure on the pipeline are different to the actual pressures on site. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur.

The Contractor shall provide permanent thrust blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that directed by the Superintendent.

The Contractor shall provide permanent anchor blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, of a volume and dimension not less than that directed by the Superintendent.

The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test. The cost of providing such anchorages shall be deemed to be included in the rates tendered for laying and jointing rising mains.

The Contractor shall obtain the consent of Townsville Water and Waste for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

(18) Rising main fittings

The Contractor shall install rising mains, air release valves and inspection pipes where shown on the design drawings or directed by the Superintendent. All rising mains shall be topped with an appropriate identification tape.

The Contractor shall provide marking plates bearing the letters "DAV" for double air valves, "SCOUR" for scour pipes and "SRM" for sewage rising main at changes of direction and at such chainages that the location of the main is marked, at least once each 100 metres, as specified hereinafter. In urban areas, the kerb adjacent to each fitting is to be painted with 2 coats of non-slip paint coloured black.

Where, in the opinion of the Superintendent, a valve or fitting is at too great a distance from any existing wall,

fence or post to which the notice plate could be conveniently fixed, the Contractor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the fitting in metres, to an accuracy of 0.1 m, shall be permanently marked on the plate with legible numbers a minimum 80 mm high. Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.

The post shall conform to the following requirements:

(a) the post shall be of sufficient length to be set firmly in place under saturated ground conditions.

(b) when installed, the post shall project 1000 mm above the ground, provided that where tall grass or crops are likely to obscure the post, or where directed by the Superintendent, its height above the ground shall be increased to 1500 mm.

(c) the post shall be painted with 2 coats of white enamel for exterior use.

The Contractor shall encase in concrete pipes in gravity sewers or rising mains, as shown on the design drawings, with less than the specified cover above the top of the pipe barrel, or where directed by the Superintendent. Concrete shall be 20 MPa complying with sub-section SC6.4.6.28 Minor concrete works and have the following minimum dimensions (WSA 02-~~2002~~2014, Part ~~3~~1, Section ~~20.6~~9.7 and SC6.4.4.8 Standard drawing SD-463):

(a) for trenches in other than rock: 150 mm minimum under, on both sides and on top of the pipe barrel; and

(b) for trenches in rock: 100 mm minimum under the pipe barrel, 150 mm on top of the pipe barrel and for the full width of trench excavated.

In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12 mm thick shall be formed in the concrete encasement at the face of each socket or at one face of each coupling.

Reinforcement in concrete encasement shall be as shown on the design drawings.

(19) Wrapping of pipelines

Where shown on the design drawings or directed by the Superintendent, the Contractor shall enclose a pipeline or a section thereof, in layflat polyethylene sleeving (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~17~~16.10).

The materials to be used shall be high impact resistance polyethylene sleeving of minimum thickness 0.2 mm polyethylene film, approved by the Superintendent, and 50 mm wide plastic adhesive tape.

The width of the sleeving when flat shall be in accordance with the pipe manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

Where necessary to distinguish pipes within close proximity, pipelines shall be identified by colour sleeving or an appropriate identification tape.

Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Superintendent. The Contractor shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving overlapped for a minimum of 250 mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three circumferential turns of adhesive tape. As the polyethylene sleeve material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately 1 metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Contractor shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving.

The Contractor shall rectify any damage done to the polyethylene tubing before, during or after backfilling of the trench. The Contractor shall present the wrapped pipeline for inspection by the superintendent prior to commencing backfilling operations.

(20) Corrosion protection of steel bolts and nuts

The Contractor shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape, approved by the Superintendent consisting of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer's recommendations. Bolts and nuts shall be dry, clean and free from rust immediately before wrapping.

(21) Cast-in-situ maintenance holes

For all maintenance holes concrete work, the Contractor shall comply with sub-section SC6.4.6.28 Minor concrete works in relation to the supply and placement of concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection except as specified below (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~18.5~~17.2.3 and SC6.4.4.8 Standard drawings SD-470 and SD-476).

Cement used in all concrete shall be Type SR to AS 3972. The Contractor may use fly ash additive to a maximum 20 per cent. Cement used shall be no older than 3 months since manufacture.

The minimum cement content shall be 360 kg/m³ of concrete and the water/cement ratio of the mix shall not be greater than 0.50 by mass.

(22)

Covers and frames

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3 mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4 mm radius~~ (WSA 02-2002, Part 3, Sections 18.1, 18.9 and 19.3)~~.

Tolerances for the dimensions on the COVER shall be – 3 mm + NIL.

Tolerances for the dimensions on the FRAME shall be -3 mm +3mm.

Maintenance hole covers shall be seated on a layer of bitumen impregnated fibre board, having a cross-section of 25 x 25 mm. Alternatively another seating material of a cross-section and composition approved by the Superintendent may be used.

Maintenance hole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces of any type. Elsewhere, covers shall be finished 25 mm above the surface of the ground where not shown otherwise on the design drawings, or such other level as directed by the Superintendent, in a manner designed to avoid as far as possible, the entry of surface water.

In locations where shown on the design drawings or directed by the Superintendent, the Contractor shall install a cast iron cover and frame. Where it is evident, or otherwise shown on the design drawings, the Contractor shall install bolt down frames and covers in areas subjected to 1 in 100 year flooding. Cast iron covers and frames shall be manufactured in accordance with AS 3996, and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.

(23)

Preformed maintenance hole and maintenance shaft systems

The Contractor shall supply components that make a watertight system and have a satisfactory surface finish.

Generally, preformed maintenance holes shall be made up in accordance with the design drawings, with components consisting of a base section, shaft sections, converter, cover and frame. Make-up Rings (1 only) of 100-150 mm may be used between converter section and cover to make up height differentials. The wall thickness of any reinforced component below the frame shall not be less than 84 mm.

Preformed maintenance shafts shall be made with section lengths that once constructed comprise the least amount of joints as required to satisfy height parameters and unit joint/wall penetration coring clearances.

The installation of all preformed components shall be in accordance with the manufacturers' recommended

procedures and requirements.

Backfill for all preformed maintenance holes and maintenance shafts shall be placed and compacted evenly around the maintenance hole to the required finished surface level according to location requirements. If necessary, the Contractor shall import and compact non-cohesive granular material.

(24) Bedding and backfill compaction requirements

After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to commencement of trench backfilling (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~21~~19). Backfill shall not be placed until the Superintendent has given approval.

Material for the bedding, side support and overlay of the pipe shall be as for pipe bedding specified in SC6.4.6.3.3(10) Pipe bedding. The material shall be compacted in layers of not more than 150 mm to a Density Index of 70 for the material used when determined in accordance with AS 1289.5.6.1.

The Contractor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150 mm thick as follows: ~~(WSA 02-2002, Part 3, Section 21)~~.

(a) Where the trench is within a roadway, proposed roadway, the remainder of the trench shall be:

(i) backfilled with a non-cohesive granular material, with a grading falling generally within the limits shown in Table SC6.4.6.3.3, and compacted to Density Index of 70 when determined in accordance with AS 1289.5.6.1:

(A) below 0.3 m of the subgrade road surface; and

(B) in the road reserve, up to top of overlay zone;

(ii) backfilled with selected material, and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to top of subgrade level of the road surface, but excluding the pavement layers;

(iii) backfilled with selected material, and compacted to 95 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to finish surface level of the areas of trench outside of roadways; and

(iv) backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1

(b) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials or 98 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1 for cohesive materials.

The Contractor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

The Contractor is to submit to the Superintendent for approval any proposal for construction of embankments in conformance with the drawings, including the method of placement and compaction and any limitations to the placement/ compaction over the top of any pipeline.

Where a roadway is to be sited over existing infrastructure, excavation of trench material down to overlay zone and subsequent backfilling with appropriate select material to the underside of sub-base to the compaction requirements stated above must be undertaken by the contractor.

The Contractor may compact backfill by trench flooding only where:

- the ground and backfill material is cohesionless sand;
- water for flooding has been sourced at the site;
- the process will not create mud which would be moved off site by vehicles or construction plant; and

- additives are not used.

The contractor shall carry out compaction tests to the full depth of zone being tested and present NATA certified test results to the Superintendent.

SC6.4.6.3.4 Pipeline testing and restoration

(1) General

The Contractor shall subject all sewers and maintenance holes to an initial test as soon as practicable after construction and backfilling is completed (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~22~~21).
All lines shall be clear and free from soil, slurry, liquids and other foreign substances at the time of initial and acceptance testing.

Where a vacuum system has been specified, the Contractor shall test the system in accordance with the testing schedule as shown on the design drawings.

(2) Initial test of gravitation sewers

The Contractor shall make the initial testing of gravitation sewers with compressed air. Before the initial test is performed, all pipe laying on the section shall be completed, and backfill shall be compacted to at least the level of the top of overlay section of trench filling. The Superintendent shall advise at the time of notification by the Contractor whether the option to inspect the initial testing is required ~~(WSA 02-2002, Part 3, Section 22.4.2)~~.

The initial test shall not be carried out before risers and/or property connection sewers are constructed.

Where the Superintendent approves the construction of pipelines in other than full lengths between maintenance holes, each length of pipeline shall be tested before backfilling together with the downstream portion of the maintenance hole length under construction.

The Contractor shall rectify any fault detected and obtain a satisfactory test before the remainder of backfill is placed.

(3) Initial test of maintenance holes

The Contractor shall test each maintenance hole for leakage, as soon as practicable after the maintenance hole is constructed and the maintenance hole cover surround fitted ~~(WSA 02-2002, Part 3, Section 22.4.4)~~.

Maintenance holes may be tested in conjunction with both upstream and downstream sections of mains using the low pressure vacuum method for the initial testing only in accordance with WSA 02-~~2002~~2014, Part ~~3~~2, Section
~~22~~21.4.2.2~~4~~. It is advised that a pressure relief valve be installed inline with a maximum setting release of 50 kPa.

Alternatively, the Contractor may request to test manholes initially using hydrostatic means. The test shall be made by plugging all pipe openings in the walls and by filling the maintenance hole with water to the lowest point on the top of the maintenance hole cover surround. The plugs shall be positioned in the pipes as near as practicable to the internal face of the maintenance hole. The Contractor shall provide details of the alternative method proposed, for approval by the Superintendent, prior to its use.

(4) Ovality test and CCTV inspection

The Contractor shall carry out deflection (ovality) testing in conformance with WSA 02-~~2002~~ 2014 Part ~~3~~2, Section ~~22~~21.6.2 upon completion of placement and compaction of trench and embankment fill. Submit proposal for deflection testing to the Superintendent for acceptance. Carry out a CCTV inspection of the sewer system and maintenance structures to WSA 05 Attachment E and WSA 02-~~2002~~ 2014 Part ~~3~~2, Section ~~22~~21.7 and SC6.4.2.2.6 Conduit assessment

The Contractor shall undertake ovality testing as follows:

(a) all sewers to DN 300 shall be tested to determine any excessive ovality using either a proving tool approved by the council or by CCTV light ring and approved measurement software. Ovality testing shall be undertaken after all earthworks on the subdivision are complete and no sooner than 14 days after

backfill of trenches has been completed. Sewer pipes having excessive ovality shall be replaced and the line retested (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~22~~21.6.2 & WSA 05-2013);

(b) the proving tool shall be rigid and non-adjustable having an effective length of not less than its nominal diameter. The minimum diameter at any point along the length shall be as specified in WSA 02-~~2002~~2014, Appendix ~~G~~K;

(c) the proving tool shall be fabricated from steel and have pulling rings at each end. The prover shall be marked to indicate the nominal pipe size and the prover outside diameter;

(d) Maximum Allowable Deflection = 3% of Mean Outside Diameter; and

(e) the testing shall require a “prover” to be pulled through each section of the pipeline by hand winching to demonstrate that the maximum allowable deflection is not exceeded.

(5) Acceptance test of gravitation sewers and maintenance holes

Acceptance testing shall be carried out before the issue of the Certificate of Practical Completion. Sewers or maintenance holes failing any test, shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained. (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~22~~21.) The Contractor shall make the acceptance test on all components in the section of the sewer in the same manner and to the same methods as the initial test. The Contractor shall submit to the Superintendent satisfactory test results from the acceptance testing.

The Superintendent may permit hydrostatic testing as an alternative to air testing for acceptance of gravitation pipelines and maintenance holes after approval from council.

Where the project contains a combination of precast and cast insitu maintenance holes, then each group must be regarded as a separate population and testing frequencies shall be in accordance with WSA 02-~~2002~~2014, Part ~~3~~2, Table ~~22~~21.5.

The Superintendent may reject any pipeline or maintenance hole in which there is visible or detectable leakage.

(6) Testing with compressed air

The Contractor shall supply and keep all necessary equipment in a condition acceptable to the Superintendent.

All test gauges must have a current calibration certificate and have a range that is suitable to be able to read decimal increments. The minimum diameter of readable face shall be 100 mm.

Sewer lines may be tested by either vacuum (negative pressure) or by positive pressure. The use of inline manhole through connectors can be utilised for ease of testing multiple lines. Manholes and sewer lines shall be tested separately.

Compressed air shall be supplied by a compressor of the rotary vane type capable of supplying at least 1 m³/minute at 35 kPa. The air shall be fed through a pressure-reducing valve capable of reducing pressure from that supplied to 28 kPa ± 4 kPa. The air shall then pass through an airtight line fitted with a pressure gauge reading from 0 to 50 kPa, a pressure relief valve that shall be set to blow off at 28 kPa ± 4 kPa and a gate valve to the pipeline to be tested.

The method of setting up and carrying out the test shall be as specified in WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~22~~21.4.2.

(7) Allowable pressure drop times

The time taken for the pressure to drop from 25 kPa to 18 kPa shall be greater than that specified in WSA 02-~~2002~~2014, Part ~~3~~2, Table ~~22~~21.43.

Pressure drop times which are less than these may indicate leakage or excessive air permeability through unsaturated pipe walls with some materials. Vitrified clay pipes, in particular, suffer from excessive air permeability under dry summer conditions. When this occurs, pipes shall be thoroughly saturated with water before testing or a hydrostatic test applied.

In any case, where the allowable pressure drop time cannot be attained and there are no visible leaks, the Contractor shall apply a hydrostatic test.

(8) Hydrostatic testing

The Contractor shall not carry out hydrostatic testing unless prior approved by the superintendent.

The pipeline under test, and the pipe or hose with container, shall be filled with water until the free surface is level with the top of the container, when that container is suspended in accordance with the requirements set out below.

The test container shall be suspended at a level such that the test head applied to the pipeline is as follows:

(a) for initial test

(i) when no property connection sewers or risers are constructed – a minimum head of 2 metres above the pipe invert at the upstream end of the line under test, or

(ii) where property connection sewers and/or risers are constructed – a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers;

(b) for acceptance test, a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers, or above the free standing level of ground-water in the vicinity whichever is the higher; and

(c) such other lesser head as the Superintendent, at the Superintendent's discretion, may direct

The Contractor shall determine, at the Contractor's expense, the free standing level of groundwater, by a method acceptable to the Superintendent.

After allowing an interval for absorption, to be determined by the Superintendent, any fall of the free water surface shall be made good by adding extra water to the container. The Contractor shall measure the fall in water level during ten minutes thereafter.

The pipeline will be regarded as satisfactory if there are no visible leaks, and if the fall in water level is not more than 25 mm for each standard test length of the pipeline under test including property connection sewers and/or risers.

A standard test length in metres is defined as 1370 m divided by the effective diameter of the pipeline in millimetres. Where the pipeline under test is all of the same size, the effective diameter shall be the nominal size of that pipeline. Where the pipeline under test has property connection sewers and/or risers of smaller nominal size than the main sewer line, then the effective diameter shall be calculated as the product of the length and the nominal size of the larger pipe added to the product of the length and the nominal size of the smaller pipe; this sum shall be divided by the total length of pipeline under test; the result shall be the effective diameter.

(9) Visual inspection and measurement of infiltration

Whenever, in the case of acceptance testing, the pipeline is subjected to a significant head of groundwater (i.e. 1500 mm or more above the soffit of the sewer main provided that groundwater is at least 150 mm above any property connection sewer included in the test), the tests previously prescribed may be dispensed with in favour of visual inspection and measurement of infiltration upon request to the superintendent.

In such circumstances, the Contractor shall propose full details of the method by which the infiltration is to be measured (WSA 02-~~2002~~ 2014 Part ~~3~~2, Section ~~22~~21.5).

If the Superintendent, at the Superintendent's discretion, approves of an inspection and infiltration test being performed for the purposes of acceptance, the Superintendent shall determine the duration over which infiltration is to be measured. The rate of infiltration shall not exceed that determined by the following formula:

Rate of Infiltration

$Q.I. = 0.65 (L_1 d_1 h_1 + L_2 d_2 h_2 + \ldots\ldots\ldots L_n d_n h_n) + H_a$

Where:

Q.I. = rate of infiltration in litres/hour

L = length of pipe in metres
d = nominal size of pipe in metres
h = average head of groundwater over the invert level of the pipe in the section under test
H_a = head of groundwater above the invert level of the outlet pipe of the maintenance hole when the maintenance hole is included in the infiltration test.

The Contractor shall determine the head of groundwater, by a method approved by the Superintendent.

(10) Testing of rising mains

The Contractor shall pressure test rising mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. Acceptance testing shall be carried out before the issue of the Certificate of Practical Completion. Rising mains failing any test, shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained (WSA 07-2007, Part 3, Section 21). The Contractor shall submit to the Superintendent satisfactory test results from the acceptance testing.

Pipelines shall be tested in sections approved by the Superintendent as soon as practicable after each section has been laid, jointed and backfilled, provided that:

(a) if so specified or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Superintendent; and

(b) the pressure testing shall not be commenced earlier than 7 days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves. A maximum length of 1000 m can be tested in one continuous section unless otherwise approved by the superintendent.

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Superintendent.

During pressure testing, all field joints which have not been backfilled shall be clean, dry and accessible.

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, the Contractor shall clean it to the satisfaction of the Superintendent and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

The hydrostatic test pressure which shall be applied to each section of the pipeline shall be equivalent to 1.25 times the maximum operating pressure of the pipeline but do not exceed 1.25 times the maximum operating pressure rating of the lowest rated pipe/fitting. The test procedure shall be in accordance with WSA 07-2007, Part 3, Section 21.4.

The Contractor shall maintain the specified test pressure for as long as required by the Superintendent, while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 4 hours. For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

The pressure testing (pipes other than PE) of a section shall be considered to be satisfactory if:

- there is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
- there is no visible leakage; and
- the measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:

Q_1 = (0.14xDxLxH)
where:
Q_1 = permissible leakage rate (litres per hour)
D = nominal internal diameter of pipe (m)
L = length of section tested (km)
H = average test head (m)

Any failure, defect, visible leakage and/or excessive leakage rate, which is detected during the pressure testing of the pipeline or during the defects liability period shall be rectified by the Contractor at the Contractor's expense. Where a thrust block or an anchor block fails, and such thrust block or anchor block has been constructed in accordance with the design drawings, and the failure is not, in the opinion of the Superintendent, the fault of the Contractor, the thrust or anchor block shall be strengthened or reconstructed as directed by the Superintendent. The cost of strengthening or reconstruction of such thrust or anchor block and the cost of retesting shall be paid as a Variation to the Contract, at such rates as are determined in accordance with the provisions of the General Conditions of the Contract.

For PE rising mains, testing shall be in accordance with WSA 07-2007, Part 3, Section 21.5.

Alternatively, the rising main may be tested by the use of compressed air. In this case, the Contractor shall provide details of the alternative method proposed, for approval by the Superintendent, prior to its use.

(11) Connection to existing sewers

The Contractor must request approval (request for private works quotation) for connection to existing sewers from Townsville Water and Waste. Works shall be either performed by the Sewer Agency or delegated to the contractor at the discretion of the Sewer Agency. Approval must only be requested upon satisfactory completion of all backfilling and testing. All necessary works required in completing connections to "live" maintenance holes (that is, accesses to sewer system that is currently in service), including all works undertaken by the Sewer Agency at "live" maintenance holes in delivering the works shall be the responsibility of the Contractor (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~24~~23).

(12) Restoration of surfaces

The Contractor shall clean pavements, lawns and other improved areas and leave them in the same order as they were at the commencement of the Works. The Contractor shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with imported turf from a source approved by the Superintendent. (WSA 02-~~2002~~2014, Part ~~3~~2, Section ~~25~~24.) The restoration works shall be done progressively and as soon as possible after the section of works is completed.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects liability period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.

Immediately the backfilling of a trench excavated through a pavement has been completed, the Contractor shall temporarily restore the pavement. Where the trench crosses bitumen or concrete pavement, the surface is to be protected from deterioration. A pre-mixed asphaltic material may be used for such temporary restoration. The Contractor shall maintain the temporary restoration until final restoration is carried out. Final restoration of the pavement shall be carried out in accordance with SC6.4.4.8 Standard drawings SD-055 to restore the pavement and its sub-base to no less than the original condition. Final restoration may include, if required by the Superintendent, the removal of temporary restoration.

In other than roadways, the Contractor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the defects liability period in order that the surface of the completed trench may then conform with the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor. Where dry weather

conditions have persisted after the original backfilling, including during the defects liability period, the Contractor shall take all necessary steps to consolidate the trench before removing surplus materials from the site.

In locations where, in the opinion of the Superintendent, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Superintendent in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the expiry of the defects liability period.

Where, within public or private property, the reasonable convenience of persons will require such, the Superintendent may order the Contractor to level trenches at the time of backfilling. The Contractor shall make good any subsequent settlement, as required by placing additional fill.

The Contractor shall immediately restore any damaged or disturbed private property and services.

Should the Contractor elect to tunnel under paving, kerb and channel or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the defects liability period.

The Contractor shall provide notice to affected property owners of any pending works.

SC6.4.6.3.5 Pump stations

(1) General

Provide only products and materials authorised by Townsville Water and Waste, the drawings and this specification. The Contractor shall submit for approval any alternative or not authorised products and materials.

The Contractor must conform to manufacturer’s recommendations for handling, transport and storage of materials and in a manner to prevent damage or deterioration or excessive distortion. Inspect all products and materials at the time of delivery and reject products and materials not in conformance with this specification and the manufacturers’ recommendations. Maintain protective crating or packaging until immediately before use.

Damaged or defective materials are not to be installed or used, including coatings and linings, outside the manufacturer’s recommended limits.

(2) Pumps

Pump construction materials for centrifugal end suction pumps shall comply with the following:

DESCRIPTION	MATERIAL
PUMP	Cast iron AS 1830 Gr T200
Casing and suction bend	Cast iron AS 1830 Gr T200
Wear rings	316 Stainless steel/AS 1449
Impeller	Gunmetal AS 1565-905C
Impeller nut	316 Stainless steel/AS 2837
Shaft sleeve	Phosphor bronze AS 1565-9060/316
Neck bush, lantern ring	Phosphor bronze AS 1565-9060
Gland studs	Cast Iron AS1830 Gr T200
Gland nuts	316 Stainless steel/AS 2837
Fixing nuts and bolts handhole	316 Stainless steel/AS 2837
Covers fitted bolts and nuts, casing and dowels	316 Stainless steel/AS 2837
Forcing screws	316 Stainless steel/AS 1449
Water thrower and drip tray	316 Stainless steel/AS 2837
Pump set base plate	316 Stainless steel/AS 2837
	316 Stainless steel/AS 1449
	Cast iron AS 1830 Gr T2000/Fabricated steel
MOTOR	Cast iron/Mild steel
Motor frame and end shield	Cast iron/Mild steel
Motor terminal box	Mild steel
Motor fan cover	Metal
Motor fan	
HOLDING DOWN BOLTS	316 Stainless steel/AS 2837
MECHANICAL SEALS	Tungsten carbide or equal
Seal faces	Nickel chrome steel
Springs	Fluoro carbon or nitrile rubber
Secondary seal	

The Contractor shall provide a written warranty from the manufacturer of the equipment. This action constitutes a hold point. The Superintendent's approval of the warranty is required prior to the release of the hold point.

The manufacturer's warranty shall require the manufacturer to accept liability for any defect in materials or workmanship which becomes apparent at any time within 2 years after the date of delivery of any piece of equipment used in work under the contract.

All nuts and bolts shall be manufactured in accordance with AS/NZS 1111 and AS/NZS 1112, 150 metric series and fitted with washers beneath bolts heads and nuts. Requirements are:

(a) all bolts, nuts and washers shall be stainless steel to AS 1449 and AS 2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated;

(b) all threads are to be rolled;

(c) all bolt heads and nuts shall be hexagonal;

(d) all bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS 2528;

(e) all nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts;

(f) all concrete anchor bolts, nuts, locking nuts and large series washers required for the bolting down of pump set discharge bends shall be provided. These anchor bolts shall be as recommended by the equipment designer with a minimum diameter of 16 mm; and

(g) concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.

Bolts on all flanges will protrude no more than 10 mm past the nut when tightened.

The Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide.

(3) Preformed pump stations and package pump stations

Preformed components or systems, complying with the design drawings, if any, otherwise complying with AS 3518, AS 3571 or AS 4198 may be used in lieu of in-situ construction provided:

(a) preformed concrete wall units are to be manufactured to AS 4058 except as modified as for the requirements for precast maintenance hole units;

(b) joints shall be internal flush; and

(c) the Contractor shall supply components that make a watertight system and have a satisfactory surface finish.

Package pump stations may be supplied and installed provided:

(d) The proposed packaged system has been appraised and recommended by WSAA;

(~~d~~e) all components comply with the requirements of this sub-section; and

(~~e~~f) the units are at least equivalent to the requirements of this sub-section and the design drawings.

(4) Electrical compliance

The Works shall be in accordance with the requirements contained in clause SC6.4.3.21.4 Electrical and mechanical except where this sub-section or the design drawings indicate otherwise. The technical requirements detailed on the design drawings shall take precedence over the requirements of this sub-section should clauses be in disagreement.

Except where clause SC6.4.3.21.4 Electrical and mechanical requires a higher standard, works shall be carried out in accordance with AS 3000, the Service Rules of the Supply Authority and all relevant statutory authorities.

The Contractor shall supply proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority.

The Contractor shall submit all designs and material, to each Authority having jurisdiction for approval. The Contractor shall arrange for each Authority having jurisdiction to inspect the Works. The Superintendent shall be advised a minimum of 7 working days in advance of the date of any inspection by an Authority. The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the inspections is to be exercised.

(5) Switchgear and control gear assembly (SCA), controls

The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Superintendent.

The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 60529.

All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A hot dipped galvanised steel channel base shall be provided.

The Contractor shall provide an effective barrier to prevent gases from the wet well entering the SCA.

Starter contactors shall have appropriate ratings for the proposed pumps to AC3.

All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the design drawings.

The Contractor shall liaise with the electricity supply authority to supply padlocks for the metering equipment, at the Contractor's expense. The Superintendent shall supply padlocks for use on the SCA at no cost to the Contractor.

The electrical characteristics of the SCA shall be:

Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire.
Motor Control Circuit: 240 V, 50 Hz.
Common Control Circuit: 240 & 24 V, A.C.
Prospective short-circuit current:
14kA for 1 second. Peak Factor: 2.2
Power Factor Correction (determined in consultation with the Superintendent)
Earthing (M.E.N. system)
Characteristics

All cables shall enter the SCA from below.

The Contractor shall supply data from the switchgear supplier confirming Type “2” co-ordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent.

Refer to Standard Specification TCC24 clause 18 for starter selection requirements and functional specification for the project.

The Contractor shall carry out of factory tests in the presence of the Superintendent's Representative and in accordance with clause SC6.4.3.21.4 Electrical and mechanical and the results shall comprise all routine Tests specified in AS 3439. The Superintendent shall be given 7 days notice of the proposed date of such tests.

Inspections and functional tests shall be in accordance with TCC24 clause 21.

The Contractor shall pack the equipment for transport after satisfactory final factory inspection and tests, and after approval has been given by the Superintendent. The Contractor shall ensure that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided.

The Contractor shall be responsible for any damage that may occur during transit and unloading at site.

The Contractor shall ensure that spare parts, tools etc., are packed separately from the main plant and shall be marked “Spare Parts”, “Tools” etc., as applicable.

The Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent.

Automatic control of the pump station pumping equipment shall be by way of hydrostatic level sensor providing single pump duty operation unless shown otherwise on the drawings. The level sensor will be compatible with those in use in the system. A float switch shall be used to provide a HIGH HIGH(overflow) level alarm. Refer to TCC24 clauses18.2, 18.2, 19.1 and 19.2.

The following wet well levels shall be used in the automatic control of the pump operation system:

(a) STOP level;

(b) Duty Start level;

(c) Standby Start level; and

(d) High level.

Pump operation requirements are described in TCC24 clause 18.

The Contractor shall supply and install control equipment that is compatible with the existing equipment.

(6) Electrical installation

The Contractor shall liaise with the Supply Authority for the electricity supply to the pump station site.

The Contractor shall be responsible for all facilities required by the Supply Authority for revenue metering

equipment and the payment of all associated connection, inspection fees and capacity charges.

The Contractor shall supply and install all cabling including consumer mains, motor, control and instrumentation cables, conduits and electrical pits.

The Contractor shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority's requirements, with a minimum 500 mm below the finished ground level in non-trafficable areas and 600 mm below the finished ground level in trafficable areas. The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.

The Contractor shall run electrical marker tape 150 mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150 mm wide and stamped with the words "DANGER – ELECTRIC CABLES BELOW" or similar.

The Contractor shall route all underground cabling with the approval of the Superintendent. Brass marking plates shall be positioned on a concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read "DANGER – ELECTRICAL CABLES BELOW". The Superintendent's approval of the route of all underground cabling is required prior to the release of the hold point.

The Contractor shall determine the points of attachment on site and the Contractor shall supply and install any consumer's connection poles for the consumer mains required by the Supply Authority.

The consumer mains shall be generally run underground and commence at the point of attachment on a steel consumers pole (if applicable), installed near the property boundary and run in conduit to the switchboard.

No aerial conductors are to be installed over structures, access road or vehicle manoeuvring areas.

The minimum size of the consumers mains shall be sized to satisfy the following:

(a) current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30 per cent minimum;

(b) be sized for a voltage drop less than 1.5 per cent to the maximum demand as calculated;

(c) be single core PVC/PVC cables. XLPE insulated cable may also be used;

(d) comply with the requirements of the Supply Authority; and

(e) AS 3000 and AS 3008.

In addition to the requirements of the Supply Authority and clause SC6.4.3.21.4 Electrical and mechanical, the Contractor shall run the main earthing conductor in conduit to the main earthing electrode. The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50 mm2 cable and a Type 4 pit for larger cable.

Earth electrode shall be bonded and suitably labelled with an engraved brass label.

Surge diverters shall be earthed in accordance with manufacturer's instructions.

The Contractor shall bond the pump station metallic pipework to the main earth.

Refer also to TCC24 clause 28.1 for installation instruction requirements.

Metering equipment and installation shall comply with the *Queensland Electricity Connections and Metering Manual.*

The Contractor shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals. Cables shall not be jointed.

The Contractor shall seal, at the completion of commissioning tests, all conduits into the outdoor SCA with a

non-setting sealing compound to prevent the ingress of vermin.

(7) Pressure gauges

The Contractor shall install one diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS 1349 per centrifugal pump installation. Cases shall be fabricated from stainless steel complying with AS 1449 or bronze. The protective diaphragm shall be suitable for dismantling for cleaning without affecting the accuracy of the gauge.

The gauge face shall be 100 mm in diameter and calibrated in metres head of water. The gauge shall accurately indicate the pump operating head and the pump no-flow head.

Each gauge shall be supplied with the nominally sized metric equivalent of three of the following bronze fittings: gate valve, union, nipple and reducing nipple.

Gauges and fittings shall be screwed into the pipe wall of ductile iron pipes, or pipe fittings, 150 mm and larger. In pipework less than 150 mm, gauges and fittings shall be screwed into a tapping band. On rising mains, where shown on the design drawings, the Contractor shall install a ball valve to allow removal of the gauge.

The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps.

(8) Valves

The Contractor shall ensure that the valves supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve. The concrete lining in pipework shall not be chipped away or reduced to provide clearance from the working parts of valves.

The Contractor shall ensure that valves are installed so as to facilitate maintenance. The Contractor shall take into account the manufacturer's recommendations, the requirements shown on the design drawings, the type of connection, and lubrication of connecting bolts.

Flanges shall comply with AS 2129 to the class shown on the design drawings.

Unless shown otherwise on the design drawings, all valves shall be anti-clockwise

closing.

The Contractor shall size "Tee" Key valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel.

Hand wheels shall display an embossed or engraved arrow, together with "open" and/or "close" corresponding to the valve operation.

One "Tee" key operator per pump station, of suitable length for operating the respective valve from the surface level, shall be provided for each size of valve installed in each pump station.

Non-return valves shall be of the swing check type to AS 3578 of cast iron or steel body, cover and disc with bronze body and disc seat rings. The leaf shall swing clear and provide an unobstructed waterway.

The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve.

Each non-return valve shall have an extended spindle, minimum grade 316 stainless steel, fitted with an adjustable counterweight.

The knife gate valve shall be constructed in accordance with the following:

(a) the design shall include an enclosed bonnet;

(b) the spindle shall be of the non-rising type;

(c) valves shall be anti-clockwise closing;

(d) the gland around the spindle shall be adjustable or formed by a double O- ring;

(e) flange jointing shall be rubber O-rings; and

(f) seating shall be achieved by flexible seats which shall be designed in a manner that will allow easy replacement. The material of the seat is to be nominated.

All assembly bolts and nuts shall be fitted with fibre or nylon isolating washers to prevent bimetallic corrosion where required.

Each valve spindle shall be fitted with a cast steel or forged steel spindle guard secured to the valve spindle with a gun metal set screw or a handwheel secured to the spindle with gun metal set screw and washer.

Valves shall be drilled and threaded, where required, in accordance with AS 2129.

(9) Testing and commissioning of pump station

The Contractor shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the sub-section requirements. The submission to the Superintendent of satisfactory test results constitutes a hold point. The approval of the Superintendent is required prior to the release of the hold point.

Tests and inspections shall comply with relevant Australian Standards.

Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.

Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation.

The Contractor shall conduct pre-commissioning in a logical sequence in accordance with the programme prepared by the Contractor and approved by the Superintendent.

The Contractor shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

Specific requirements for pre-commissioning shall include, but are not limited to:

(a) initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for “running in”;

(b) physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc., depending on the type of equipment;

(c) electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary;

(d) tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms; and

(e) equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to the Superintendent prior to commissioning.

The Contractor shall carry out pre-commissioning tests to the satisfaction of the Superintendent and shall record the results of the tests on the appropriate Pre- commissioning Record Sheet.

Refer to TCC24 clause 28.1.11 for electrical test documentation requirements.

The Contractor shall furnish the Superintendent with one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Superintendent's Representative who witnessed the test.

Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions.

The Contractor shall give the Superintendent 5 working days notice of the Contractor’s intention to undertake commissioning and supply to the Superintendent the copies of each of the pre-commissioning record sheets and three copies of the operational and maintenance manuals at the time that notice of commissioning is given.

The Contractor shall conduct commissioning in a logical sequence in accordance with a programme prepared by the Contractor and approved by the Superintendent.

Throughout commissioning the Contractor shall be responsible for the test programme.

The Contractor shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests.

The Contractor shall prepare, schedules, test record sheets and programmes for approval by the Superintendent prior to each stage of the overall commissioning.

The Contractor shall carry out final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc) including setting and adjustment of equipment in accordance with SC6.4.3.21 Townsville water and planning design guidelines.

The Contractor shall arrange for all testing, commissioning and any adjustments.

(10) Practical completion of pump station

The Contractor shall ~~fulfil~~fulfill the following requirements before the Certificate of Practical Completion can be issued which constitutes a hold point:

(a) receipt by the Superintendent of a certificate of approval from the relevant statutory authorities;

(b) pump station is in working order as demonstrated by the testing and commissioning;

(c) approval by the Superintendent of operating and maintenance manuals; and

(d) receipt by the Superintendent of as-built drawings of the pump station.

(11) Telemetry

The Contractor shall make provision for equipment to link the pump station to the existing telemetry network to be provided by Townsville Water and Waste at the Contractor's expense. Refer to TCC24 clause 17.1, 28.2, Appendix B2 and Appendix C.

The pump station shall be capable of being operated automatically by control signals from the existing or proposed telemetry system. In addition, either one or any combination of pumps may operate at any one time by control signals from the telemetry system..

(12) Operation and maintenance manuals

(a) Manuals shall contain the following information:

(i) contractor’s name, address and telephone number;

(ii) client’s contract number, job name; and

(iii) pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and electrical installation.

(b) Manuals for pumps shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing of pump and motor;

(v) sectional arrangement drawing with parts and list; and

(vi) dimensioned sectional arrangements detailing:

(A) maximum and minimum shaft/bearing clearance (radial);

(B) maximum and minimum impeller/bowl clearance (radial);

(C) maximum and minimum impeller/bowl clearance (axial);

(D) impeller/bowl wear rings;

(E) motor/pump coupling – type, make and model number; and

(F) mechanical seals where applicable.

(c) Manual for motors shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing;

(v) sectional arrangement drawing for submersible motor power cabling where applicable;

(vi) gland sealing arrangement drawing for submersible motor power cabling where applicable;

(vii) cables where applicable; and

(viii) terminal block arrangement drawing where applicable.

(d) Manuals for electrical equipment shall comply with TCC24 clause 23 and requirements for electrical drawings are described in TCC24 clause 22.

(e) Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves.

(f) Manuals shall contain the following test curves:

(i) pump witnessed test curves;

(ii) motor test curves; and

(iii) motor torque/speed/efficiency characteristic curves.

(g) The operating and maintenance manual shall include:

(i) safe working procedures - for switching and isolating the supply and distribution system;

(ii) comprehensive description of operation, including flow charts detailing each operational activity (e.g. manual pump operation, routine test procedures);

(iii) maintenance procedures - recommended maintenance periods and procedures;

(iv) tools - particulars of maintenance equipment and tools provided, with instructions for their use;

(v) equipment - a technical description of the equipment supplied, with diagrams and illustrations where appropriate;

(vi) dismantling - where necessary, procedures for dismantling and reassembling equipment; and

(vii) spare parts - a list of the spare parts provided.

Trouble shooting instructions shall be included for pumps, motors, valves and SCA.

Step by step procedures for dismantling and reassembly of pumps, motors and valves using any special tools shall be detailed together with step by step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc.

SC6.4.6.3.6 Construction compliance

(1) ~~Work as executed~~As-constructed details and operation and maintenance manuals

The Contractor shall submit ~~to the Superintendent work as executed design~~as-constructed drawings showing the actual location and alignment of pipelines, maintenance holes and junctions, all pump station details together with operating and maintenance manuals in accordance with SC6.4.7. Refer to SC6.4.3.21.3(5)(n) for the pump station documentation requirements.

Details shall include the size, type, levels, grade of pipelines, maintenance hole, and maintenance shaft location, types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details. The Contractor shall record on ~~work as executed design~~as-constructed drawings the area of side fill which should not be disturbed in future without special precautionary measures where side fill construction is part of the structural integrity of a constructed pipeline of a diameter more than 225 mm.

The Contractor shall ensure that a registered surveyor certifies the plans showing location and alignment.

The Contractor shall provide records, for Townsville Water and Waste's Asset Register, to the Superintendent at the time of practical completion of the Contract. The records are to be in a form consistent for inputting into the Asset Register as directed by the Superintendent.

(2)

Video records

Unless advised otherwise by the Superintendent, the Contractor shall provide a video recording of the internal condition of all mains. The video recording shall be undertaken at the time of practical completion of the Contract.

SC6.4.6.4 Stormwater drainage

SC6.4.6.4.1 Introduction

(1) Introduction

Drainage works shall form a complete system carrying water through and away from the Works.

This is the general sub-section common and applicable to all types of drainage lines, open drains, kerb and channel, and drainage structures and shall be read in conjunction with drainage specifications:

(a) SC6.4.6.6 Pipe drainage;

(b) SC6.4.6.7 Precast box culverts;

(c) SC6.4.6.5 Drainage structures; and

(d) SC6.4.6.9 Open drains.

(2) General scope

The work to be executed under this sub-section consists of:

(a) preparation for stormwater drainage construction;

(b) temporary drainage during construction;

(c) siting of pipes, pipe arches and box culverts;

(d) all activities and quality requirements associated with excavation and backfilling; and

(e) all concrete work associated with stormwater drainage.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(3) Extent of work

Details of the work are shown on the drawings. The extent of works under this specification is summarised as follows:

(a) pipe culvert stormwater drainage;

(b) precast box culvert stormwater drainage;

(c) drainage pits, headwalls, wingwalls and aprons;

(d) kerb and channel;

(e) open concrete dish drains;

(f) scour protection of open drains at outlets to drainage structures; and

(g) demolition and removal of existing redundant pipe culverts, headwalls and pits.

(4) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.28 Minor concrete works

(b) Australian Standards
AS 1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.7.1 - *Compaction control test Hilf density ratio and Hilf moisture variation (rapid method)*

(c)
AS 1597 Precast reinforced concrete box culverts
AS/NZS2566.2 Buried flexible pipelines installation
AS/NZS3725 Design for installation of buried concrete pipes

Other

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

SC6.4.6.4.2 Construction

(1) Temporary drainage during construction

(a) For each part of the drainage system, complete the erosion and sedimentation control measures before commencing the drainage works (except those parts of the drainage system forming part of the control measures). Measures for erosion and sedimentation control must be provided in accordance with the requirements of the accepted project erosion and sediment control plan and/or *Best Practice Erosion and Sediment Control* and make adequate provision for runoff flows at drainage works under construction or at surrounding areas/structure.

(b) The Contractor shall make adequate provision for runoff flows at 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 as a result of the Contractor's activities.

(c) The Contractor shall not implement any proposals to dam up or divert existing watercourses (either temporarily or permanently) without the prior approval of council by way of approved drawings or written instruction.

(d) The Contractor's material and equipment shall be located clear of all watercourses.

(2) Siting of culverts

(a) Before commencing construction of any culvert, the Contractor shall set out on site the culvert inlet and outlet positions to the location and levels shown on the drawings, and shall present this set-out for inspection by the Superintendent.

(b) The Superintendent may amend the inlet or outlet locations or designed levels or the culvert length to suit actual site conditions. Any such amendments must ensure no negative impacts on neighbouring land parcels and existing properties. Prior approval must be sought from council.

(c) Should the Contractor propose changes to the culvert location, length, designed levels, culvert strength, conditions of installation or cover to suit the construction procedures, the Contractor shall present the proposed culvert set-out in addition to the designed set-out for consideration by the Superintendent and council. No changes shall be made unless prior written approval from council is obtained.

(3) Excavation

(a) Before undertaking stormwater drainage excavation, topsoil shall be removed in accordance with SC6.4.6.10 Earthworks (construction).

(b) In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

(c) Where public utilities exist in the vicinity of stormwater drainage works the Contractor shall obtain the approval of the relevant authority/corporation to the method of excavation before commencing excavation.

(d) Excavation by blasting, if permitted by council, shall be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed culvert or drainage structure does not exceed 25mm per second. The Contractor shall comply with other requirements concerning blasting operations in SC6.4.6.10 Earthworks (construction).

(e) Trench or foundation excavation for stormwater drainage works shall be undertaken to the planned level for the bottom of the specified bedding or foundation level. All loose material shall be removed by the Contractor.

(f) Any material at the bottom of the trench or at foundation level which the Superintendent deems to be unsuitable and inadequate to support the proposed drainage structure shall be removed and disposed in accordance with SC6.4.6.10 Earthworks (construction) by the Contractor and replaced with backfill material in accordance with the requirements of this sub-section and the sub-sections for particular culvert types. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, shall be parallel with the specified level and slope of the culvert.

(g) The excavated material shall be used in the construction of embankments backfilling or spoiled in accordance with SC6.4.6.10 Earthworks (construction).

(4) Backfilling

Backfilling shall be carried out in accordance with the requirements of the relevant culverts or drainage structures sub-sections and to the compaction requirements specified in SC6.4.6.4.2(5) Compaction.

In situ concrete structures are not to be backfilled in accordance with Clause 6.4.6.5.2 8(a) unless otherwise directed by the Superintendent.

The shape of the culvert must be checked by the Contractor during backfilling to ensure that on completion of backfilling, the vertical and horizontal centreline dimensions of the pipe or structure do not vary from the manufacturer's specified dimensions by more than ± 2% for pipes and pipe arches.

(5) Compaction

Foundations, bedding (other than for pipe drainage) and backfilling shall be compacted to the following requirements when tested in accordance with AS 1289.5.4.1 or AS 1289.5.7.1 for standard compactive effort.

Refer to Table SC6.4.6.4.3 for details of compaction and moisture tolerances.

Compaction requirements adjacent to pipe drainage for concrete, steel or UPVC pipes are set out in sub-section SC6.4.6.6 Pipe drainage.

(6) Concrete work

For all concrete work, the Contractor shall comply with sub-section SC6.4.6.28 Minor concrete works in relation to the supply and placement of normal class concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection.

(7) Sprayed concrete

If sprayed concrete has been specified, shown on the drawings or directed by the Superintendent, it shall comply with requirements in sub-section SC6.4.6.28 Minor concrete works.

(8) Construction traffic

If proposing to move heavy construction plant or vehicles over pipe or box culverts structures, provide verification and certification of protective measures to the Superintendent for confirmation and approval of protection measure proposed.

SC6.4.6.4.3 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.4.3below:

Table SC6.4.6.4.3 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Excavation by Blasting**		
	peak particle velocity	≤25mm/sec	SC6.4.6.4.2(3)
2.	**Relative Compaction (Standard)**		
	(a) Foundations or trench base to a depth of 150mm below foundation levels	95%	SC6.4.6.4.2(5)
	(b) Material replacing unsuitable material		
	(c) Bedding material		
	(d) Selected backfill and ordinary backfill material:		
	• other than sub-grade (sand 70% Density Index)		
	• other than sub-grade (other than sand)		
	• at sub-grade level to 300mm below		
	• in a pavement zone		
	(e) Backfill material within the selected material zone		
3.	**Backfill**		
	(a) Layers	≤ 150mm	SC6.4.6.4.2(5)
	(b) Moisture Content	>60%, <95%	SC6.4.6.4.2(5)

SC6.4.6.6 Pipe drainage

SC6.4.6.6.1 Introduction

(1) Scope

(a) This sub-section covers the supply and installation of pipe culverts and pipe arches for stormwater drainage.

(b) This sub-section should be read and applied in conjunction with sub-section SC6.4.6.4 Stormwater drainage.

(c) The work to be executed under this sub-section consists of supply of pipes and pipe arches, bedding, installation and backfilling.

(d) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.4 Stormwater drainage
SC6.4.6.5 Drainage structures
SC6.4.6.21 Subsurface drainage
SC6.4.6.28 Minor concrete works

(b) Australian Standards
AS 1141.11 - *Particle size distribution –sieving method.*
AS 5101.4 - *Unconfined compressive strength of compacted materials.*
AS/NZS 1254 – *PVC-U pipes and fittings for stormwater or surface water applications.*
AS 1289.3.3.1 - *Calculation of the plasticity index of a soil.*
AS 1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.4.3.1 - *Determination of the pH value of a soil - Electrometric method.*
AS 1289.4.4.1 - *Determination of the electrical resistivity of a soil – Method for sands and granular materials.*
AS 1289.5.6.1 - *Compaction control test - Density index method for a cohesionless material.*
AS 1397 – *Continuous hot-dip metallic coated steel sheet and strip – coatings of zinc and zinc alloyed with aluminium and magnesium.*
AS 1646 - *Elastomeric seals for waterworks purposes.*
AS 1762 - *Helical lock-seam corrugated steel pipes - Design and installation.*
AS/NZS 2032 - *Installation of PVC pipe systems.*
AS/NZS 2041 - *Buried corrugated metal structures.*
AS/NZS 2566.1 - *Buried flexible pipelines - structural design*
AS/NZS 2566.2 – *Buried flexible pipelines - Installation*
AS/NZS 2666.1 - *Buried flexible pipes*
AS/NZS 3725 – *Design for installation of buried concrete pipes*
AS/NZS 3750.9 – *Paints for steel structures - Organic zinc-rich primer.*
AS/NZS 3750.15 - *Paints for steel structures - Inorganic zinc silicate paint.*
AS 4058 - *Precast concrete pipes (pressure and non-pressure).*
AS/NZS 4131 - *Polyethylene (PE) compounds for pressure pipes and fittings*.
AS 4139 - *Fibre reinforced concrete pipes and fittings.*
AS/NZS 4680 - *Hot-dip galvanised (zinc) coatings on fabricated ferrous articles.*
AS/NZS 5065 - *Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.*
AS/NZS ISO 9001:2008 *(as amended) - Quality management systems - Requirements*.

(c) Department of Transport and Main Roads Technical Standards

MRTS 25 - Manufacture of pre-cast concrete pipes ~~(06/09)~~
MRTS 26 - Manufacture of fibre reinforced concrete drainage pipes ~~(10/12)~~

(d) Other
AASHTO Standard, *M190 - Bituminous coated corrugated metal culvert pipe and pipe arches.*
ASTM F2562/F2562M-08 - *Specification for steel reinforced thermoplastic ribbed pipe and fittings for non-pressurised drainage and sewerage*
Safety in Design CWPHESS

SC6.4.6.6.2 Common requirements

(1) General

(a) Pipes and/or pipe arches shall not be placed in position until the Contractor has produced documentary evidence to the Superintendent, that the manufacture of the products to be used in the works has complied with the Manufacturer's Quality Plan in accordance with ISO 9001.

(b) Documentation shall comprise a conformance certificate to AS 4058 or AS 4139 as appropriate for each batch of pipes or pipe arches to be included in the works, including manufacturer's installation recommendations. The above documentations certificates are to be supplied at least 24 hours in advance of dispatch to site.

Note—Table 3.6 of AS 4058 shall be replaced by Table ~~4 C~~7A of *MRTS 25 - Manufacture of Precast Concrete Pipes* in determining the acceptability of pipe wall and joint surface defects.

(c) Each unit shall be marked at time of manufacture with:

(i) class and size;

(ii) manufacturer's name; and

(iii) date of casting.

(d) Where a Contractor wishes to use drainage pipe other than the pipes described in SC6.4.6.6.3(1) to (5) inclusive, the Contractor shall submit, for agreement by the Superintendent, full details in accordance with AS/NZS 2566.1 of the characteristics of the pipe materials and embedment and design loads, together with certification from the manufacturer of its suitability and quality for use in each particular application. Certification of the suitability of any pipe will address the bedding requirements, deflection, strength, buckling and any other considerations appropriate to the particular application. Upon agreement, the Superintendent must submit an application for a variation to the development consent for approval by council.

(e) The Contractor shall take all necessary steps to drain the excavation to allow the foundation, the bedding and any backfilling to be compacted to the specified relative compaction.

(f) Culverts shall be installed within 10mm of the grade line and within 50mm of the horizontal alignment specified on the drawings. The Contractor shall relay any culvert which is not within these tolerances. Where longitudinal gradients are less than 0.5 per cent, culverts shall be installed within +/- 6mm of the grade line'.

(g) Where shown on the drawings at the discharge end of culverts terminating at pits and headwalls a 3m length of 100mm diameter subsurface drain shall be laid in the trench 100mm above the invert level of the culvert and discharging through the wall of the pit or headwall at 100mm above the invert level of the culvert or headwall. The subsurface drainage pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric in accordance with SC6.4.6.21 Subsurface drainage.

(h) Excavation and backfilling for pipe drainage shall be undertaken in a safe manner and in accordance with all statutory requirements. The Contractor must present to the Superintendent the installed pipe drainage upon completion of backfill to the top side of the side zone for inspection prior completion of backfill.

(i) Where the Contractor proposes to travel construction plant in excess of 5 tonnes gross mass over pipe drainage structures, the Contractor shall design and provide adequate protective measures for the crossings and shall submit the proposals to the Superintendent for prior approval.

(j) Upon completion of installation of pipe drainage, the Contractor shall submit relevant test results to demonstrate compliance to the requirements indicated on clauses

SC6.4.6.6.3 Precast reinforced concrete ~~and fibre reinforced concrete pipes~~

(1) Pipes

(a) Precast reinforced concrete pipes shall comply with AS 4058 and shall be of the class and size as shown on the drawings.

Note—Table 3.6 of AS 4058 shall be replaced by Table ~~4 C~~7A of *MRTS25 - Manufacture of Precast Concrete Pipes* in determining the acceptability of pipe wall and joint surface defects.

(b) Fibre reinforced concrete drainage pipes shall comply with AS 4139 and shall be of the class and size as shown on the drawings.

(c) Unless specified otherwise, joints shall be flush type with external elastomeric bands complying with AS 1646 and as recommended by the manufacturer.

(d) Where precast pipes are to be installed into a marine or saline environment, the contractor is to ensure and provide documentation that the supplied pipes are “fit for purpose” and are suitable for the intended site application.

(2) Excavation

(a) Unless otherwise indicated on the drawings, or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

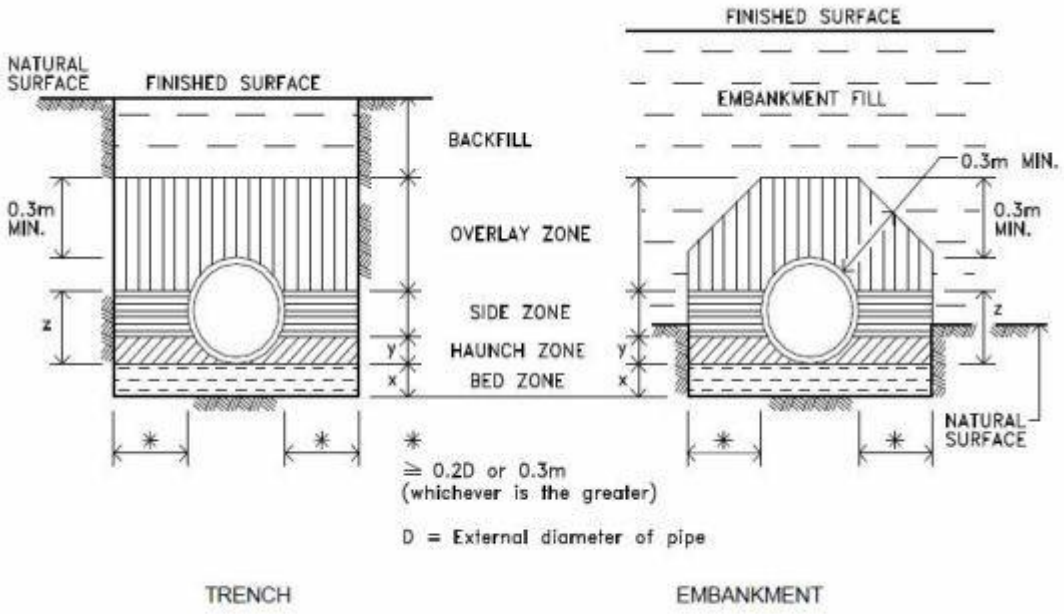
(b) For normal trench conditions, the pipe shall be laid in an excavated trench with bedding as specified in SC6.4.6.6.2(3). The trench shall be excavated to a width as specified in Figure SC6.4.6.6.1.

(c) Care is necessary to avoid laying pipe drainage in trenches excavated to excessive width. Pipes laid in wide trench conditions will be deemed to be in embankment conditions (positive projection). Wide trench conditions apply when, for a single pipe, the width of trench, $W \geq D + 0.6$ metre where D is the pipe diameter. For multi-cell pipes wide trench conditions apply when the width of trench, $W \geq \sum D + \sum S + 1.6$ metre where S is the square spacing between the pipelines. This definition of wide trench conditions as equivalent to embankment conditions relates to the size and geometry of the excavation utilised at construction. Pipes shown on the drawings to require trench conditions shall not be placed under embankment conditions without a design check for compliance of the pipe strength and trench support requirements in accordance with AS 3725.

(3) Bedding

(a) Bedding shall be in accordance with this sub-section, AS 3725 and AS 3725 Supplement 1 for the pipe support types as shown on the drawings. Where the pipe support type is not shown on the drawings, the support type shall be HS3 within road reserves (HS3 is recommended for high embankment fill) and H2 elsewhere.

(b) Figure SC6.4.6.6.1 below and Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) in AS/NZS 3725 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions for all AS 3725 pipe support types.



		Pipe Support Type						
		U	H1	H2	H3	HS1	HS2	HS3
Dimension (minimum)	x	75 on rock Nil on soil	100 for D ≤ 1500 150 for D > 1500		0.25 D but >100	100 for D ≤ 1500 150 for D > 1500		
	y	—	0.1D	0.3D	0.3D	0.1D	0.3D	0.3D
	z	—	—	—	—	≥ 0.7D		

D = External diameter of pipe

Figure SC6.4.6.6.1 Pipe installation conditions

(c) Bedding material for the bed and haunch zones shall consist of a granular material having a grading, determined by AS 1141.11, complying with Table SC6.4.6.6.1 Bedding Material Grading Limits, and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6. Select fill material in the side zones, for pipe support type HS, shall also comply with Table SC6.4.6.6.1.

Table SC6.4.6.6.1 Bedding material grading limits

Sieve size mm	Weight passing %	
	Bed and Haunch Zones	Side Zones/Overlay Zones
75.0	-	100
19.0	100	-
9.5	-	50 - 100
2.36	50 -100	30 - 100
0.60	20 - 90	15 - 50
0.30	10 - 60	-
0.15	0 - 25	-
0.075	0 - 10	0 - 25

(d) The Contractor shall advise the Superintendent of the source of bedding material.

(e) All material shall be compacted in layers not exceeding 150mm compacted thickness except where explicitly approved by the Superintendent, for the first placed layer above the pipe crown in the overlay zone, in order to protect the pipe from construction damage. Each layer shall be compacted to the relative compaction specified before the next layer is commenced. Cohesionless materials can be

compacted in one operation by saturation and vibration to achieve the minimum Density Index (DI) specified.

(f) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(g) Compaction of select fill material in the bed and haunch zones shall be to the appropriate pipe support requirements shown in Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) in AS/NZS 3725, when tested in accordance with AS 1289.5.6.1. H3 Pipe Support includes concrete bedding. Concrete shall be grade N20 to AS 3600. Pipe shall be suitably reinforced in accordance with AS 3725 as standard elliptically reinforced pipe may not be adequate for H3 Pipe Support. Unless specifically selected pipes are nominated for use with H3 bedding, a design check shall be required to confirm the suitability of the proposed pipes.

(h) The top 0.1Dmm of the bedding and haunch material directly under the pipe shall be placed and shaped accurately to house the pipe after compaction is achieved in the bedding and haunch zone external to the area of direct pipe support.

(i) Where the impermeability of the natural ground and the slope of the drainage line is such that erosion of bedding material is considered by the Superintendent to be a likely problem, the Superintendent may specify cementitious stabilisation of the bedding material used in the bedding and haunch zones.

(4) Installation

(a) General

Pipes shall be laid with the socket (female) end placed upstream. Pipes which have marks indicating the crown or invert of the pipes shall be laid strictly in accordance with the markings. Unless specified, no individual length of pipe shall be shorter than 1.2m.

The contractor is to ensure that all trenching is to conform to the requirements of Workplace Health and Safety (WHS) Act and regulations and Excavation Work Code of Practice 2013. ~~*Work Cover Queensland – Handbook Building and Construction Industry WHS Guide*.The contractor must ensure that if a person is entering a trench more than 1.5m deep, one of the following control measures is to be implemented:~~

~~(i) Has shoring or shielding in place;~~

~~(ii) The trench is benched not higher than 1.5m;~~

~~(iii) The trench is battered - angle not exceeding 45º and the bottom vertical face is not to exceed 1.5m high;~~

~~Is approved as a safe work place (in writing) by a suitably qualified geotechnical engineer.~~

~~(iv)~~

Pipes can be stiffened temporarily by the use of timber structs, erected before filling is placed. Struts shall be of hardwood measuring at least 100mm by 100mm or 125mm diameter. One strut shall be placed in a vertical position at each pipe joint, thence at a spacing not greater than 1,200mm. Struts shall bear against a sill laid along the invert of the pipe and a cap bearing against the crown of the pipe. Both the sill and the cap shall be continuous throughout the length of the pipe. Struts shall be made to bear tightly against the pipe by the use of wedges between the top of the struts and the cap. Struts, sills and caps shall be removed on completion of the embankment, unless removal is ordered earlier.

Lifting holes in all pipes shall be sealed with plastic preformed plugs approved by the Superintendent, or a 3:1 sand:cement mortar, before the commencement of backfilling.
Bulkheads shall be constructed in accordance with SC6.4.6.5 Drainage structures on all lines where the pipe gradient exceeds 5 per cent.

The Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to commencement of trench backfilling.

(b) Joints in reinforced concrete pipes

(i) Rubber Ringed Joints

Before making the joint, the spigot and socket and the rubber ring shall be clean and dry.

The rubber ring shall be stretched on to the spigot end of the pipe, square with the axis and as near as possible to the end, care being taken that it is not twisted. The spigot end of the pipe shall then be pushed up to contact the socket of the pipe with which it is to join, and be concentric with it. The spigot end shall then be entered into the socket of the already laid pipe and forced home by means of a bar, lever and chain, or other method approved by the Superintendent.

The joint shall be tested to ensure that the rubber ring has rolled evenly into place.
Where wedge shaped “skid” rubber rings are prescribed the Manufacturer’s instructions, which include the use of lubricants, shall be followed.

(ii) Flush or butt jointsThe ends of the pipes shall be butted together so as to be as tight and as even as possible.

The joints shall be sealed externally with proprietary E.B bands, supplied and installed in accordance with the manufacturer's recommendations, care being taken that the bands are not twisted.

(c) Joints in fibre-reinforced cement pipes

(i) New Pipes
Joints shall be of a flexible type. Rubber rings shall be used to seal joints in both rebated and spigot and socket jointed pipes in the manner specified in SC6.4.6.6.3(4) Installation.
Alternatively, a jointing compound comprising plasticised butyl rubber and inert fillers may be used to seal such pipes in accordance with the manufacturer's instructions.

(ii) Direct Side Connections to Other Pipes
Direct side connections to other pipes shall be as detailed on the drawings.

(5) Backfill

(a) Select fill material to the side zones shall be compacted to the requirements shown in Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725 when tested in accordance with AS 1289.5.4.1 for standard compactive effort.

(b) Ordinary fill to the side zones and overlay zones, for all pipe support types, except type HS shall consist of Selected Backfill as defined in SC6.4.6.10 Earthworks (construction) or alternatively cohesionless material in accordance with Table 6.4.6.6.1 Bedding material grading limits. It shall be placed around the pipe to the dimensions shown in Figure SC6.4.6.6.1 Pipe installation conditions.

(c) All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced, or compacted in one operation by saturation and vibration to achieve a minimum Density Index as specified in Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725.

(d) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(e) The remainder of the trench to the underside of the subgrade, or selected material zone as specified in SC6.4.6.10 Earthworks (construction), shall be backfilled with material satisfying the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction). Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in SC6.4.6.10 Earthworks (construction).

(f) When compacted adjacent to culverts or drainage structures, the Contractor shall adopt compaction methods which will not cause damage or misalignment to any culvert or drainage structure. Any damage

caused shall be rectified by the Contractor. Backfilling and compaction shall commence at the pipe or wall so as to confine remaining uncompacted material at commencement.

SC6.4.6.6.4 Steel pipes and pipe arches

(1) Nestable steel pipe and drainage units

(a) Nestable steel pipes and drainage units shall be supplied in accordance with AS 2041 and shall be of the class and size as shown on the drawings

(b) The galvanised steel sheets used in manufacture shall comply with AS 1397 for steel base grade G250 and a minimum coating Class of Z600.

(c) Where specified, the pipes and drainage units shall be given a protective coating over the steel, after assembly of a coal tar epoxy paint or equivalent as approved by the Superintendent, to a thickness of 400 microns.

(d) Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of zinc-rich organic primer complying with AS/NZS 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZS 3750.15.

(2) Helical lock-seam corrugated steel pipe

(a) Helical lock-seam corrugated steel pipe shall be supplied in accordance with AS 1761 and AS 1762 and shall be of the class and size as shown on the drawings.

(b) The galvanised steel sheet used in manufacture shall comply with AS 1397 for steel based grade G250 and a minimum coating Class of Z600.

(c) Unless otherwise approved by the Superintendent, no part of the pipe shall incorporate steel strips which have been joined by welding. Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of organic zinc-rich primer complying with AS/NZS 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZS 3750.15. Pipes and coupling bands shall be given a protective hot-dip coating of bitumen on both sides to AASHTO standard M190 or equivalent as part of the process of manufacturing.

(3) Bolted steel pipes, pipe arches and special shapes

(a) Bolted steel pipes, pipe arches and special shapes shall be supplied in accordance with AS 2041 and shall be of the class and size as shown on the drawings. The corrugated pipe or plate shall be hot-dip galvanised on both sides after fabrication in accordance with the requirements for coating thickness and mass for articles in AS/NZS 4680.

(b) Also, after assembly, all bolted steel pipes, pipe arches and special shapes shall be given a protective coating on the outside of the steel plate, of a coal tar epoxy paint complying with AS 3887 or equivalent paint approved by the Superintendent. Invert plates shall be coated on the outside before they are placed on the pipe bed. The plate surface shall be cleaned and degreased with a cleaning solution recommended by the protective coating manufacturer. The protective coating shall be applied to give a uniform minimum dry thickness of 400 microns. Any coating damaged shall be recoated by first cleaning any grease, mud or other foreign matter from the affected area. The area shall then be recoated so that the minimum dry thickness of the coating is 400 microns.

(4) Materials and surface treatment of steel pipes and pipe arches

All steel pipes and pipe arches will require an Engineer's certification that the pipe materials and surface treatments are adequate to provide for installation and in-service loading, as well as corrosion protection for a satisfactory design life of 100 years, unless indicated otherwise on the drawings. Such certification shall address the chemistry of the soil, groundwater, stream and backfill material as specified SC6.4.6.6.4(5).

(5) Materials against steel structures

(a) The severity of corrosive attack on steel structures will depend on the pH value and electrical resistivity of the soil surrounding the structure and the pH value of the water in the stream.

(b) Besides meeting the normal requirements of the bedding, selected backfill materials and the materials used for embankment construction above the steel structures and within a horizontal distance from the structure equal to the height of the filling over the structure, the pH and resistivity limits as shown in Figure SC6.4.6.6.2 will determine the level of corrosion protection required.

(c) Notwithstanding the height of fill, embankment material within 6m of the structure shall conform to these requirements.

(d) The pH and electrical resistivity of the material shall be determined in accordance with AS 1289.4.3.1 and AS 1289.4.4.1.

(e) The Contractor shall nominate the sources of the various materials and submit documentary evidence from a NATA registered laboratory that the representative samples conform to the requirements of this clause and the protective treatment provided. The samples shall be pre-treated if necessary so as to represent the condition and grading when compacted and in service.

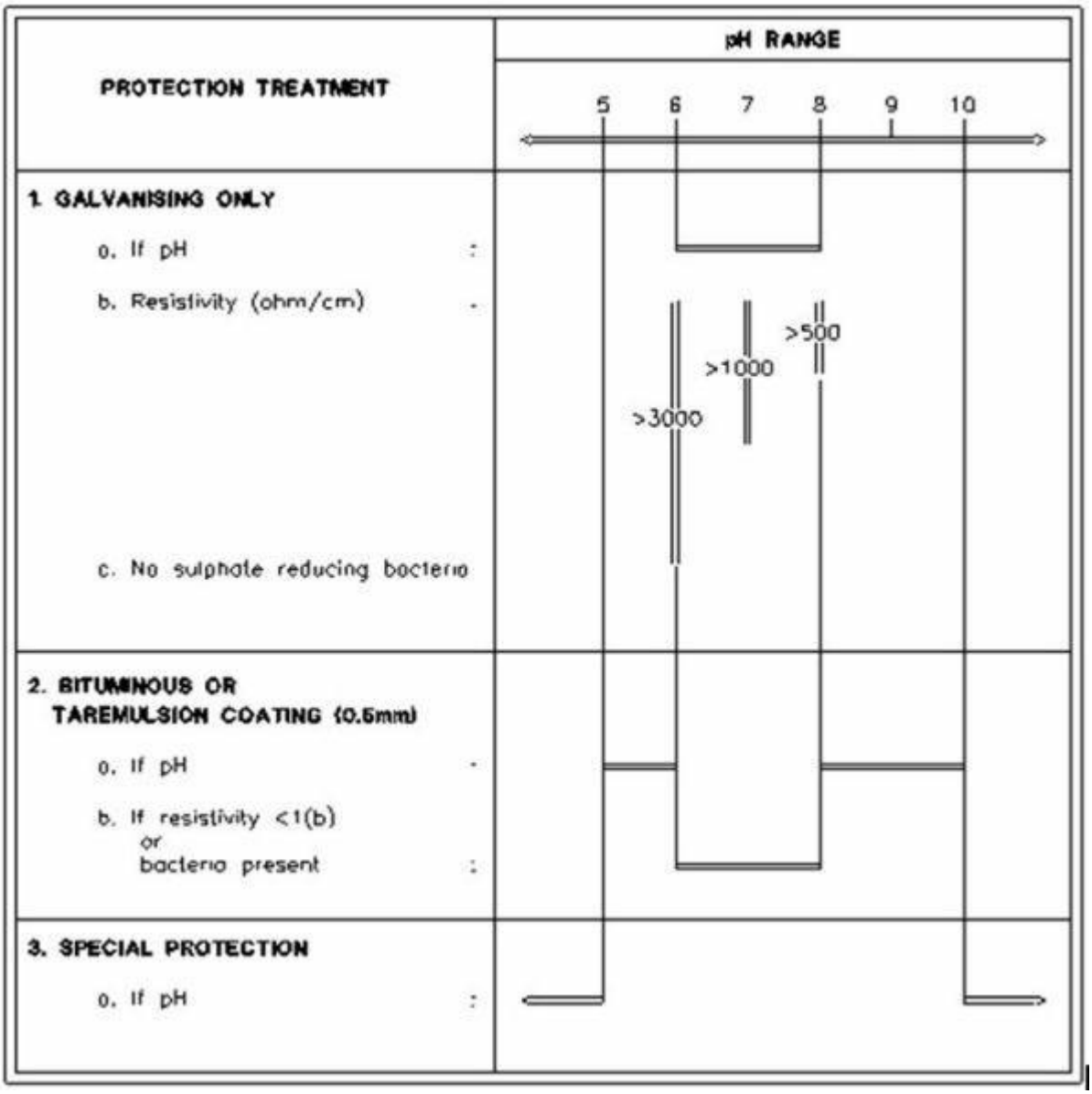


Figure SC6.4.6.6.2 Corrosion protection requirements for steel structures

(6) Excavation and foundation preparation

(a) Unless otherwise indicated on the drawings or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

(b) The trench shall be excavated to a level 75mm below the design invert and for a minimum width of 600mm on each side of the structure.

(c) Where unsuitable material, as determined by the Superintendent, is encountered at the foundation level,

it shall be removed to a depth approved by the Superintendent. The additional excavation shall be backfilled with material complying with, selected material as per SC6.4.6.10 Earthworks (construction).

(d) Where rock is encountered at the foundation level, the foundation shall be excavated for an additional depth of 250mm, or 0.25 times the structure width, whichever is the lesser and for a width equal to the width of the structure. The additional excavation shall be backfilled with material complying with, and compacted to, the requirements for HS3 pipe support as specified in SC6.4.6.6.3 3(b).

(7) Bedding

Bedding shall meet the requirements of SC6.4.6.6.3(3)(f). The thickness of uncompacted bedding material between the foundation and the outer surface of corrugation shall not be less than 75mm. The uniform blanket of loose material which provides the minimum 75mm thick bedding, shall be placed on the shaped, compacted selected material foundation to allow the corrugations of the structure invert to bed in and become filled with the material.

(8) Installation

(a) General

The assembly of all corrugated steel pipes and pipe arches as well as helical lock-seam corrugated steel pipes shall be carried out in accordance with the manufacturer's recommendations. These recommendations shall be submitted to the Superintendent before assembly or laying of the culverts is commenced.

If deemed necessary after consultation with the manufacturer, temporary bracing of corrugated steel pipes or pipe arches shall be carried out in accordance with the manufacturer's recommendations.

(b) Joints

Corrugated steel pipes or pipe arches shall be joined in accordance with the manufacturer's recommendations and AS 2041.

Where helical-lock seam corrugated steel pipes are to be joined, both ends of the join shall be rerolled with four annular corrugations of pitch 68mm. Coupling of the re-rolled ends shall be made in accordance with AS 1761 by using semi-corrugated bands. Rubber ring joint seals shall be used in conjunction with the coupling bands except where specifically indicated otherwise in the drawings.

All joints or lap joints in pipes or pipe arches (excluding rubber ring joint coupling bands) shall be covered with strips of non-woven geotextile material, of minimum 250mm width and of minimum mass 270 grams per square metre in accordance with the requirements for geotextile in SC6.4.6.20 Subsoil, foundation and pavement drains, to prevent loss of sand backfill or bedding into the pipe.

(9) Backfill

(a) Compaction of the material in the side support and overlay zones shall comply with the requirements of clause SC6.4.6.6.3(~~7~~5) except that the required relative compaction in the side support and overlay zones shall be 95 per cent (AS 1289.5.4.1 standard compaction). Backfill shall be placed around the steel pipe or structure, to a minimum dimension equal to the pipe width, on both sides.

(b) All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

(c) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(d) The remainder of the trench to the underside of the subgrade, or selected material zone as specified in SC6.4.6.10 Earthworks (construction), shall be backfilled with material satisfying the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction). Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in SC6.4.6.10 Earthworks (construction).

(e) The Contractor shall check the shape of the culvert during backfilling to ensure that on completion of backfilling, the vertical and horizontal centreline dimensions of the pipe or structure shall not vary from the manufacturer's specified dimensions by more than plus or minus 2 per cent for pipes and pipe arches.

(10) Invert protection of corrugated steel pipes and pipe arches

(a) Where shown on the drawings, the invert of corrugated steel pipes and pipe arches shall be protected using sprayed concrete.

(b) The sprayed concrete shall be placed to a thickness of not less than 100mm over the crest of the corrugations and to a width such that the bottom third of the pipe circumference is covered symmetrically about the invert of the pipe.

(c) All foreign material shall be removed from the surface to be protected. Where corrosion has occurred all loose scale shall be removed.

(d) The production, application and curing of sprayed concrete shall be in accordance with sub-section SC6.4.6.28 Minor concrete works.

(e) The sprayed concrete shall be reinforced with a fabric of hard drawn steel wire 4mm diameter with 200mm square mesh. The fabric shall be securely supported at a central location within the sprayed concrete by non-metallic supports.

(f) Laps in fabric shall be 300mm and a cover of 50mm of sprayed concrete shall be provided to the fabric at all edges.

(g) Immediately after placement of the sprayed concrete, all free water shall be removed and the surface coated with cement slurry.

(h) No water shall be allowed to flow over the surface of the sprayed concrete for twenty-four hours after the placement of sprayed concrete.

SC6.4.6.6.5 UPVC pipes

(1) Materials

(a) Unplasticised PVC (UPVC or similar material) Pipes and Fittings shall be manufactured in accordance with AS/NZS 1254 and shall be of the type and size as shown on the drawings. Where pipes with extreme external diameter are equal to or greater than 450mm (375mm nominal internal diameter) are proposed, a separate approval from the Superintendent and council is required.

(b) Embedment material in the bedding, side support and overlay zones shall be in accordance with bed and haunch zone material in SC6.4.6.6.3(~~7~~3).

(c) Trench backfill material shall satisfy the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction).

(2) Excavation and bedding

(a) Unless otherwise indicated on the drawings or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

(b) Figure SC6.4.6.6.3 and Table SC6.4.6.6.2 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions, unless otherwise indicated on the drawings.

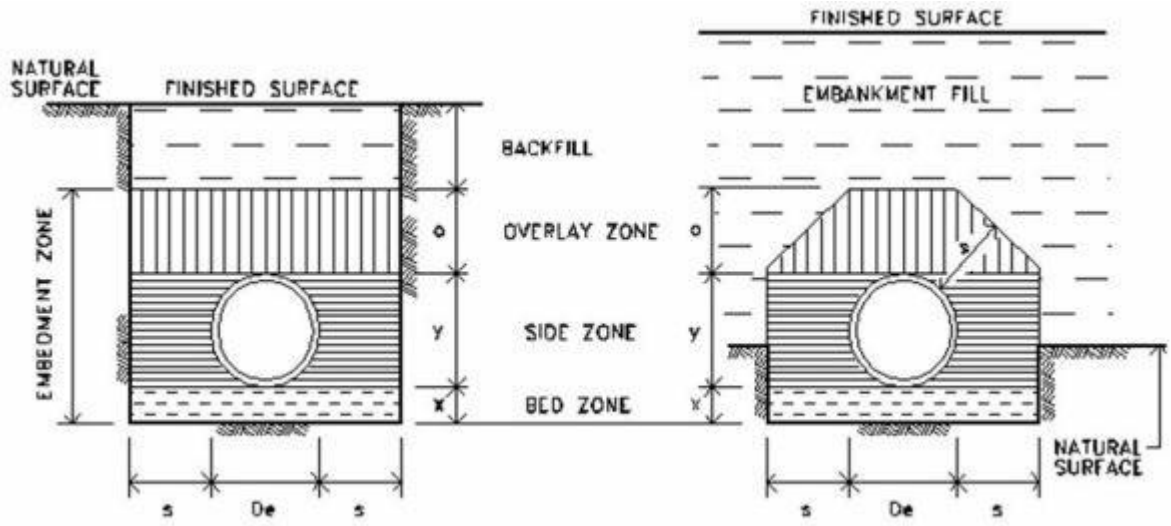


Figure SC6.4.6.6.3 Pipe installation conditions

Table SC6.4.6.6.2 Trench and embedment dimensions

Extreme External	Minimum Dimensions (mm)			
Dia (De)mm	x	s	o	y
³75 ≤~~£~~150	75	100	100	Pipe dia.
>150 ≤~~£~~300	100	150	150	Pipe dia.
>300 ≤~~£~~450	100	200	150	Pipe dia.

Note - Where multiple pipes are laid side by side, the minimum distance between the pipes shall be dimension "s" for the larger of adjacent pipes.

(c) Bedding zone material shall be placed and compacted in accordance with the requirements in Table 5.5 of AS/NZS 2566.2.

(3) Installation

(a) Embedment of the UPVC pipe shall be in accordance with the requirements of AS/NZS 2566.2 and to the dimensions shown in Figure SC6.4.6.~~6~~3.

(b) Pipe laying shall be in accordance with Part 7 of AS 2032 and solvent-cement pipe jointing shall be in accordance with Part 3 of AS 2032. Jointing may be performed with the pipes either in the trench or at ground level. All pipes, or jointed pipelines, shall be lowered into the trench without being dropped. Pipelines shall be placed so that joints are not strained.

(4) Backfill

(a) Compaction of the material in the side support and overlay zones shall comply with the requirements of SC6.4.6.6.3(~~7~~5) for HS3 support type.

(b) All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced, or compacted in one operation by saturation and vibration to achieve a minimum Density Index as specified in Table 5.5 of AS/NZS 2566.2 – Buried Flexible Pipelines – Installation.

(c) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content, which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(d) The remainder of the trench to the underside of the subgrade, or selected material zone as specified in SC6.4.6.10 Earthworks (construction), shall be backfilled with material satisfying the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction). Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be

backfilled with selected material as defined in SC6.4.6.10 Earthworks (construction).

SC6.4.6.6.6 Limits and tolerances

The limits and tolerances for materials and product performance related to the various clauses in this sub-section are summarised in Table SC6.4.6.6.3 Summary of Limits and Tolerances below.

Table SC6.4.6.6.3 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
	Culvert Position	± 10mm	SC6.4.6.6.~~1(3)~~2(1)
	(a) Grade Line	± 6mm	
	(b) Grade line <0.5%		
	(c) Horizontal Alignment	± 50mm	SC6.4.6.6.~~1(3)~~2(1)
	Bedding		
	(a) Bed and Haunch Zone Compaction	Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725	SC6.4.6.6.3(3)
	Backfill - Concrete Pipes (a) Side and Overlay Zone Compaction	Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725	SC6.4.6.6.3(5)
	Backfill - Steel Pipes (a) Side and Overlay Zone Compaction	Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725, HS3	SC6.4.6.6.4(9)
	(b) Pipe/Structure		
	(i) Horizontal and Vertical Variation	< 2% of specified dimensions	SC6.4.6.6.4(9)
	Sprayed Concrete (a) Over crest of corrugations over bottom third of pipe circumference	> 100mm	SC6.4.6.6.4(10)
	Bedding Zone Compaction	DI 70	SC6.4.6.6.5(2)
	Backfill - UPVC Pipes (a) Side and Overlay Zone Compaction	³95%, DI 70	SC6.4.6.6.5(4)

SC6.4.6.7 Precast box culverts

SC6.4.6.7.1 Introduction

(1) Scope

(a) This sub-section covers the installation of precast concrete box culverts and should be read in conjunction with sub-section SC6.4.6.4 Stormwater drainage.

(b) The work to be executed under this Specification consists of:

(i) preparation of foundations;

(ii) provision of bedding;

(iii) construction of base slabs

(iv) installation of precast culvert units;

(v) headwalls and wingwalls;

(vi) backfilling against structures;

(vii) provision and removal of coffer dams; and

(viii) excavation of inlet and outlet channels.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.4 Stormwater drainage
SC6.4.6.9 Open drains
SC6.4.6.12 Flexible pavements
SC6.4.6.28 Minor concrete works

(b) Australian Standards
AS1597.1 - *Precast reinforced concrete box culverts - Small culverts*
AS1597.2 - *Precast reinforced concrete box culverts - Large culverts*
AS/NZS ISO 9001:2008 - *Quality management systems - Requirements.*

(c) Other
Austroads, *Guide to Geotextiles*
Department of Transport and Main Roads
MRTS05 - *Unbound Pavements*
MRTS24 - *Manufacture of precast concrete culverts*

SC6.4.6.7.2 Materials

(1) Culvert units, link and base slabs

(a) The supply and testing of precast reinforced concrete box culvert units, link and base slabs shall be in accordance with AS1597~~MRTS24~~ with the following alterations or additional requirements:

(i) proof load testing ~~shall~~ must be arranged by the Contractor in batches as specified in either AS 1597.1 or AS 1597.2 as appropriate;

(ii) proprietary lifting anchors ~~shall~~ must be provided in the culvert units, link and base

(iii) slabs; delivery and unloading ~~shall be~~is the Contractor's responsibility; and

(iv) the supplier ~~shall~~ must implement and maintain a Quality System in accordance with ISO 9001 to ensure materials, manufacture and proof load testing conform to the appropriate Standards.

(b) A conformance certificate, to ~~MRTS24 shall~~AS1597 must be submitted to the Superintendent at least 3 working days

prior to despatch.

(c) Each unit ~~shall~~ must be marked at time of manufacture with:

(i) type and size;

(ii) casting date;

(iii) manufacturer's name; and

(iv) inspection pass and date.

(2) Handling, delivery and storage

(a) Ensure adequate equipment and load shifting machineries are available for safe handling and unloading

(b) Upon delivery of precast units, ensure that the following criteria have been achieved:

(i) 70% of the minimum concrete strength;

(ii) small culvert units: Cured to AS 1597.1 clause 2.6.3; and

(iii) large culvert units: Cured to AS 1597.2 clause 2.7.

(c) Prior inspection of the stored precast box culvert units is to be undertaken for dimensional accuracy and defects following delivery. Results of the inspections must show that the units conform to the following:

(i) small culvert unit: To AS 1597.1; and

(ii) large culvert unit: To AS 1597.2

(3) Concrete

The concrete and reinforcement for cast-in-situ base slabs shall comply with sub-section SC6.4.6.28 Minor concrete works.

(4) Selected backfill

The quality of selected backfill shall comply with the requirements in AS 1597.2, or alternatively comply with the requirements of side/overlay zone materials in Table SC6.4.6.6.1 *Bedding material grading limit* of sub-section SC6.4.6.6 Pipe drainage.

(5) Ordinary backfill

Ordinary backfill is material obtained from culvert excavations, cuttings and/or borrow areas which are in accordance with the requirements for the upper 0.3 m of embankment construction as detailed in SC6.4.6.10 Earthworks (construction).

SC6.4.6.7.3 Construction

(1) Coffer dams

(a) At some sites it may be expedient for the Contractor to construct a coffer dam. The construction of coffer dams shall be the responsibility of the Contractor.

(b) Coffer dams shall be sufficiently watertight to prevent damage of the concrete by percolation or seepage through the sides, and shall be taken sufficiently below the level of the foundations to prevent loosening of the foundation materials by water rising through the bottom of the excavation. Coffer dams shall be adequately braced and shall be so constructed that removal will not weaken or damage the structure.

(c) A coffer dam may be constructed to the actual size of the reinforced concrete invert slab and used as side forms for the concrete. The details of the coffer dam and formwork, and the clearances proposed shall be subject to the approval of the Superintendent, but the Contractor shall be responsible for the successful construction of the work.

(d) Coffer dams which have tilted or have moved laterally during sinking, shall be righted or enlarged to provide the clearances specified. This work will be at the Contractor's expense.

(e) No timber or bracing shall be left in the concrete or in the backfill of the finished structure. Coffer dams, including temporary piles, shall be removed at least to the level of the invert after completion of the structure. Upon completion of works, remove coffer dams, including temporary piles, at least to the level

of the culvert invert after completion of the structure. Ensure that no material associated with the coffer dam or dewatering can enter the culvert.

(2) Excavation

Excavation shall be carried out in accordance with the provisions in sub-section SC6.4.6.4 Stormwater drainage.

(3) Foundations

(a) Rock foundations shall be neatly excavated to the underside of the mass concrete or selected fill bedding shown on the drawings. All minor fissures shall be thoroughly cleaned out and refilled with concrete, mortar or grout. All loose material shall be removed.

(b) Where rock is encountered over part of the foundation only, or lies within 300mm below the underside of the mass concrete or selected fill, all material shall be removed to a depth of 300mm below the mass concrete or selected fill for the full width of the foundation over the length where the rock is encountered. This additional excavation shall be backfilled with ordinary backfill material.

(c) Over-excavation or uneven surfaces shall be corrected with mass concrete so as to provide a uniform surface at least 50mm above the highest points of rock.

(d) Earth foundations shall be finished to line and level to the underside of bedding shown on the drawings. Care shall be taken to avoid disturbing material below this level.

(e) All soft, yielding or unsuitable material shall be removed and replaced with ordinary backfill material as directed by the Superintendent and backfilled in accordance with sub-section SC6.4.6.4 Stormwater drainage.

(4) Bedding

(a) Cast-in-situ base slabs

No bedding material shall be placed until the foundations have been inspected and approved by the Superintendent.

Bedding shall be either mass concrete or lightly bound paving material which complies with the requirements of at least a Type 3, Subtype 3.3 material as defined in the Specification MRTS05 (04/11), whichever is shown on the drawings.

Mass concrete bedding blinding layer shall be 20 mpa compressive strength and shall not be less than 50mm thick over any point in the foundation. It shall be laid to the line and level of the underside of the base slab to a tolerance of ±10mm in level and ±50mm in line. The bedding shall be finished to a smooth surface. Where longitudinal gradients are less than 0.5 per cent, concrete blinding layers shall be installed with +/- 6mm of the grade line.

(b) Precast base slabs

Precast base slabs, U-shaped culvert units and one piece culvert units shall be supported on a bed zone of selected backfill of minimum compacted depth 150mm in accordance with AS 1597.2.

If suitable compaction of the trench subgrade cannot be achieved, it will be the responsibility of the developer to recommend an alternate solution to council to achieve the desired bearing capacity for the structure prior to construction.

(5) Cast-in-situ base slabs

(a) Cast-in-situ base slabs shall be constructed to the dimensions shown on the drawings and in accordance with the requirements of sub-section SC6.4.6.28 Minor concrete works. The invert levels shall be within -10mm to +10mm of the design level, grade 5mm in 2.5m (1 in 500) and plan position ±50mm. Where longitudinal gradients are less than 0.5 per cent cast insitu base slabs shall be installed within +/- 6mm of the grade line.

(b) Recesses or nib walls to accommodate the walls of the precast crown units shall be formed in the base slab to the dimensions shown on the drawings.

(6) Installation of precast units

(a) Precast units shall not be installed until the base slab has attained a minimum compressive strength of 20 MPa.

(b) Precast crown units shall be placed on a bed of mortar either on the slab or in the recesses in the base slab. Any gaps between the side walls and the sides of the recesses shall be packed with cement mortar. Lifting holes and butt joints between units shall be packed or sealed with cement mortar or grout or flexible joint filler.

(c) Before placement of top slabs on U-shaped units or link slabs on adjacent crown units, the bearing areas of the supports shall be thoroughly cleaned and covered with a bed of mortar of minimum thickness 5mm after placement of precast unit.

(d) Lifting anchor recesses shall be filled to the surface with cement mortar.

(e) In the case of multi-cell culverts, a nominal 50mm gap shall be provided between adjacent cells. This gap shall be filled with cement mortar or grout.

(f) All mortar joints shall be protected from the sun and cured in an approved manner for not less than 48 hours.

(g) All external surfaces of vertical joints between precast crown units, shall be covered full length, and minimum 100mm width, with strips of denso tape or similar as an alternative to joint filling.

(7) Backfill

(a) All bracing and formwork shall be removed prior to backfilling. Prior to backfill placing, present to the Superintendent for inspection all seals, joints and levels.

(b) Selected backfill shall be placed in the side zones of the box culverts and wingwalls, and to a depth of 300mm in the overlay zone of the culverts, in layers with a maximum compacted thickness of 150mm in accordance with the backfilling and compaction requirements of AS 1597.2. Alternatively cohesionless materials can be compacted in one operation by saturation and vibration to achieve a minimum Density Index of 70. The remainder of the excavation shall be backfilled with ordinary embankment fill in accordance with SC6.4.6.10 Earthworks (construction).

(c) Backfill shall be placed against wingwalls, headwalls and retaining walls in accordance with SC6.4.6.28 Minor concrete works.

(d) Backfill layers shall be placed simultaneously on both sides of the culvert with a maximum 600mm level difference to avoid differential loading. Backfilling and compaction shall commence at the wall and proceed away from it.

(e) Where the slopes bounding the excavation are steeper than 4:1, they shall be cut in the form of successive horizontal terraces of at least 1m width before the backfill is placed.

(8) Excavation of inlet and outlet channels

(a) Excavation of inlet and outlet channels shall be carried out as shown on the drawings and shall extend to join the existing stream bed in a regular manner as detailed SC6.4.6.9 Open drains.

(9) Construction loading on culverts

(a) Construction vehicles and plant shall not pass over the culvert until 28 days after the casting of the base slab or until the cylinder compressive strength of the base slab concrete has reached 32 MPa.

(b) Construction vehicle loads on culverts for various design fill heights shall be in accordance with AS 1597.2.

SC6.4.6.7.4 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.7.1 Summary of Limits and Tolerances below:

Table SC6.4.6.7.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Spec Clauses
1.	**Mass Concrete Correction**		
	a) Over highest points of rock	50mm	SC6.4.6. 7.3(3)
2.	**Mass Concrete Bedding**		
	a) Level	± 10mm	SC6.4.6. 7.3(4)
	b) Level where grade line <0.5%	+/- 6mm	
	c) Line	± 50mm	SC6.4.6. 7.3(4)
3.	**Culvert Location**		
	a) Invert Level	±10mm	SC6.4.6.7.3(5)(a)
	b) Invert where grade line is <0.5%	+/- 6mm	
	c) Grade	5mm in 2.5m (1 in 500)	SC6.4.6.7.3(5)(a)
	d) Plan Position	±50mm	SC6.4.6.7.3(5)(a)

SC6.4.6.9 Open drains

SC6.4.6.9.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the construction, lining and protection of all types of open drains including the construction of rock filled wire mattresses and gabions associated with stormwater drainage infrastructure.

(b) This sub-section should be read in conjunction with SC6.4.6.4 Stormwater drainage, and other drainage sub-sections as applicable:

(i) SC6.4.6.6 Pipe drainage;

(ii) SC6.4.6.5 - Drainage structures; and

(iii) SC6.4.6.7 Precast box culverts.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

Editors note - A reference to drawings is a reference to construction drawings.

(2) Terminology

Open drains	are all drains other than pipe and box culverts and include catch drains, contour drains, diversion drains, table drains, batter drains, swales, channels, gutters and kerb and channel.

(3) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.6.4 Stormwater drainage
SC6.4.6.6 Pipe drainage
SC6.4.6.5 Drainage structures
SC6.4.6.21 Subsurface drainage
SC6.4.6.28 Minor concrete works
SC6.4.6.7 Precast box culverts
SC6.4.6.26 Landscaping

(b) Australian Standards

AS 1141.22 - *Wet/dry strength variation*
AS 1289.5.4.1 - *Compaction control test – Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.7.1 - *Compaction control test Hilf density ratio and Hilf moisture variation (rapid method)*
AS 2758.4 - *Aggregate for gabion baskets and wire mattresses*
AS 2876 - *Concrete kerbs and channels (gutters) – Manually or machine placed*
AS/NZS 4534 - *Zinc and zinc/aluminium-alloy coatings on steel wire.*
AS/NZS 4680 - *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

(c) Other

Austroads, *Guide to Pavement Technology, Part 4B – Asphalt (AGPT04B)*
Austroads, *Guide to Pavement Technology, Part 4G – Geotextiles and Geogrids (AGPT04G)*
ASTM International, ASTM A975 - *Standard specification for double-twisted hexagonal mesh gabions and revet mattresses (metallic coated steel wire or metallic coated steel wire with PVC coating)*
International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

SC6.4.6.9.2 Unlined open drains general

Open drains shall be designed and constructed in accordance with the relevant clauses in Chapter 9 of QUDM 2013. Locate and construct open drains to avoid recharging groundwater, a shallow water table and salinity degradation of adjacent land.

Any unsuitable material must not be used for the bed and banks of the drain and must be removed from the site. Where a tree is marked for preservation, any drain must be diverted around it with sufficient clearance to avoid damage to the tree's root system.

Where open drains pass through private property, drainage easements of sufficient width to contain the flow and vehicular access for maintenance must be provided and registered as an encumberance on the title of the land through which the drain passes.

Prior to works commencing, temporary drainage measures must be implemented in accordance with the requirements of Best Practice Erosion and Sediment Control.

(1) Types

Catch drains shall be provided above the top and at the toe of embankments as part of the construction of the adjacent roadway. The edges of catch drains shall be positioned not less than 2 m from the tops of cuttings or the toes of embankments nor more than is necessary to maintain the fall of the drains unless otherwise approved.

Minor diversion and contour drains shall be constructed where shown on the construction drawings. Minor diversion drains shall have the same capacity as the nearest pipe culvert on the line of the drain unless otherwise approved by the Superintendent.

Table drains, swales and depressed medians shall be constructed to the line and level shown or calculated from the drawings. Their construction is deemed to be part of the earthworks.

(2) Inlet, outlet and diversion drains shall extend to join the existing stream bed and be of sufficient size to accommodate the design flows from the upstream catchment. The drain shall be excavated to the full width of the structure and care must be taken to ensure the stream bed can accommodate the additional flow with only minimal disturbance.

(3) Construction material excavated from drains shall be placed on the lower sides of the drains and formed as banks with slopes graded in accordance with QUDM Third edition 2013 – Provisional. This material shall be compacted in accordance with AS 1289.5.4.1 and shall be not less than 95 per cent for standard compactive effort.

The Contractor shall ensure that none of the activities associated with the work disturbs any watercourse outside the site. Any excavation below the level of the natural channel shall be backfilled with suitable material compacted to a density equal to and compatible with that existing naturally.

Any excess material shall be legally and responsibly disposed of by the Contractor.
Unlined drains and areas adjacent to open drains shall be treated and revegetated immediately after the drains are complete, in accordance with SC6.4.6.26 Landscaping.

SC6.4.6.9.3 Lined open drains general

(1) Contractors must only use proprietary products which are suited to the terrain and have been approved for use by council. This would include the use of

(a) organic fibre and vegetation mats installed in accordance with the manufacturer's instructions;

(b) rock filled wire mattresses; or

(c) concrete where there is insufficient width to accommodate the required water way area, or the flow velocity in the drain will exceed the non-scouring velocities or where the drail is likely to be used as a bikeway of footpath during dry periods. Lining shall conform to the profile of the drain and shall be provided as soon as possible after forming the drain.

Before placing any lining material, the foundation material shall be shaped and compacted to not be less than 95 per cent for standard compactive effort as determined by AS 1289.5.7.1 or AS 1289.5.4.1
This section does not include kerb and channel.

(2) Concrete lining

Concrete lining for open drains shall be cast-in-situ or sprayed concrete supplied and placed to a minimum thickness of 100 mm measured at right angles to the surface of the lining in accordance with sub-section SC6.4.6.28 Minor concrete works.

Polyfibres must not be used in marine environments, or where there is risk of fibres escaping into the environment, without approved controls to capture loose polyfibre strands.

Weepholes shall be provided in the concrete at intervals of 2 m spacing with non-horizontal elements or as determined by the Superintendent.

Contraction joints in concrete lining, consisting of narrow transverse and vertical grooves, 5-10 mm in width, 20 mm deep, shall be formed neatly in the surface of the freshly placed concrete at intervals of 3 m unless otherwise specified by the Superintendent.

(3) Expansion joints shall be placed at intervals not more than 15 m with a minimum width of 15 mm and shall consist of preformed jointing material of bituminous fibreboard or alternate approved material and shall be of sufficient depth to fill the joint.

Stone pitching

(4) Stone pitching shall consist of sound durable rock not less than 100 mm thick, properly bedded on approved loam or sand and mortared to present a uniform surface. The exposed surface of each stone or block shall be generally flat and not less than 0.05 square metres in area. Spaces between adjacent stones or blocks shall not exceed 20 mm in width.

Batter drains

Batter drains shall be constructed using either half round steel pipes or precast nestable concrete units as shown and detailed on the drawings.

The units shall be installed in carefully excavated and template controlled trench to produce an even rim line of +0 mm to –50 mm from the batter line at the underside of topsoil.

Any over excavation and undulations in the batter line shall be backfilled and both sides of the drain compacted over the full length to form a firm shoulder against the rim of the batter drain.

(5) When topsoil is placed it shall be tapered over a width of 1 m to zero thickness at the rim of the drain. Both sides of the drain shall then be turfed for minimum width of 1 m and pinned down as provided in SC6.4.6.26 Landscaping.

Proprietary products

Unless shown on the drawings, proprietary products may only be used with the approval of the Superintendent. Where specified, they must be used strictly in accordance with the manufacturer’s instructions.

SC6.4.6.9.4 Rock filled wire mattresses and gabions general

(1) Prior to installation of rock filled wire mattress or gabion excavate so the mattresses finish flush and level with the surrounding ground. Rock-filled wire mattresses and gabions shall be placed at the locations shown on the drawings. Installation shall be in accordance with the manufacturer's instructions. A geotextile, as shown on the drawings, shall be placed between the wire cage and the material being protected.

Foundations of floors of gabions should ideally be within cut material, however if in fill areas or embankments then material must be compacted in layers not greater than 150 mm thick, to a relative compaction of 95 per cent when tested in accordance with AS 1289.5.4.1, for standard compactive effort.

(2) Materials

For wire mattresses and gabions, the galvanising requirements for wire of circular cross section cited in this Clause as "heavily galvanised", shall comply with the coating mass requirements for round wire, Class W10, in AS/NZS 4534. The contractor must submit for approval the type of mattress/gabion proposed along with

confirmation of compliance to ASTM A975 and a schedule of installation locations.

(a) Gabions

The gabions shall be of the sizes shown on the drawings and fabricated of woven heavily galvanised wire mesh and PVC coated where specified on the drawings. Each gabion shall be divided by diaphragms into cells whose length shall not be greater than the width of the gabions plus 100 mm. Gabions shall have a nominal mesh size of 80 mm x 100 mm and body wire shall be a minimum diameter of 2.7 mm heavily galvanised with an additional thickness of 0.4 mm PVC coating where specified on the drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 3.4 mm and 2.2 mm respectively.

(b) Wire mattresses

Unless specified otherwise, the wire mattresses shall be supplied in units having dimensions of 6 m x 2 m x 230 mm, and shall be cut to suit areas as shown on the drawings. The mattresses shall be divided by diaphragms into cells of length not exceeding 600 mm. Unless otherwise specified, they shall be fabricated of woven heavily galvanised wire and PVC coated where specified on the drawings.

Mattresses shall have a mesh size of 60 mm x 80 mm and body wire shall be a minimum diameter of 2.0 mm heavily galvanised with an additional minimum thickness of 0.4 mm PVC coating where specified on the drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 2.7 mm and 2.2 mm respectively.

(c) Geotextile

A chemically and biologically stable geotextile with a minimum strength rating (G) of 1350 and minimum mass of 180 grams per square metre, in accordance with Guide to Pavement Technology Part 4G Geotextiles, shall be used.

Samples, manufacturer's specification and instructions on installation shall be submitted to the Superintendent seven days before the intended use of geotextile.

(d) Rock Fill Material

The rock fill shall consist of clean hard rock complying with the requirements of AS 2758.4.
Rock fill for gabions shall have particle sizes between 100 mm and 250 mm. Rock fill material should be placed by hand and only when approved by the superintendent shall they be placed using a suitable mechanical device to ensure fill is tightly packed with a minimum of voids. Fill material shall be levelled off 25 mm to 50 mm above the top of the mesh to allow for settlement.
When the mattress is on a slope, rock fill material shall be placed into the units starting from the low end. Units shall be filled slightly overfull by 25 mm to 50 mm to allow for settlement and to provide an even tight and smooth surface of the required contour.

(3) Assembly and erection

Before laying out the gabions or wire mattresses, geotextile shall be placed on the founding material and against any surface that will be in contact with either drainage course or earth backfill.

Adjust the position of the diaphragms so that the sides hinge up on the thicker wire woven in the mesh. Lace the gabion boxes along all diaphragm points and edges at to all adjacent boxes. Internal bracing wires 4 per m at 330 mm centres to prevent distortion. Face bracing wires 4 per m of face.

Ensure star pickets are either driven or cut off level with the top of the mattress.

After tying diaphragms and adjacent units of mattresses/gabions on all three adjacent corners(rear, floor and front face), leave top edge untied to allow for securing along with the lid section. The end corners of wire mattress/gabion tied sections shall be firmly tied after galvanised star pickets are driven and stretched in place a minimum of 900 mm into the surrounding ground in the final location at one end.

Carefully secure the opposite end of the gabions without damaging or distorting the dimensions of the units to a suitable mechanical device and apply a stretching force to the assembled mattress/gabion section to be filled. Whilst under tension, secure each corner of each unit using galvanised star pickets driven into foundation

ensuring each unit is stretched tight in all directions.

(4) Filling

Fill whilst the gabion boxes are under tension. Place the rocks at the front face and other exposed faces by hand to produce a neat face free of excessive bulges, depressions and voids.

Redistribute the filling materials by hand to ensure that all diaphragm compartments are fully filled to produce a neat and level top surface. Overfill by 25 to 50 mm to allow for subsequent settlement.

Mechanical filling equipment may be used with caution ensuring to protect any PVC or galvanized coatings from abrasion. Release the tension on the mattress/gabion boxes only when fully laced so as to prevent any slackening.

The upstream edge of wire mattresses shall be folded down into a trench of minimum depth 300 mm and filled with rock fill. This edge shall be tied to star pickets.

Final lacing should be undertaken as soon as practicable after filling particularly if there is a storm or flood expected. Stretch lids tightly over the filling and lace down securely. The works should be inspected upon completion of lacing.

SC6.4.6.9.5 Summary of limits and tolerance

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.9.1 below.

Table SC6.4.6.9.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Open Drains - General**	Grade - QUDM 2013 Table 9.5.2	SC6.4.6.9.2(3)
	(a) Grading		
	(b) Depth	Based on hydraulic capacity of the channel	SC6.4.6.9.2
	(c) Freeboard	QUDM 2013 table 9.3.1 & Fig 9.8	SC6.4.6.9.2
	(d) Channel Side Slopes	QUDM 2013 Section 9.5.3	SC6.4.6.9.2(3)
	(e) Compaction	>95% (standard compaction)	SC6.4.6.9.2(3)
2.	**Open Drains - Lining**	>95% (standard compaction)	SC6.4.6.9.3(1)
	(a) Compaction of Foundation		
3.	**Stone Pitching**	>100mm thickness	SC6.4.6.9.3(3)
	(a) Rock Dimensions		
	(b) Exposed Surface Area	>0.05 sq m	SC6.4.6.9.3(3)
	(c) Spaces between Stones	<20mm width	SC6.4.6.9.3(3)
4.	**Batter Drains**	+0, -50 from batter line	SC6.4.6.9.3 (4)
	(a) Rim line		
5.	**Kerb and channel**		
	(a) Compaction of foundation	To AS 2876	SC6.4.6.9.3(6)
	(b) Level of gutter surface	Level ≤ ±6mm of design level	SC6.4.6.9.3(6)
	(c) Alignment	Level ≤ ±50mm of design alignment	
	(d) Surface uniformity	Deviation of kerb and channel surface from 3m straight edge ≤5mm	SC6.4.6.9.3(6)
	(e) Contraction Joints		
	(i) Area	≥50% of CS area	SC6.4.6.9.3(6)
	(ii) Groove Width	≥5mm	SC6.4.6.9.3(6)
	(f) Expansion Joint Interval	at all gully pits and associated structures	SC6.4.6.9.3(6)
	(g) Backfill behind Kerb		
	(i) Layer thickness	≤150mm	SC6.4.6.9.3(6)
	(ii) Compaction	>95% (standard compaction)	SC6.4.6.9.3(6)

Item	Activity	Limits/Tolerances	Clause
6.	**Rock Fill for Gabions and Wire Mattresses**	>100kN	SC6.4.6.9.4(2)(d)
	(a) Wet Strength		
	(b) Wet/Dry Strength variation	<35%	SC6.4.6.9.4(2)(d)
	(c) Particle size for Gabions	>100mm <250mm and preferably not greater than 200 mm	SC6.4.6.9.4(2)(d)
	(d) Fill Level	>25mm <50mm above top of mesh	SC6.4.6.9.4(2)(d)
	(e) Particle size for Wire Mattresses	Between 75 mm and two-thirds of the mattress thickness, or 250 mm, whichever is the lesser	SC6.4.6.9.4(2)(d)
7.	**Erection of Gabions and Wire Mattresses**	Depth in ground >900mm Spacing <1m	SC6.4.6.9.4(3)
	(a) Star pickets for ties		
	(b) Trench Depth for upstream edge	Depth >300mm	SC6.4.6.9.4(3)

SC6.4.6.14 Mass concrete sub-base

SC6.4.6.14.1 Introduction

(1) Scope

This policy sub-section provides standards advice and guidelines for the construction, by mechanical or hand placement of mass concrete sub-base including trial sections and sub-grade beams.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note - A reference to drawings is a reference to construction drawings.

(2) Thickness and levels of subbase

The sub-base thickness and levels shall be as per design requirement.

(3) Provision for base slab anchors

During construction of the sub-base, in advance of concrete base construction the Contractor shall make provision to permit construction of base slab anchors at the locations and to the dimensions shown on the design. Excavation of material, trimming of trenches, compacting of the bottom of the trench, disposal of surplus material and construction of the concrete anchors shall be carried out in accordance with sub-sectionSC6.4.6.15 Plain and reinforced concrete base as part of the concrete base construction.

(4) Reference and source documents

Documents referenced in this Sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.15 - Plain and reinforced concrete base
SC6.4.6.28 - Minor concrete works.

(b) Australian Standards:

AS1012.1 - *Sampling of fresh concrete*
AS1012.3.1
AS1012.4.2 - *Determination of properties related to the consistence of concrete - Slump test*
AS1012.8
AS1012.8 - *Determination of air content of freshly mixed concrete - Measuring reduction in air*
AS1012.9 *pressure in chamber above concrete*
AS1012.13 - *Method of making and curing concrete – Compression and indirect tensile test specimens*
AS1012.14
AS1141.11. - *Method of making and curing concrete – Flexure test specimens*
1
AS1141.14 - *Determination of the compressive strength of concrete specimens*
AS1141.22
- *Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory*
- *Securing and testing cores from hardened concrete for compressive strength*
- *Particle size distribution – Sieving method*
- *Particle shape, by proportional calliper*
- *Wet/dry strength variation*

AS1160 - *Bitumen emulsions for the construction and maintenance of pavements*

AS-1379 - *Specification and manufacture of concrete*
AS-1478.1 - *Chemical admixtures for concrete, mortar and grout – Part 1: Admixtures for concrete*
AS-2758.1
AS3582.1 - *Concrete aggregates*

- *Supplementary cementitious materials for use with portland and blended cement - Flyash*

AS3799 - *Liquid membrane-forming curing compounds for concrete*
AS3972 - *General purpose and blended cements*

(c) Other
Austroads, *Guide to Pavement Technology Part 4G: Geotextiles and Geogrids*

SC6.4.6.14.2 Materials for concrete

(1) Cement
Cement shall be Type GP Portland cement or Type GB blended cement complying with AS-3972. Cement shall be from a source approved under the Queensland Government's State Purchasing Policy.

When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General the Contractor shall nominate the brand and source of the cement. On approval of a nominated mix by the Superintendent, the contractor shall use only the nominated cement in the work.

Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, the Superintendent may require a retest to ensure the cement complies with AS-3972, before the cement is used in the work.

Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

(2) Flyash
Flyash shall be from a source approved under the Queensland Government's State Purchasing Policy. The use and the quality of flyash shall comply with AS-3582.1.

When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General, the Contractor shall nominate the powerhouse source of the flyash. On approval of a nominated mix by the Superintendent, the Contractor shall use only flyash from the nominated powerhouse.

Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

(3) Water
Water used in the production of concrete shall be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.

(4) Admixtures
Chemical admixtures and their uses shall comply with AS-1478.1. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below shall not be used. An air entraining agent may be included in the mix. If an air entrainer is used, the air content of the fresh concrete shall comply with Clause SC6.4.6.14.3(5) Air content.

Fresh concrete with an air content not complying with Clause SC6.4.6.14.3(5) Air content shall be rejected.

During the warm season (October to March inclusive), a lignin or lignin based (“ligpol”) set retarding admixture approved by the Superintendent, shall be used to control slump within the limits stated in Clause SC6.4.6.14.3(4) Consistency. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS-1478.1 shall be submitted to the Superintendent, together with the proposed `dosage chart' in accordance with SC6.4.6.14.4(1) General.

If the Contractor proposes to vary the admixture between the warm and cool seasons such variation shall constitute a proposed change to an approved mix for the purposes of Clause SC6.4.6.14.4(2) Variations to approved mixes.

When submitting details of the nominated mix in accordance with Clause SC6.4.6.14.4(1) General, the Contractor shall nominate the proprietary source, type and name of each admixture to be used. Documentary evidence of the quality shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

(5) Aggregates

(a) General

(i) When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General, the Contractor shall nominate the sources of aggregate to be used and shall submit details of the geological type of each aggregate.

(ii) Aggregates shall all pass the 37.5mm AS sieve and shall comply with AS2758.1 in respect of bulk density, water absorption (maximum 5%), material finer than 75 micrometres, impurities and reactive materials. The proportion of misshapen particles (2:1 ratio) determined by AS1141.14 shall not exceed 35%.

(iii) When submitting details of the nominated mix, the Contractor shall submit to the Superintendent a NATA Certified Laboratory Test Report on the quality and grading of the aggregate proposed to be used. The grading shall be known as the "Proposed Grading".

(iv) If the Contractor proposes to blend two or more aggregates to provide the Proposed Grading the Test Reports for each constituent material shall be submitted separately and the Superintendent advised of the proportions in which the various sizes and constituents are to be combined. The aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

(v) All aggregate used in the production of concrete shall be clean, hard, durable rock fragments free from the inclusion of mineral salts, oils, organic matter or other materials deleterious to the performance of concrete.

(b) Grading

(i) The grading of the combined aggregate used in the work, determined by AS1141.11, shall not deviate from that of the proposed grading by more than the amounts shown in Table SC6.4.6.14.1 Aggregate grading deviation limits.

Table SC6.4.6.14.1 Aggregate grading deviation limits

Australian Standard Sieve	Maximum Deviation Per Cent Passing by Mass of Total Sample
37.5mm	-5
19mm	+ or -10
4.75mm	+ or -10
1.18mm	+ or -5
600mm	+ or -5
150mm	+ or -2

(c) Durability

Any fraction of any constituent and any fraction of combined aggregate shall conform to the following requirements:

(i) Wet Strength AS-1141.22 Shall not be less than 50kN; and

(ii) 10% Fines Wet/Dry Variation AS-1141.22 Shall not exceed 35%.

(d) Storage

(i) Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

(ii) The area surrounding the storage facilities and mixing plant shall be so constructed that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of the Superintendent, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of the Superintendent.

SC6.4.6.14.3 Quality requirements of concrete

(1) Cement and flyash content

When a cement and flyash blend is nominated the minimum acceptable range is 40 – 75-% by mass of the total cementitious material (cement and fly ash) in accordance with AS-3582.1.

(2) Compressive strength

The compressive strength of concrete shall be determined in accordance with AS1012.9. The minimum compressive strength at 7 days shall be 4MPa and at 28 days shall not be less than 5MPa for flyash blended cement. The maximum compressive strength at 28 days shall be less than 15MPa, with the exception that where the nominated mix demonstrates a 28 day shrinkage less than 400 microstrains, then the concrete achieving a strength less than 20MPa shall be accepted.

(3) Shrinkage

The drying shrinkage of the nominated mix, determined by AS1012.13 shall not exceed 450 microstrain after 21 days air drying. The drying shrinkage at the nominated slump plus 10mm shall be taken as the average of the reading or readings within 5% of the median of the three readings obtained in accordance with AS1012.13.

Consistency

(4) The Contractor's nominated slump, determined in accordance with AS1012.3.1, shall be neither less than 25mm nor more than 40mm for mechanically placed concrete and shall be neither less than 50mm nor more than 65mm for hand placed concrete. The compactibility index range shall be between 60 and 80 in accordance with AS1012.3.4.

Air content

(5) If an air entraining agent is used, the air content of the fresh concrete, determined in accordance with AS1012.4.2, shall be neither less than 3% nor more than 7% when discharged from the transport vehicle ready for placement.

SC6.4.6.14.4 Design and control of concrete mixes

(1) General

The Contractor shall submit, for approval by the Superintendent, details of the concrete mix or mixes and the materials, including source, to be used for each of mechanically placed and hand placed subbase, including nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a “nominated mix”.

The Contractor shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The

certificate shall confirm that the required testing has been carried out in the twelve month period before the date of submission to the Superintendent.

In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 1MPa of the median.

These details shall be submitted at least 21 days before using the nominated mix in the work.

(2) Variations to approved mixes

The Contractor shall not make any changes to the approved mix, its method of production or source of supply of constituents without the prior written approval of the Superintendent.

Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with clause SC6.4.6.14.4(1) General. If the variations to the quantities, qualities or sources of the constituents in the approved mix are less than 10kg for Portland cement, 20kg for other cementitious material and 5% by mass for each other constituent, except admixtures, per yielded cubic metre of concrete, the superintendent may approve the changes without new trials being carried out.

Notwithstanding these tolerances, the minimum cement content shall be 90kg per yielded cubic metre of concrete, the minimum flyash content shall be 100kg per yielded cubic metre of concrete.

SC6.4.6.14.5 Conformance for concrete strength and thickness

(1) Concrete cylinders

(a) Test specimens

Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS1012.8.1. The Contractor shall supply a sufficient number of moulds to meet the requirements for the frequency of testing specified in this clause and shall also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to the Superintendent.

Samples of concrete for testing shall be taken in accordance with AS1012.1. The selection of the batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable.

The method of making and curing specimens shall be in accordance with AS1012.8.1 with compaction by internal vibration.

The Contractor shall mark the specimens for identification purposes.

Specimens shall be inspected, capped and crushed in accordance with AS1012.8.1 and AS1012.9.

(b) Frequency of moulding of test specimens

Test specimens shall be moulded as follows:

(i) For the determination of the compressive strength at twenty eight days:

- For each lot of up to 50 cubic metres of concrete placed at the one time - One pair of specimens

(ii) For the determination of the compressive strength at seven days:

- For each lot of up to 50 cubic metres of concrete placed at the one time - One pair of specimens

(iii) For the determination of compressive strength for any early testing as deemed necessary by the Contractor:

- For each lot of up to 50 cubic metres of concrete placed at the one time -

One pair of specimens

A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed in the subbase.

(2) Compressive strength of concrete

(a) General

The compressive strength of the concrete represented by a pair of specimens moulded from one sample shall be the average compressive strength of the two specimens.

At the time of approving the mix design, the Superintendent shall nominate whether 7 day or 28 day compressive strength or both shall be the acceptance criteria for strength.

(b) Adjustment of test compressive strength for age of specimen

Should any specimen be tested more than 28 days after moulding the equivalent 28 day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table SC6.4.6.14.2 - Concrete age conversion factors.

For intermediate ages the factor shall be determined on a pro rata basis.

Table SC6.4.6.14.2 Concrete age conversion factors

Age of Specimen at time of test (days)	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 or greater	1.25

(c) Conformance for compressive strength

If the compressive strength of test cylinders for any lot is less than the criteria specified in Clause SC6.4.6.14.3(2) Compressive strength, the lot represented by the test cylinders shall be removed and replaced.

In case of non-conformance the Contractor may request permission of the Superintendent to core the in situ subbase for testing of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by the Superintendent. Such locations may be determined by the use of a nuclear density meter, or any alternative method. Testing shall be carried out at the request of the Contractor. Subbase concrete failing to reach the required in situ compressive strength shall not be retested for at least 72 hours after the determination of the value of the in situ compressive strength.

(3) Specimens cut from the work

(a) Specimens cut from the work shall be tested in a NATA registered laboratory nominated by the Contractor. Specimens shall be in the form of cylindrical cores of hardened concrete.

Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012.14 with the following amendments:

(i) The requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However, concrete must have hardened enough to permit removal without disturbing the bond between the mortar and the coarse aggregate.

(ii) The preferred dimension for cores shall be 100mm diameter but in no case shall the diameter be less than 75mm or two and one half times the nominal size of the coarse aggregate, whichever is the greater.

(iii) When inspected in the uncapped state, cores shall be rejected if any diameter departs by more than 5mm from the mean diameter.

(iv) Cores shall be rejected where the length of the core when ready for capping is less than the diameter. The test strength determined shall be adjusted for form by a factor in accordance with Table SC6.4.6.14.3 Core strength factor.

(v) Wet Conditioning only shall be used.

Table SC6.4.6.14.3 Core strength factor

Length/Diameter Ratio	Correction Factor
2.00	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.89

Note—for intermediate form ratios, the factor shall be determined by interpolation.

Core cutting shall be carried out by the Contractor in the presence of and at the locations nominated by the Superintendent. The frequency of coring shall be such that a core is taken to represent each lot or the area of subbase placed between any two consecutive construction joints whichever is the lesser. The lot represented by each core shall be nominated by the Contractor at the time of sampling and duly recorded prior to testing.

Cores shall be despatched to arrive at the testing laboratory within 24 hours of the core being cut from the subbase. Wet curing shall commence within 24 hours of the receipt of the cores.

The cutting and transporting the cores to the testing laboratory and restoring all holes in the subbase shall be the responsibility of the Contractor. The method of restoration shall be approved by the Superintendent.

(4) Acceptance of cored concrete for compressive strength

Concrete shall achieve an in situ compressive strength of 5MPa within 28 days of placement.
If the specimen cut from the subbase reaches 4MPa for in situ compressive strength, base paving may proceed.

(5) Conformance for thickness

(a) General

No thickness measurements will be carried out if the surface of the subbase is within the level tolerances as specified in Clause SC6.4.6.14.7(5)(b) Surface tolerances.
If scabbling is required to achieve the level tolerance limits, the Superintendent may order thickness checks to be carried out. Where the survey ground model of the subgrade is available, subbase thickness shall be calculated from levels taken on a 5-m grid on the plan area. Alternatively, the Superintendent may authorise coring and measurement at the edges of the layer. Thickness measurements shall be rounded off to the nearest 5mm.

(b) Thickness below specification

After making due allowance for the tolerances, subbase which is more than 20-mm below the theoretical thickness shall be rejected and removed from the site. The removal and disposal from the site shall be the responsibility of the Contractor.

Subbase which is 20-mm or less below the theoretical thickness may be accepted by the Superintendent providing that it represents isolated sections within a lot and such sections comprise less than 10% of the area of the lot.

SC6.4.6.14.6 Productions, transport and consistency of concrete

(1) Production and transport of concrete

At least 3 weeks before commencing work under this sub-section, the Contractor shall submit, for the information of the Superintendent, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport.

(2) Handling, storage and batching materials

The methods of handling, storing and batching materials for concrete shall be in accordance with AS1379, with the following additional requirements:

(a) certificates of calibration issued by a recognised authority shall be made available for inspection by the Superintendent, as evidence of the accuracy of the scales;

(b) cementatious material shall be weighed in an individual hopper, with the cement weighed first;

(c) the moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water; and

(d) where a continuous type mixer is employed, the components shall be measured by a method of continuous weighing approved by the Superintendent, except for liquids which may be measured by volume or flow rate meter.

(3) Mixers and agitation equipment

Details of proposed mixers and agitation methods shall be in accordance with the plant and equipment sections of AS1379, with the following additional requirement that in Appendix A of AS1379 the maximum permissible difference in slump shall be 10mm.

(4) Mixing and transport

Mixing and transport methods shall be in accordance with the production and delivery sections of AS-1379, with the following additional requirements:

(a) The mixer shall be charged in accordance with the manufacturer's instructions.

(b) For the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS-1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15% ~~per cent~~ and 85% ~~per cent~~ along the length of the tray.

(c) For truck mixed concrete, addition of water in accordance with the batch production section of AS-1379 shall be permitted only within ten minutes of completion of batching and within 200-m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water:cement ratio be exceeded. Mixing of the concrete shall be completed at that location.

(d) After addition of the cement to the aggregate, concrete shall be incorporated into the work within:

(i) one and a half hours, where transported by truck mixer or agitator; and

(ii) one hour, where transported by non agitating trucks.

Means of verification, satisfactory to the Superintendent, of the times of addition of cement to the aggregate shall be provided.

The times within which the concrete shall be incorporated into the work may be reduced if the Superintendent considers the prevailing weather, mix type, or materials being used warrant such a change.

(e) The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80% of the gross volume of the drum of the mixer.

(5) Maximum mixing time

Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of 10 minutes except for split drum mixers where the maximum shall be 5 minutes.

For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded.

(6) Consistency

The consistency of the concrete shall be such as to allow the production of a dense, non segregated mass with bleeding limited so as to prevent bleed water flowing over the slab edge under the conditions of placement. If bleed water does so flow, the Contractor shall cease paving until the consistency of the mix is adjusted to prevent flow or the mix is redesigned and approved by the Superintendent. The edge produced shall maintain its shape and shall not sag or tear.

The Contractor shall provide all equipment, materials and labour for consistency testing and shall carry out tests in the presence of the Superintendent.

The consistency of the concrete shall be checked by use of a slump cone in accordance with AS1012.3.1. The test shall be made on concrete samples obtained in accordance with AS1012.1. The compactibility index range shall be between 60 and 80 in accordance with AS1012.3.4. Check tests shall be done on each truckload of concrete or as directed by the Superintendent.

SC6.4.6.14.7 Placing and finishing concrete subbase

(1) General

At least four weeks before commencing work under this Specification, the Contractor shall submit as part of the Quality Plan, for the information of the Superintendent, full details of the equipment and methods proposed for placing and finishing the concrete subbase together with a paving plan showing proposed paving widths, sequence and estimated daily outputs.

The Contractor shall give the Superintendent 7 days written notice of the intention to commence construction of the subbase on any section of work (including the placement of the trial subbase in accordance with Clause SC6.4.6.14.11.

The surface on which concrete subbase is to be placed shall be clean and free of loose or foreign matter and in damp condition.

Submit the work-as-executed survey of the subgrade to the full extent of the works to the Superintendent for confirmation, and highlight any locations where the actual level is higher than the design levels. If the underlying layer is required to be spray sealed, take levels on the top of the seal and after removal of foreign or loose material such as aggregate. Report levels to the nearest millimetre and survey on 5~~.0~~ m grid on a plan area. In the case of non conforming levels, locally redesign the pavement levels as directed by the Superintendent.

Concrete shall not be placed either during rain or when the air temperature in the shade is below 5~~.~~ °C or above 38~~.~~ °C.

The temperature of the concrete placed in the work shall be neither less than 10~~.~~ °C nor more than 32~~.~~ °C.

(2) Rate of evaporation

When the value of Rate of Evaporation, determined from the graph in Figure SC6.4.6.14.1 Rate of evaporation, exceeds 0.5~~0~~kg ~~kilograms~~ per square metre per hour the Contractor shall take precautionary measures, satisfactory to the Superintendent, for the prevention of excessive moisture loss. If, in the opinion of the Superintendent, such precautionary measures prove to be unsatisfactory, the Contractor shall cease work while the evaporation rate is in excess of 0.5kg per square metre per hour.

Should the Contractor elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except minor manual bull floating, are complete.

The Contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement, and for continuously measuring and recording air temperature and relative

humidity daily, at the site throughout the course of the work. The Contractor shall provide and maintain all equipment and shall provide suitable personnel necessary for all such measuring and recording.

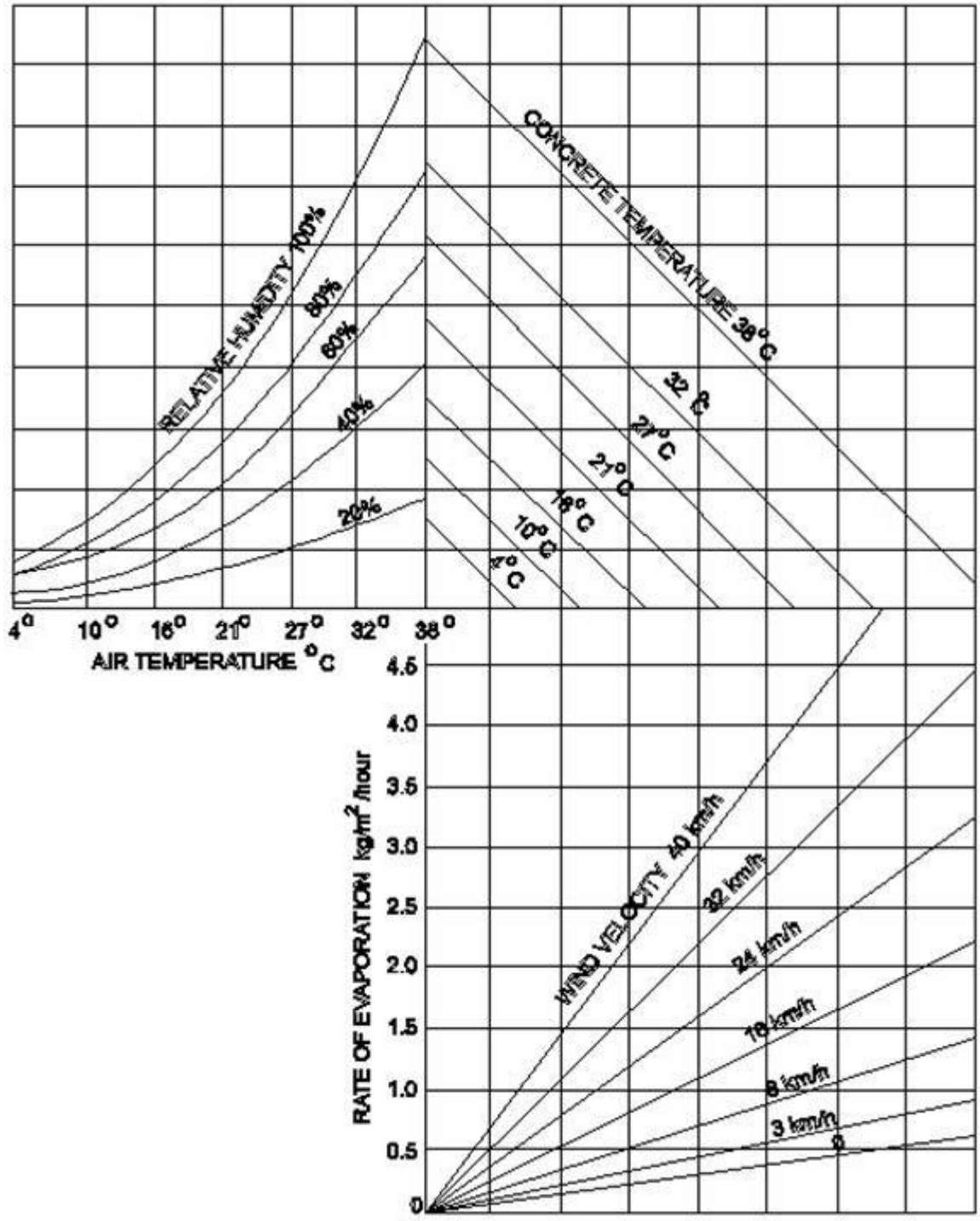


Figure SC6.4.6.14.1 Rate of evaporation

Note—the graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27ºC
- with relative humidity at 40%
- with concrete temperature at 27ºC
- with a wind velocity of 26 km/h

the rate of evaporation would be 1.6 kg/m/hour.

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27ºC), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27ºC. Move vertically down to the respective wind velocity curve - in this case interpolating for 26 km per hour -

and then horizontally to the left to intersect the scale for the rate of evaporation.

(3) Mechanical paving

The mechanical paver shall be a self propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features:

(a) an automatic control system with a sensing device to control line and level to the specified tolerances;

(b) means of spreading the mix uniformly and regulating the flow of mix to the vibrators without segregation of the components;

(c) internal vibrators capable of compacting the full depth of the concrete;

(d) adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces; and

(e) capability of paving in the slab widths or combination of slab widths and slab depths shown on the drawings.

The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that a minimum of finishing by hand will be required. A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be in a smooth and firm condition.

Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations.

(4) Hand placing

Forms shall be so designed and constructed that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and debonded to ensure non adhesion of concrete to the forms.

Concrete shall be delivered in agitator trucks and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two passes of a hand guided vibratory screed traversing the full width of the slab on each pass. Any buildup of concrete between the forms and vibratory screed shall be prevented.

If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations.

A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

(5) Alignment and surface tolerances

(a) Horizontal alignment tolerance

The outer edges of the subbase shall be square to the subgrade and shall be constructed 50mm wider than the plan position of the base formation with a tolerance of 25mm.

Where an edge of a slab is to form a longitudinal construction joint line, the allowable horizontal

alignment tolerances shall comply with clause SC6.4.6.14.8(2) Longitudinal construction joints.

(b) Surface tolerances

The level at any point on the top of the subbase shall not vary by more than 0mm above or 20mm below that shown on the drawings or as directed by the Superintendent. Where the concrete is found to be above the level tolerance, it shall be removed. Where the concrete is found to be below level tolerance, it shall be made up with base concrete.

The top surface of the subbase shall also not deviate from a 3m straightedge, laid in any direction, by more than 5mm.

(6) Curing

The subbase shall be cured by the use of one of the following:

(a) chlorinated rubber curing compound complying with AS3799 Class C Type 1D or resin-based curing compound complying with AS3799 Class B, Type 1D or Type 2, if an asphalt base is used; or

(b) white pigmented wax emulsion curing compound complying with AS3799 Class A Type 2, if a concrete base is used; or

(c) bitumen emulsion Grade CRS/170 complying with AS1160 for either asphalt or concrete base.

The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance for the curing compound from an Australian Laboratory, approved by the Superintendent, showing an Efficiency Index of not less than 90% when tested in accordance with Appendix B of AS3799.

The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the Certificate of Compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.35 litres of residual bitumen per square metre. When applied with a hand lance the rates should be increased by 25%.

The average application rate shall be checked by the Contractor and certified to the Superintendent by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by the Superintendent.

The curing membrane shall be maintained intact for seven days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.

Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

(7) Protection of work

The Contractor shall ensure that the temperature of the concrete does not fall below 5 ºC during the first twenty four hours after placing. The Contractor shall provide, for the information of the Superintendent, details of procedures and equipment proposed to be used for the protection of sections recently placed in the event of low air temperatures. If the Contractor fails to maintain the temperature of the concrete at or above 5ºC and if, in the opinion of the Superintendent, the concrete exhibits any deficiencies, due to failure to comply with this Specification, the concrete shall be rejected.

The Contractor shall protect the work from rain damage and shall provide, for the information of the Superintendent, detailed proposals fro procedures and equipment to be used for such protection.

Neither traffic nor construction equipment, other than that associated with testing, shall be allowed on the subbase until the strength of the subbase has reached at least 4MPa. Thereafter, only construction equipment necessary for the following operations shall be permitted to traffic the subbase:

(a) bond-breaker and spall treatment; and

(b) concrete or asphalt paving;

(c) Notwithstanding the above, any damage caused to the subbase by the Contractor's operations shall be rectified to the Superintendent's satisfaction.

SC6.4.6.14.8 Joints

(1) Transverse construction joints
Transverse construction joints shall:

(a) be provided only at discontinuities in the placement of concrete determined by the Contractor's paving operations;

(b) be constructed normal to the edge line and to the dimensions shown on the drawings;

(c) not deviate from a 3m straightedge placed along the joint by more than 10mm; and

(d) cut back the edge of the previously placed concrete by sawing the concrete, to at least 1/3 the slab depth to expose an even, clean, sound, vertical surface, without disturbing the concrete that is to remain in place.

(2) Longitudinal construction joints
Longitudinal construction joints shall:

(a) be formed no closer than 300mm of the base longitudinal joints as shown in the drawings, unless directed otherwise by the Superintendent;

(b) not deviate from the plan or nominated position at any point by more than 20mm;

(c) not deviate from a 3m straightedge placed along the joint by more than 10mm, having made due allowances for any planned curvature; and

(d) be smooth across the joint.

SC6.4.6.14.9 Bond breaker and spall treatment

(1) General
Subbase to be covered by concrete base shall be provided with a wax emulsion bond breaker. The wax emulsion shall comply with AS3799 Class A Type 2.

Where the base consists of asphaltic concrete, no bond breaker shall be used. In this case bond is essential and wax emulsion curing compounds shall not be permitted.

Subbase with spalled areas shall be treated, where directed by the Superintendent, prior to application of the bond breaker or asphaltic concrete.

(2) Preparation of subbase
Immediately prior to any spalled area treatment and the application of bond breaker, the subbase surface shall be cleaned to the satisfaction of the Superintendent of all loose, foreign and deleterious material.

(3) Treatment of spalling
Where directed by the Superintendent, spalled areas shall be treated before the application of the bitumen bond breaker or asphaltic concrete by infilling with 6:1 sand/cement mortar to provide a surface flush with the surrounding concrete. The area shall be wetted and sprinkled with neat cement before screeding the mortar into the patches.

A spalled area, if directed to be treated, shall have such treatment completed no earlier than five working days before the application of the bond breaker. Treated spalled areas damaged by the Contractor or others shall be made good by the Contractor.

(4) Application of bond breaker
The wax emulsion used as bond breaker should be the same as used for curing compound. This second application shall be applied at a minimum rate of 0.2 litres per square metre and not earlier than 72 hours before the placement of the base concrete.

The method of application shall conform to the requirements of Clause SC6.4.6.14.10(6) Curing.

(5) Treatment of unplanned cracks

The Superintendent shall direct treatment of unplanned cracks whose width exceeds 0.3mm. This may take the form of applying an approved 300mm minimum width geotextile backed polymer modified bitumen strip *(reference Guide to Pavement Technology Part 4G: Geotextiles and Geogrids*) over the crack prior to placement of the first asphalt base layer or concrete base, or an extra application of wax emulsion for a width of 300mm along the crack when a concrete base is required.

The Contractor shall install the Stress Alleviating Membrane strip in accordance with the manufacturer's instructions.

SC6.4.6.14.10 Subgrade beams

(1) General

Subgrade beams shall be provided below the subbase at expansion joints and isolation joints in the concrete base as shown in the drawings or as directed by the Superintendent. They shall extend the full length of joints unless otherwise indicated on the drawings.

(2) Excavation

Excavation for subgrade beams shall be to the dimensions shown on the drawings. All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be recompacted, where required, to the degree of consolidation of the adjacent undisturbed material. Excavated material shall be legally disposed of by the Contractor.

(3) Concrete

Concrete in subgrade beams shall comply with the requirements of sub-section SC6.4.6.28 Minor concrete works. The minimum compressive strength at 28 days shall be 32MPa.

(4) Steel reinforcement

Steel reinforcement shall be of the type and size shown on the drawings and shall be supplied and installed in accordance with sub-section SC6.4.6.15 Plain and reinforced concrete base.

(5) Construction and protection

Subgrade beams shall be constructed before construction of the subbase. The top surface of the subgrade beam shall be level with the top of the subgrade. Any loose subgrade material shall be recompacted to the correct level. If the contractor elects to remove any loose material, the voids shall be filled with mortar or concrete and screeded to provide a surface flush with the top of the subgrade beam and the surrounding subgrade.

A steel float shall be used to produce a smooth surface finish, free of any texture.

The subgrade beams shall be protected from damage by plant, motor vehicles and the paving operation. Any damage shall be made good by the Contractor.

(6) Curing

The top surface of the subgrade beam shall be cured in accordance with clause SC6.4.6.14.7 Curing before placing the subbase.

(7) Bond breaker

The top surface of the subgrade beam shall be treated with a bond breaker which shall consist of a further application of curing compound neither less than twenty four hours nor more than seventy two hours before placing of subbase concrete.

SC6.4.6.14.11 Trial concrete subbase

Before the commencement of paving, the Contractor shall construct a trial section of concrete subbase on the carriageway to demonstrate to the Superintendent the Contractor's capability of constructing subbase in accordance with the sub-section. This section shall be constructed so that it may be incorporated in the finished work.

The trial subbase shall be constructed using the same materials, concrete mix, equipment and methods the Contractor intends to use for the remaining subbase work. The Contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound and the construction of joints.

The trial shall also be used to demonstrate that the Contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum requirements specified.

A trial length of between 100m and 200m or lesser length in compliance with council requirements for mechanical paving equipment or between 20m and 50m for hand placement is required. The trial length shall be the maximum width proposed to be laid, and shall be constructed in one continuous operation.

Unless advised by the Superintendent of any deficiencies in the trial concrete subbase, due to failure to comply with this sub-section, the Contractor may proceed with placing concrete subbase from a time five working days after the completion of the trial concrete subbase or such earlier time as the Superintendent may allow. In the event of deficiencies in the trial concrete subbase, the Superintendent may order the Contractor to construct a further length of trial concrete subbase which shall be treated as the first. If, after three trials, the subbase still is deficient in some way, the Superintendent may require the Contractor to justify to the satisfaction of the Superintendent why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel.

The Superintendent shall have the right to call for a new trial section at any stage of work under the contract when changes by the Contractor in the equipment, materials, mix, plant or rate of paving are deemed by the Superintendent to warrant such procedure or when concrete as placed does not comply with this sub-section.

SC6.4.6.14.12 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.14.4 below:

Item	Activity	Limits/Tolerances	Clause
1.	**Materials for Concrete**		
	a. Misshapen Particles	2:1 ratio < 35%	SC6.4.6.14.3(5)(a)
	b. Aggregates Grading	Deviation from submitted sample not greater than Table C247.1	SC6.4.6.14.2(5)(b)
	c. Durability	Wet Strength > 50 kN 10% Fines < 35%	SC6.4.6.14.2(5)(c)
2.	**Concrete**	Drying Shrinkage <450 microstrain	SC6.4.6.14.3(3)
	a. Shrinkage		
	b. Consistency	Mechanically placed: >25mm<40mm Hand Placed: >50mm <65mm	SC6.4.6.14.3(4)
	c. Air Content	≥3, ≤7%	SC6.4.6.14.3(5)
	d. Thickness	Concrete shall be removed if thickness >20mm below specified thickness.	SC6.4.6.14.5(5)
	e. Mixing and Transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within: (i) One and a half hours where transported by truck mixer or agitator. (ii) One hour where transported by non agitating trucks.	SC6.4.6.14.6(4)

Item	Activity	Limits/Tolerances	Clause
	f. Placing	Concrete shall not be placed when the air temperature in the shade is less than 5ºC or >38ºC. Temperature of concrete shall be >10ºC but <32ºC.	SC6.4.6.14.7(1)
		Concrete shall not be placed when the Rate of Evaporation exceeds 0.5kg per square metre per hour.	SC6.4.6.14.7(2)
3.	**Alignment and Surface Tolerances** a. Horizontal Alignment	Outer edges not to deviate from plan position by more than ±25mm.	SC6.4.6.14.7(5)
	b. Surface	Level on top surface to be no more than +0mm or -20mm to that shown on the drawings.	SC6.4.6.14.7(5)
		The top surface shall not deviate from a 3m straightedge laid in any direction by more than 5mm.	SC6.4.6.14.7(5)
4.	**Joints** a. Transverse Construction	Shall not deviate from a 3m straight-edge placed along the joint by more than 10mm.	SC6.4.6.14.8(1)
	b. Longitudinal Joint	(i) Shall not deviate from the plan or nominated position at any point by more than 20mm. (ii) Shall not deviate from a 3m straightedge placed along the joint by more than 10mm after allowing for any curvature.	SC6.4.6.14.8(2)
5.	**Bond Breaker** a. Wax Emulsion	Minimum 0.2 litres per square metre, not earlier than 72 hours before placement of base.	SC6.4.6.14.9(4)

SC6.4.6.13 Asphaltic concrete

SC6.4.6.13.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the production and placing of asphalt including the supply of materials, sampling, testing and any other operations necessary to provide asphalt. . The extent of the policy sub-section ~~shall~~ includes:

(i) manufacture/supply of the production mix;

(ii) provision of a testing laboratory;

(iii) preparation of the surface on which asphalt is to be placed;

(iv) transport of asphalt;

(v) laying and compaction of asphalt; and

(vi) sampling and testing.

(b) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editors note - A reference to drawings is a reference ~~and~~ to construction drawings.

(2) Plant

The Contractor ~~shall~~ must provide all the plant, equipment and labour necessary for carrying out the work in accordance with this sub-section.

All plant and equipment used on the work ~~shall~~ must be in accordance with the submitted quality documentation and kept in good operating condition. The Contractor ~~shall~~ must not use in the work any plant or equipment demonstrated to be faulty in operation so as to effect the product quality or unsafe in operation as assessed by the Superintendent.

All plant ~~shall~~ must be registered and insured as appropriate to its use on a public road and ~~shall~~ must comply with statutory environmental regulations.

(3) Protection of services and road fixtures

The Contractor ~~shall~~ must take all necessary precautions to prevent asphalt or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, access chamber covers, bridge or culvert decks and other road fixtures. Immediately after the asphalt has been spread the Contractor ~~shall~~ must clean off or remove any such material as directed by the Superintendent and leave the services and road fixtures in a condition satisfactory to the Superintendent.

(4) Control of traffic

The Contractor ~~shall~~ must provide for traffic control in accordance with the requirements of sub-section SC6.4.6.30 Control of traffic while undertaking the work.

The Contractor ~~shall~~ must take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the road users or employees.

(5) Work records

Particulars of the work performed ~~shall~~ must be recorded by the Contractor on the Asphalt Work Record at SC6.4.6.13 Attachment A Asphalt Work Record or as per the Contractor's own procedures where equivalent. The Contractor ~~shall~~ must complete the Asphalt Work Record, which ~~shall~~ must be countersigned by the Superintendent each day as a true record of the work performed. ~~A copy shall be supplied to the Superintendent.~~

Delivery dockets stating the mass of each truck load of asphalt ~~shall~~ must be attached to the Asphalt Work Record.

(6) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections

SC6.4.6.30 - Control of traffic

(b) Australian Standards

AS 1141.11	*- Particle size distribution by dry sieving*
AS 1141.14	*- Particle shape, by proportional calliper*
AS 1141.17	*- Voids in dry compacted filler*
AS 1141.18	*- Crushed particles in coarse aggregate derived from gravel*
AS 1141.22	*- Wet/dry strength variation*
AS 1141.42	*- Pendulum friction test (PAFV)*
AS 1160	*- Bitumen emulsions for the construction and maintenance of pavements*
AS 2008	*- Residual bitumen for pavements*
AS 2150	*- Hot mix asphalt*
AS 2758.5	*- Asphalt aggregates*
AS 2891.1	*- Sampling of Asphalt*
AS 2891.3.1	*- Bitumen content and aggregate grading - Reflux method*
AS 2891.5	*- Determination of stability and flow - Marshall procedure*
AS 2891.8	*- Voids and density relationships for compacted asphalt mixes*
AS 2891.9.3	- Determination of bulk density of compacted asphalt - Mensuration method
AS 2891.10	- Water and volatile oils content

(c) Queensland Department of Transport and Main Roads Specifications

MRS17 ~~(11/11)~~	*- Bitumen*
MRS18 ~~(11/11)~~	*- Polymer Modified Binder*
MRS21 ~~(06/09)~~	*- Bituminous Emulsion*
MRS30 ~~(06/13)~~	*- Dense Graded and Open Graded Asphalt*
~~*MRS31 (06/13)*~~	~~*- Heavy Duty Asphalt*~~

(d) Austroads

AGPT03-2009 *Guide to Pavement Technology Part 3 – Pavement surfacings*
AGPT04B-2007 *Guide to Pavement Technology Part 4B - Asphalt*

SC6.4.6.13.2 Materials

Materials and mix ingredients ~~shall~~ must be in accordance with MRTS30. Binder ~~shall~~ must be in accordance with MRTS17 and polymer modified binder in accordance with MRTS18.

SC6.4.6.13.3 Asphalt mix design

(1) Approved mix

The supply only of an approved mix in accordance with MRTS 30.

The Contractor ~~shall~~ may not make any changes to the approved mix, or constituent materials without the prior written approval of the Superintendent.

Notwithstanding any approval given by the Superintendent to a proposed asphalt mix, the Contractor ~~shall be~~is responsible for producing asphalt which satisfies all requirements of this policy sub-section.

Asphalt produced in the plant and delivered to the site ~~shall~~ must be known as the "production mix".

(2) Production

(a) Asphalt production ~~shall~~ must comply with the requirements of MRTS30.
The Superintendent, upon provision of notice to the asphalt supplier or the supplier's representative, ~~shall~~ must have access to the mixing plant for purposes of inspection to verify production procedures and the supplier's compliance with the Contractor's Quality Management Manual and Project Quality Plan. The Superintendent ~~shall~~ must have the right to declare any non-conformance and ~~shall~~ be entitled to request

correction of either the Contractor's Quality Management Manual or the Project Quality Plan or both.

(b) Storage of asphalt

Asphalt may be stored in an insulated storage bin prior to delivery. Asphalt which has been stored for more than twenty four hours or is below the minimum temperature specified ~~shall~~ must not be used. Binder manufacturer's instructions must be followed when polymer modified asphalt is stored.

(c) Contractor's laboratory

The Contractor ~~shall~~ must maintain and operate an appropriately registered NATA testing laboratory at or near the mixing plant to control the quality of the asphalt produced.

The Contractor will make the laboratory available for inspection by the Superintendent at any time during the course of the works.

All documented test results ~~shall~~ must be submitted to the Superintendent for inspection and approval in a format and to a timetable suitable to the Superintendent.

The Contractor ~~shall be~~is responsible for taking samples and ~~shall~~ must supply all facilities, equipment and labour for that purpose. The samples ~~shall~~ must be taken by the Contractor.

(d) Frequency of sampling

For the purpose of testing production mix the Contractor ~~shall~~ must sample production lots at the minimum frequencies set in MRTS30. This testing frequency requirement ~~shall~~ must apply to each asphalt mix type. The test results ~~shall~~ must be related to production intervals with samples representing the full lot of production of the relevant mix for the production interval.

Test results from this production control sampling are acceptable as representative of deliveries made under this contract subject to the traceability of production from specific production intervals to the location at the paving site.

Such traceability shall include registration of lot number and time of production on the delivery docket system. The size of any production lot shall be limited to production from a 12 hour "shift".

Sampling shall be performed in accordance with Test Method Q301. Samples shall be identified so as to allow traceability of the mix to the paving site. Each sample or sample portion as appropriate sampled as a referee sample shall be stored in an airtight container labelled so as to be traceable to the job and paving site location.

Testing required shall be arranged by the Contractor at an appropriately registered NATA laboratory. Test reports will be made available to the Superintendent as soon as they are available and always within 7 days of delivery of material.

Dense graded asphalt that does not include modified bitumen may include a proportion of RAP up to but not exceeding 20% ~~per cent~~ by mass. The resultant asphalt shall meet all requirements for the Nominated Mix.

The RAP to be utilised shall be nominated by source and/or stockpile. Testing of the Nominated Mix shall include RAP sampled from the stockpile and of similar physical properties as that to be utilised for the contract. Any change in RAP supply shall be brought to the attention of the Superintendent prior to proposed usage in asphalt under this contract.

(3) Delivery

The bodies of haulage trucks shall be kept clean and coated with a thin film of an approved release agent to prevent asphalt sticking to the body of the truck. Any surplus release agent shall be removed before loading.

During transport asphalt shall be covered with a canvas or other suitable cover which is held down securely.

When transported to site until delivery to the hopper, the mix must be covered with a heavy duty canvas or similar waterproof cover which shall overlap the sides of the truck body by at least 250 mm and shall be tied

down securely. The bodies of all trucks shall be suitably insulated.

Delivery of the asphalt shall be at a uniform rate within the capacity of the spreading and compacting equipment.

The mass of all truck loads of asphalt shall be measured on a registered weighbridge.

(4) Placing

Placing of asphalt shall not be permitted when the surface of the road is wet or while rain appears imminent, or when cold winds chill the asphalt to such an extent that, in the opinion of the Superintendent, spreading and compaction will be adversely affected. The Superintendent may order work to cease temporarily on account of adverse weather, unsatisfactory pavement surface condition, or other circumstance which the Superintendent feels may adversely affect the subsequent operations.

(5) Preparation of pavement

The existing surface shall be dry, clean and free from any loose stones, dirt and foreign matter. The surface shall be swept beyond the edge of the proposed asphalt layer by at least 300 mm. Any foreign matter adhering to the pavement and not swept off shall be removed by other means. Any areas significantly affected by oil contamination shall be cleaned to the satisfaction of the Superintendent.

Surface preparation shall be in accordance with AS 2734. Thermoplastic linemarking or other linemarking, where indicated necessary by the Superintendent will be removed prior to paving. Raised pavement markers shall be removed prior to paving.

The Contractor, when paving over existing road pavement, shall be responsible for the recording of lane marking positions including the extent of barrier line. After paving the Contractor will mark up the pavement to re-establish such positions using conventions agreed with the Superintendent and to a standard adequate to allow accurate re-establishment of line marking.

The Contractor shall repair any damage to the existing pavement surface caused by the Contractor's activities. Affected areas designated by the Superintendent shall be removed and reinstated to the Superintendent’s satisfaction.

A corrector course shall be used to correct irregularities in an existing surface and/or modify the shape of an existing surface. Any surface depressions greater than 25 mm in depth and any uneven surface shall be brought to the general level of the surrounding pavement/deck surface. Where a corrector course is used to modify the shape of an existing surface, the course shall be laid to the reduced levels and/or shape specified in the documents.

The Contractor shall mark out, in the presence of the Superintendent, the areas where corrector course is to be applied and shall not lay corrector course prior to receiving acceptance of the proposed areas from the Superintendent.
The asphalt in these patches shall be compacted to comply with the general level of the existing surface to the Superintendent’s satisfaction.
Back filling and stress absorbing fabric strips is to be carried out in accordance MRTS30 where indicated on the drawings or directed by the superintendent.
Preparation of the prepared surface is to be to the satisfaction of the Superintendent. Subsequent inspection and Superintendent’s approval of surface condition shall be required prior to the release of the hold point.

(6) Tack coat

Only on multiple courses shall tack coat be used between each course unless directed otherwise by the Superintendent. The whole of the area to be sheeted with asphalt shall be tack coated with a light and even coat of bitumen emulsion. Bitumen emulsion shall comply with the requirements of MRTS21.

The bitumen emulsion shall be applied at a rate of between 0.10 litres per square metre and 0.20 litres per square metre of undiluted bitumen unless otherwise specified.

The bitumen emulsion shall be applied by a mechanical sprayer with spray bar. Where the areas to be sprayed are small, irregular or inaccessible to mechanical sprayers, such areas shall be tack coated by hand spraying or brushing.

The bitumen emulsion may be warmed or diluted with water to facilitate spraying. Adequate time shall be allowed for the emulsion to break before asphalt is laid. Over application of tack coat, due to surface depressions, shall be removed or dispersed by brushing.

All contact surfaces of kerbs and other structures and all cold joints shall be coated with a thin uniform application of tack coat.

Care shall be taken to ensure that bitumen emulsion is not sprayed on, or allowed to coat, any services or exposed fixtures including concrete kerbs, guardfence or bridge handrails. Appurtenances susceptible to overspray shall be protected with suitable paper.

When trucks or other vehicles are likely to move from tack coated areas onto adjacent finished surfaces, the Superintendent may require that the finished surfaces be suitably protected from carryover of bituminous material.

In locations of heavy pedestrian traffic, such as shopping areas, the Contractor shall take appropriate precautions in accordance with sub-section SC6.4.6.30 Control of traffic to keep pedestrians off tack coated areas.

(7) Laying

(a) Paver

The paver(s) shall be expected to have a minimum spreading capacity of 50 ~~t~~~~onnes~~ of asphalt per hour and be capable of spreading a width of at least 3.7 m to the requirements of this sub-section. It shall be expected to have automatic screed control operated from joint matching shoe, fixed line, travelling straight edge or levelling beam. The Contractor shall provide the Superintendent with notice of proposed pavers without these capabilities and obtain Superintendent's agreement to their use.

(b) Laying operations

The work shall be so arranged as to keep the number of joints, both longitudinal and transverse to a minimum.

The paver shall operate at a uniform speed and the delivery of asphalt shall match the output of the paver such that continuous laying of asphalt is achieved.

When laying asphalt in echelon the distance between pavers shall be such that the temperature of the asphalt at the edge of the asphalt laid by the advance paver is not less than 80 °C by the time the following paver matches the longitudinal joint.

In the event of faulty operation of the paver causing irregularities in the spread asphalt, work shall cease until the fault is rectified.

Unless otherwise approved by the Superintendent, asphalt shall not be spread by hand behind the paver. Workers shall not stand or walk on the hot surface until compaction has been completed except where necessary for correction of the surface.

The Superintendent may approve spreading asphalt by hand for minor correction of the existing surface and in areas inaccessible to mechanical pavers.

Asphalt shall not be placed when the surface of the pavement is wet or while rain appears imminent.

AS 2734 shall constitute a valid reference of good practice for asphalt laying practice.

(c) Laying temperature

Weather restrictions and minimum asphalt temperatures at the time of discharge into the paver shall be in accordance with MRTS30. Measurement may be made by calibrated infra-red thermometers when accepted by both Contractor and Superintendent.

The Superintendent may reject that part of any truck load which contains lumps of cooled asphalt which are liable to affect the quality of the finished surface.

The laying temperature shall be measured in the paver hopper. A suitable stem type thermometer readable and accurate to within plus or minus 2 °C with a range from at least 0 °C to 200 °C shall be used. The stem shall be inserted into the asphalt to a depth of approximately 200-mm at a location at least 300-mm from the side of the paver. The average of two readings shall be adopted as the temperature of the mix. Measurements of asphalt and road surface temperatures and wind velocity to comply with this Clause shall be recorded on the Asphalt Work Record Sheet.

(d) Level control

The minimum controls for level set out below shall be used. Additional controls may be necessary to obtain the required finished pavement properties.

Corrective courses shall be automatically controlled by programmed computer control of the paver, joint matching shoe or stringline sensor. Where the correction is only minor, the Superintendent may allow the use of levelling beams at least 10-m long.

Intermediate courses shall be automatically controlled by programmed computer control of the paver or a joint matching shoe.

The wearing course shall be controlled by levelling beams at least 10-m long and, as required by the Superintendent or a joint matching shoe. When identified in the Project Quality Plan and/or approved in writing by the Superintendent, small areas (as defined) may be paved as wearing course without the use of levelling beam to achieve target levels.

(e) Layer thickness

The compacted thickness of each course shall be as shown on the drawings. A course may comprise one or more layers. The nominal compacted layer thickness shall be in accordance MRTS30.

(8) Joints

(a) General

The location of longitudinal and transverse joints shall be as approved by the Superintendent and at the spacing nominated in the drawings. All joints shall be compacted and finished with a smooth, planar surface coinciding with, and being of similar appearance to the remainder of the layer.

(b) Longitudinal joints

An automatically controlled joint matching device shall be used to control the levels of adjacent runs. Care shall be taken to provide positive bond between adjoining runs. Longitudinal joints shall be:

(i) continuous and parallel;

(ii) coincident within 150-mm of line of change in crossfall;

(iii) offset by at least 150-mm from joints in underlying layers;

(iv) located away from traffic wheel paths; and

(v) located beneath proposed traffic linemarkings in the case of a wearing course.

Work shall be arranged to avoid longitudinal joint faces being left exposed overnight.

When pavers are laying asphalt in echelon, the hot joint so produced shall be constructed by leaving an uncompacted strip approximately 150-mm wide along the edge of the first run, and after the adjoining run has been spread, both sides of the joint shall be rolled simultaneously.

A joint shall be considered “cold” when the temperature of the asphalt has dropped below 60ºC for dense graded mix. Cold joints will require tack coating.

(c) Transverse joints

When the end of the asphalt layer has cooled due to disruption of the work, or when resuming work on the next day, a transverse joint shall be formed.

Transverse joints shall be at right angles to the direction of laying. They shall be staggered by at least 1-m between successive layers and between adjacent runs.

Runs shall end either against a timber bulkhead to ensure a straight vertical, well compacted edge or by feathering out and compacting. In the latter case, before continuing the run the feathered material shall be cut back to a line where the full layer thickness exists. The surface shape of the end of the run shall be checked by a straight edge to locate the line of cut. The end of the previous run shall be lightly tack coated before the laying of the next run proceeds.

When the asphalt layer is required to join and match the level of an existing pavement surface, bridge deck or other fixture, sufficient of the existing material shall be cut out to achieve the minimum layer thicknesses requirements.

SC6.4.6.13.4 Compaction

(1) Plant and equipment

The proposed compaction fleet and rolling pattern shall be adequate to achieve the specified compaction and finish.

The minimum number of rollers used for compaction of asphalt laid at various rates should be as shown in Table SC6.4.6.13.1 Minimum roller combinations for compaction.

For compaction of confined areas or patching works a small vibrating roller, or hand operated vibrating compactor acceptable to the Superintendent shall be used.

Table SC6.4.6.13.1 Minimum roller combinations for compaction

ASPHALT OUTPUT	ALTERNATIVE ROLLER COMBINATION		
	Dense Graded Asphalt		
Tonnes per hour per paver	Static Steel	Steel Vibrating	Pneumatic Tyred
Up to 45	1	-	1
	-	1	1
45 to 85	1	-	2
	-	1	1
85 to 120	1	-	3
	2	-	2
	-	2	1
Above 120	As for 85 to 120 plus additional rollers as determined by Compaction Trials		

Note— 1. At the discretion of the Superintendent, the minimum number of rollers may be decreased for layer thicknesses in excess of 60-mm.

2. Additional pneumatic tyred rollers to those specified may be required for backrolling asphalt.

(2) Dense graded asphalt

(a) Initial rolling

Initial rolling shall be carried out using steel rollers. Vibratory steel rollers may be used, but they shall be operated in the static mode for the first pass. On deep lift asphalt, pneumatic tyred rollers may be used.

Initial rolling shall commence as soon as possible after laying has commenced. Rollers shall be operated as close as possible to the paver.

The transverse and longitudinal joints and edges shall be compacted first.

The minimum asphalt temperature at the commencement of rolling shall be as detailed in MRTS30.

(b) Secondary rolling
Secondary rolling shall immediately follow initial rolling. In secondary rolling, static steel rollers or pneumatic tyred rollers shall be used. The tyre pressures of pneumatic tyred rollers should equal or exceed 550 kilopascals.

Rolling shall commence at the longitudinal joint side of the run.

Secondary rolling shall be completed before the mix temperature falls below 80 °C.

(c) Final rolling
Final rolling shall be carried out by a pneumatic tyred roller to eliminate all roller marks and to produce a uniform finish. If secondary rolling has been carried out with a pneumatic tyred roller, a steel roller may be used for final rolling instead of the pneumatic tyred roller specified.

Final rolling shall be completed before the asphalt temperature falls below 60 °C.

(3) Acceptance criteria for compaction
The acceptance for compaction shall be on a lot by lot basis where each day's work in one layer is generally one lot. Any defective areas which show cracking, bony material or exhibiting excessive binder shall be excluded from the lot and shall be rectified by the Contractor before being tested.

When directed by the Superintendent the Contractor shall arrange for the determination of the relative compaction of the lot by either of the following methods:

The acceptance for compaction on a lot shall be on the basis of characteristic value of relative compaction in accordance with MRTS30.

(4) Finished pavement properties
Each course of asphalt shall be finished parallel to the finished surface of the wearing course.

(5) Thickness
The thickness of asphalt shall be specified and/or measured in one of the following ways:

(a) No finished surface levels specified
When asphalt is placed over an existing pavement in one or more courses and no corrective course is applied, the calculated average compacted thickness of each course shall be in accordance with the course thickness specified in the Drawings and tolerances indicated in MRTS30.

(b) Finished surface levels specified
When asphalt is placed to specified levels, vertical tolerances and thicknesses shall be in accordance with MRTS30.

(6) Shape
The surface shall not deviate from the bottom of a 3 m long straightedge laid in any direction by more than 5 mm.

(7) Removal and replacement of rejected material
The sections of work that have been rejected under the preceding clauses of this sub-section or as otherwise determined by the Superintendent shall be removed within 15 days from the work and replaced with fresh asphalt mix material corresponding in grade and quality to that material specified in the Approved Mix unless otherwise approved by the Superintendent.

If removal of the single nonconforming pavement strata is impossible, the affected area as determined by the Superintendent shall be removed to subbase or subgrade depth as appropriate to provide a smooth level

surface on which to found the reinstated base and/or subbase course.

The perimeter of the nonconforming area shall be prepared in accordance with the practice pertaining to longitudinal and transverse cold joints (AS 2734).

In rejected sections the material is to be removed over the full length of the affected area except that a minimum length of 5 m and a minimum width equal to the paver width shall be removed.

The Superintendent shall have the right to alter the constitution, quality, grading, or other parameters of the "reinstatement pavement" if it is felt that reconstruction of the affected area with the Approved Mix would produce nonconforming pavement as a result of non-continuous pavement structure.

After removal of the rejected base or subbase course the area shall be made available to the Superintendent for inspection and approval to proceed with the works. Superintendent inspection and approval is required prior to release of hold point.

All materials used in the reinstatement of the nonconforming area shall comply with the requirements of this sub-section unless otherwise directed by the Superintendent.

SC6.4.6.13.5 Limits and tolerances

The limits and tolerances applicable to the various clauses of this sub-section are summarised in Table SC6.4.6.13.2 below:

Table SC6.4.6.13.2 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	Materials and mix ingredients and manufacture	~~DG~~ AC Asphalt - MRTS 30 and current TMR supplementary specifications. Bitumen - MRTS 17 Polymer modified binder - MRTS 18	SC6.4.6.13.2
2.	**Preparation of Pavement** (a) Cleaning of Surface	>300mm beyond the edge of proposed layer	SC6.4.6.13.3(1)
3.	**Tack Coat** (a) Bitumen Emulsion	Application Rate > 0.10 and < 0.20 litres per square metre	SC6.4.6.13.3(1)
4.	**Laying** (a) Paver Capacity	>50 tonnes asphalt per hour	
	(b) Spread Width	>3.7m	
	(c) Laying in Echelon	Distance between pavers is such that temperature of asphalt at edge (or laid by leading paver) is >80°C when following paver matches the longitudinal joint.	
	(d) Laying Temperature (i) Dense Grade AC	As per MRTS30	
	(e) Level Control	>10m length	SC6.4.6.13.3(7)(d)
	(i) Levelling Beam for Corrective Course		
	ii) Levelling Beam for Wearing Course	>10m length	SC6.4.6.13.3(7)(d)
	(f) Course and Layer Thickness	Nominal size mix and compacted layer thickness as per MRTS30.	
5.	**Longitudinal Jointing** (a) Change in Crossfall	Within 150mm of line of change.	
	(b) Where Underlying Layers	Offset at least 150mm from joints in underlying layers.	
6.	**Transverse Jointing** (a) Where Underlying Layers	Stagger to be >1m between successive layers and adjacent runs.	

Item	Activity	Limits/Tolerances	Clause
7.	**Compaction**	Initial Rolling:	SC6.4.6.13.3(2)(c)
	(a) Dense Graded Asphalt	To be commenced before asphalt temperature falls below 115ºC for layer ≤40mm. Refer to MRTS30	
		Secondary Rolling:	SC6.4.6.13.3(2)(d)
		Tyre pressures on pneumatic rollers to be≥550kPa.	
		Rolling to be completed before the asphalt temperature falls below 80ºC.	
		Final Rolling:	SC6.4.6.13.3(2)(d)
		Rolling to be completed before asphalt temperature falls below 60ºC.	
	(b) Acceptance Criteria for Compaction	On bases of characteristic value of relative compaction as per MRTS30 ~~DG~~ AC7 90% ~~DG~~ AC10 90% ~~DG~~ AC14 91% (92% > 50mm) ~~DG~~ AC20 93%	SC6.4.6.13.3(4)
8.	**Finished Pavement**	Max. compacted thickness tolerance as for Table 12.3.3.2 of MRTS30	
	(a) Thickness	~~DG~~ AC7 ± 5mm ~~DG~~ AC10 ± 5mm ~~DG~~ AC14 ± 7mm Where finished surface levels are specified, thickness and level shall comply with requirements of MRTS30. Reduced level primary tolerance ± 10mm.	
	(b) Shape	Shall not deviate from bottom of 3m straight edge by more than 5mm	SC6.4.6.3(6)

Attachments

SC6.4.6.13 Asphalt Work Record

Click here to obtain a copy of the following form.

SC6.4.6.12 Flexible pavements

SC6.4.6.12.1 Introduction

(1) Scope

This policy sub-section provides standards, advice and guidelines for the supply, spreading, compaction and trimming of base and subbase courses of flexible ~~and semi-rigid~~ (bound) pavements.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

Editor's note - A reference to drawings is a reference to construction drawings.

(2) Pavement structures

Flexible ~~or semi-rigid~~ pavement material types and layer thicknesses ~~shall~~must be as per design requirements.

(3) Activity plan

Prior to commencement of work, the Contractor must provide the Superintendent a Pavement construction plan and detail the following activities:

(a) allocation of plant and personnel for the contract period;

(b) work programming to meet the constraints of all inspection points; and

(c) prepare and submit a Pavement construction plan for the flexible base and subbase construction consistent with the drawings and subject to direction by the Superintendent. Include the following:

(i) a time based program;

(ii) a drawn sectional plan showing lots and sequence;

(iii) site availability, assumptions on weather, plant and materials;

(iv) a list of activities requiring approvals or notification of local authorities, statutory bodies, and local residents; and

(v) off-site storage of plant, personnel and maintenance facilities.

(4) Inspection, sampling and testing

Inspection, sampling and testing of the pavement ~~shall~~must be undertaken by the Contractor in accordance with the requirements of this sub-section before, during and after the construction of the pavement. Testing ~~shall~~must be carried out by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel.

The Contractor ~~shall~~must provide the Superintendent with written notice when testing is being carried out and copies of all test reports for approval to proceed.

Field density tests ~~shall~~must be carried out in accordance with AS 1289.5.3.1, or, with the Superintendent's concurrence, with a Nuclear Density Meter in accordance with Clause SC6.4.6.12.6(3).

(5) Terminology

Base material	materials designated as Base are of a suitable quality that form the uppermost structural element of a pavement and on which the surfacing may be placed.
Bound material	bound material incorporates binder/s to produce structural stiffness (UCS > 1.5 MPa at ~~7~~ 28 days in accordance with TMR Test Method Q115).

Flexible pavement	a flexible pavement consists of a base and a subbase constructed of unbound granular materials or modified material, obtaining its load spreading properties from intergranular pressure, mechanical interlock and cohesion between the particles of the pavement material.
Modified material	modified material incorporates small amounts of stabilising binder to improve the properties of the material without significantly affecting structural stiffness. A modified material must have sufficient stabilising binder to achieve a UCS range of 0.8 MPa - 1.5 MPa at ~~7~~ 28 days in accordance with TMR Test Method Q115.
Subbase material	materials designated as Subbase are laid on the subgrade (or selected material), below the base, either for the purpose of making up additional pavement thickness, to prevent intrusion of the subgrade into the base, or to provide a working platform.
Unbound material	unbound materials are granular materials with no significant capacity to resist tensile stresses.

(6) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.6.16 - Sprayed bitumen surfacing

SC6.4.6.19 - Stabilisation

SC6.4.4.2 – Pavement design

(b) Queensland Department of Transport and Main Roads specifications

MRTS05 - Unbound Pavement

(c) Queensland Department of Transport and Main Roads Test Methods

Q142A - Dry Density - Moisture Relationship (Standard Compaction).

Q115 - Unconfined Compressive Strength of Compacted Materials.

Q701 - Benkelman Beam Deflections.

(d) Australian Standards

AS 1141.14	*- Particle shape, by proportional calliper*
AS 1141.22	*- Wet/dry strength variation*
AS 1289.3.1.1	*- Determination of the liquid limit of a soil - Four point Casagrande method*
AS 1289.3.3.1	*- Calculation of the plasticity index of a soil*
AS 1289.3.6.1	*- Determination of the particle size distribution of a soil - Standard method of analysis by sieving*
AS 1289.3.6.3	*- Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer*
AS 1289.5.1.1	*- Determination of the dry density/moisture content relation of a soil using standard compactive effort*
AS 1289.5.3.1	*- Determination of the field density of a soil - Sand replacement method using a sand-cone pouring apparatus*
AS 1289.5.4.1	*- Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.8.1	*- Determination of field density and field moisture content of a soil using a nuclear surface moisture - density gauge - Direct transmission mode*
AS 1289.6.1.1	*- Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen*

SC6.4.6.12.2 Materials

(1) General

The Contractor ~~shall~~must submit details of all constituents of the proposed base and subbase materials, including sources of supply and the proposed type and proportion of any binder including targeted 28 days unconfined compressive strength (UCS). These details ~~shall~~must be submitted to the Superintendent, supported with test results from a nominated NATA registered laboratory confirming that the constituents comply with the requirements of this sub-section.

If the proposed base or subbase is a bound material, the Contractor ~~shall~~must submit a completed SC6.4.6.19 Attachment A Stabilisation mix design contained in the sub-section SC6.4.6.19 Stabilisation.

No material ~~shall~~ may be delivered until the Superintendent has approved the source of supply.

If, after the Contractor's proposals have been approved, the Contractor wishes to make changes in any of the material constituents the Contractor ~~shall~~must inform the Superintendent in writing of the proposed changes. No delivery of material produced under the altered proposal ~~shall~~must take place without the approval of the Superintendent.

At least 2 weeks before placement of the material on site, the Contractor ~~shall~~must submit a Certificate from a laboratory with appropriate NATA registration demonstrating and stating that the unbound material or the mix and its constituents comply with the requirements of this sub section.

Ongoing testing of materials during delivery and construction ~~shall~~must be undertaken on samples taken from the site.

(2) Unbound base and subbase

Base materials ~~shall~~must comply with the requirements of type 2.1 materials as per clause 7.2 of MRTS05, grading B or C.

Sub-base materials ~~shall~~must comply with the requirements of type 2.3 materials as per clause 7.2 of MRTS05, grading B or C.

Lower sub-base ~~shall~~must comply with the requirements of type 2.4 materials as per clause 7.2 of MRTS05, grading B or C.

Unbound materials, including blends of two or more different materials, ~~shall~~must consist of granular material which does not develop significant structural stiffness when compacted. Material produced by blending ~~shall~~must be uniform in grading and physical characteristics.

(a) **Surface Evenness**

Townsville City Council reserves the rights to carry out the necessary test procedure and supply results to the Contractor.

(b) **Layer Thickness**

Unbound pavement material ~~shall~~must be laid at a minimum thickness of 125mm and a maximum thickness of 250mm.

(c) **Longitudinal Joins**

Longitudinal joins for paving runs for the top layer of the base courses ~~shall~~must be aligned to coincide with the position of the traffic lane markings, except where approved otherwise in writing by the Superintendent.

(d) **Segregation**

Segregation is the uneven distribution of particle sizes. The construction process ~~shall~~must minimise segregation. There ~~shall~~must be no visible signs of segregation on each lot. Samples ~~shall~~must be taken from each lot to check that segregation of the material in the lo~~s~~t has not occurred. Additional samples ~~shall~~must be taken from any areas which show visible signs of segregation. Each sample ~~shall~~must be tested in accordance with Test Method Q103A.

(3) Lime modified base and subbase materials

Modification of unbound base and subbase materials to meet the requirements of clause SC6.4.6.12.2(2) Unbound base and subbase by the addition of hydrated lime or quicklime ~~shall be~~is subject to approval by the Superintendent and to the additional requirements of this clause. After modification, the material ~~shall~~must meet the requirements of clause SC6.4.6.12.2(2) Unbound base and subbase.

Modification of materials must be by means of blending either hydrated lime through a stationary mixing plant or by hydrated lime or quicklime utilising in-situ operations.

Material requirements of hydrated lime and quicklime ~~shall~~must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The method of incorporating lime through the stationary mixing plant ~~shall~~must ensure that the lime is mixed uniformly through the material.

In-situ operations ~~shall~~must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The proportion of lime ~~shall~~must be not less than 1.5% ~~per cent~~ nor more than 4% ~~per cent~~ by mass. The material prior to lime treatment ~~shall not~~must contain ~~any~~ no added pozzolanic material.

The lime treated material ~~shall~~ must yield an unconfined compressive strength not exceeding 1~~.0~~ MPa, when tested in accordance with Test Method Q115 where sampling is undertaken within 24 hours of adding the lime and testing is after ~~7~~ 28 days ~~accelerated~~ curing.

(a) **Curing Final Layer**

Moist curing process has the potential to "wash" the cementitious paste from the upper surface, which leaves an unbound, non-cohesive, soft pavement matrix with high embedment potential for the subsequent sealing aggregate. Therefore, wherever possible the completed pavement ~~shall~~ should not be moist cured within ~~72~~ 48 hours of placing. ~~After 72 48 hours, m~~Moist curing ~~shall~~ must be carried out using equipment fitted with spray jets that deliver water to the pavement as a fine mist. The use of conventional spray bars or high pressure water nozzles with large aperture sprays holes will not be permitted. Conventional bituminous surface curing may be used within ~~72~~ 48 hours.

~~(4) Insitu lime stabilisation of subgrade~~

~~Lime stablisitation of subgrade material shall be carried out as a two day operation to a minimum depth of 250mm, except for natural subgrades of CBR 0.5% where stabilisation depth shall be a minimum of 300mm. The stabilising agent shall be spread using a purpose built spreader and the stabilising agent and water shall be incorporated into the material using a reclaimer/stabiliser. Alternatively, a reclaimer/stabiliser with a calibrated integrated spreader/applicator may be used to incorporate the stabilising agent and water directly into the material to be stabilised. Where a reclaimer/stabiliser with calibrated integrated spreader/applicator is used, quicklime shall not be used as the stabilising agent.~~

~~**Day 1:** A single lime pass at a rate of up to half the required rate shall be applied. Where quicklime is spread over the subgrade, it shall be slaked in accordance with the requirements in this document. In situations where hydrated lime is used, slaking is not required mixing the stabilising agent into the soil. The hydrated lime or lime slurry formed from the slaking of quicklime shall then be mixed into the material in accordance with the requirements in this document. The depth of mixing shall not exceed 90% of the specified stabilisation thickness. The material shall be lightly rolled to seal the surface prior to the completion of work on that particular day.~~

~~**Day 2:** After the overnight amelioration period, the balance of the required lime shall be spread in accordance with the requirements in this document. Where quicklime is spread over the subgrade, it shall be slaked in accordance with the requirements in this document. In situations where hydrated lime is used, slaking is not required before mixing the stabilising agent into the soil. The hydrated lime or lime slurry formed from the slaking of quicklime shall then be mixed into the material in accordance with the requirements in this document. Notwithstanding this a minimum of two mixing passes shall be completed.~~

~~Lime shall be spread at a maximum spread rate of 12 kg/m2. The number of passes shall be calculated to comply with this requirement. The stabilising agent shall be uniformly spread over the insitu material at a controlled rate (mass per unit area, kg/m2). The total rate of spread shall be such that the stabilising agent spread rate for the compacted material is within the specified tolerances. Once the stabilising agent has been spread, no traffic, other than the construction plant employed for the stabilisation work, shall travel over it. After each spreading run at least one mixing run, and trimming and/or compaction as required, shall be completed. Further mixing operations between spreading runs shall comply with requirements in this document.~~

~~Quicklime shall be slaked with sufficient water to allow complete hydration such that the material remains friable after slaking and no further exothermic reaction occurs when further water is added to the lime. All through traffic shall be stopped during any slaking operation.~~

~~The entire stabilisation process shall not proceed in any of the following situations: during rainfall;~~

- ~~when rainfall appears to be imminent;~~
- ~~during periods when the wind is strong enough to cause particles of the stabilising agent to become airborne;~~
- ~~during conditions that may result in the work causing nuisance or danger to people, property, the environment, or live stock;~~
- ~~when the pavement temperature, measured 50 mm below the surface, drops below 10ºC; and when the air temperature, measured in the shade, exceeds 40ºC .~~

(4~~5~~) Bound base and subbase materials (Including Modified Material)

Bound material for a UCS ~~>~~ 1.5 MPa (~~7~~ 28 days) to be used as subbase generally or base layer may be supplied as a pugmill quarry product with stabilising agent and ~~layed~~ laid using a paving machine or grader laid ~~pugmill~~. Alternatively it may be produced by the in- situ stabilisation of natural or blended gravel where stabilisation is undertaken by mobile plant at the site.

Prior to stabilisation, the ~~base~~ layer ~~material~~to be stabilised ~~shall~~must meet the appropriate requirements for subbase material. Material requirements for the stabilising agent ~~shall~~must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The stabilisation process ~~shall~~must meet the requirements of sub-section SC6.4.6.19 Stabilisation.

The unconfined compressive strength (UCS) of the material after 28 days curing as determined by Test Method Q115 ~~shall~~must be not less than ~~3.0~~2.5 MPa for stabilised pavements and not less than ~~1.0~~0.8 MPa for modified pavements. Sampling and test specimen compaction of the material ~~shall~~must be undertaken within one hour of the incorporation of the stabilising agent.

The maximum period (working time) between mixing cement with the gravel material and the completion of compaction ~~shall~~must be ~~3.5~~3 hours. Council reserves the rights to reject the work if working time is not achieved and the material must be removed from site.

(a) **Surface Evenness**
Townsville City Council reserves the rights to carry-out the necessary test procedure and supply results to the contractor.

(b) **Layer Thickness**
Bound pavement material (including Modified Material) ~~shall~~must be laid at a minimum thickness of 150mm and a maximum thickness of 250mm. If bound layers are placed with a paving machine, Council may approve thinner layers.

(c) **Longitudinal Joins**
Longitudinal joins for paving runs for the top layer of the base courses ~~shall~~must be aligned to coincide with the position with the traffic lane markings, except where approved otherwise in writing by the Superintendent.

(d) **Segregation**
Segregation is the uneven distribution of particle sizes. The construction process ~~shall~~must minimise segregation. There ~~shall~~must be no visible signs of segregation of the material in the lot has not occurred. Additional samples ~~shall~~must be taken from any areas which show visible signs of segregation. Given the presence of cement additive in the material, the relevant test for segregation ~~shall~~must be as specified in AS 1289.3.6.1.

(e) **Curing Final Layer**
Moist curing process has the potential to “wash” the cementitious paste from the upper surface, which leaves an unbound, non-cohesive soft pavement matrix with high embedment potential for the subsequent sealing aggregate. Therefore, the completed pavement ~~shall~~must not be moist cured within ~~72~~ 48 hours of placing. After ~~72~~ 48 hours, moist curing ~~shall~~must be carried out using equipment fitted with spray jets that deliver water to the pavement as a fine mist. The use of conventional spray bars or high pressure water nozzles with large aperture sprays holes will not be permitted. Conventional bituminous surface curing may be used within ~~72~~ 48 hours.

SC6.4.6.12.3 Delivery, stockpiling and processing of pavement material

(1) Delivery to site
Materials must be supplied sufficiently damp to avoid segregation and loss of fines during transit.

(2) Stockpiling of unbound materials
Stockpile sites ~~shall~~must be located as shown on the drawings or as approved by the Superintendent.

Stockpile sites, which ~~shall~~must be cleared of all vegetation and extraneous matter, ~~shall~~must be shaped to form a crown so as to be free draining and compacted over the whole area to provide a relative compaction, determined by
AS 1289.5.4.1 for standard compactive effort, of not less than 95% ~~per cent~~.

Stockpiles and stockpile sites ~~shall~~must be maintained so as to prevent the stockpiled materials from becoming intermixed or contaminated with foreign material.

The total height of any stockpile ~~shall~~must not exceed 3 m.

Stockpiles ~~shall~~must be of uniform shape with side slopes neither steeper than 1.5h to 1v nor flatter than 3h to

1v. The worked face of any stockpile ~~shall~~must be the full face of the stockpile. The stockpiled material

~~shall~~must be
maintained at a moisture content sufficiently damp to avoid loss of fines.

(3) At the completion of the works, stockpile sites ~~shall~~must be cleared of all surplus material and left in a clean and tidy condition.

Delivery of modified or bound materials
Modified or bound materials ~~shall~~must be delivered in vehicles fitted with covers of canvas or other suitable material to prevent loss of moisture during transport.

The time between mixing and conveyance by delivery trucks to the site, ~~shall~~must be such as to allow incorporation into the works including trimming and compaction within the nominated field working period.

Each truck load of bound material ~~shall~~must be identified by delivery dockets, indicating the time and date of mixing and registration or fleet number of the delivery truck, and such dockets ~~shall~~must be made available to the Superintendent at the point of delivery.

Bound materials ~~shall~~must comply with the requirements of sub-section SC6.4.6.19 Stabilisation.

SC6.4.6.12.4 Spreading pavement materials
The contractor must present the underlying layer to the Superintendent prior to placement of subsequent layers and must ensure~~ing~~ that moisture content of the underlying layer does not exceed 90% ~~per cent~~ of the laboratory optimum moisture content as determined by AS 1289.5.1.1. If the underlying layer ~~or which~~ has become rutted or mixed with foreign matter, it. ~~The underlying layer~~ ~~shall~~must be corrected to comply with this Sub-section before spreading of the next layer of pavement.

Where the underlying layer was constructed by the Contractor, or where the Contractor’s activities caused the

underlying layer constructed by others to become non-complying with this sub-section, ~~the~~ correcting the underlying layer to comply ~~shall be~~is the responsibility of the Contractor.

Each layer of material ~~shall~~must be deposited and spread in a concurrent operation and, after compaction, the finished surface levels on the base and subbase courses ~~shall~~must be within the permitted tolerances stated in Clause SC6.4.6.12.6(6)(c) Levels and surface trim without subsequent addition of material. The thickness of each compacted layer ~~shall~~must be neither less than ~~150~~ 125 mm nor more than ~~300~~ 250 mm for all pavement layer types, unless otherwise approved by the Superintendent.

At all work boundaries in bound materials the Contractor ~~shall~~must provide vertical faces to provide for transverse and longitudinal joints.

When spread for compaction processes the moisture content of the unbound and bound base materials must be in the range of 60-90% and ~~or~~ subbase materials ~~shall~~must be in the range of ~~60-90 per cent and~~ 75-100% ~~per cent respectively~~ of laboratory optimum moisture content in accordance with AS 1289.5.1.1.

Bound materials with UCS > 1.5 MPa (~~7~~ 28 days) ~~shall~~must not be spread with a self-propelled paver when the ambient air temperature in shade is either below 5 °C or above 35 °C ~~with a self-propelled paver~~. ~~The working time shall not exceed 3 hours (i.e. materials must be trimmed and compacted within 3 hours from the time the cement is added to the material at the quarry).~~ Where the materials are to be spread outside the required ambient air temperature range, the Contractor must submit a work proposal to the Superintendent for approval.

SC6.4.6.12.5 ~~Trimming and c~~Compaction

(1) General requirements

Each layer of the base and subbase courses ~~shall~~must be uniformly compacted over its entire area and depth to satisfy the requirements of relative compaction set out in clauses SC6.4.6.12.6(3) Relative compaction and SC6.4.6.12.6(4) Compaction requirements and acceptance.

On sections of pavement with one way crossfall, compaction ~~shall~~must begin at the low side of the pavement and progress to the high side. On crowned sections, compaction ~~shall~~must begin at the sides of the pavement and progress towards the crown. Each pass of the rollers ~~shall~~must be parallel with the centreline of the roadway and uniformly overlap each preceding pass. The outer metre of both sides of the pavement ~~shall~~must receive at least two more passes by the compaction plant than the remainder of the pavement.

At locations where it would be impracticable to use self propelled compaction plant, the pavement material ~~shall~~must be compacted by alternative hand operated plant approved by the Superintendent.

Watering and compaction plant ~~shall~~must not be allowed to stand on the pavement being compacted.
If any unstable areas develop during rolling, the unstable material ~~shall~~must be rejected. The rejected material ~~shall~~must be removed for the full depth of the layer, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses. This operation will be at cost to the Contractor.

The placement of subsequent layers ~~shall~~must not be allowed until the requisite testing has been completed and the test results for each layer have been accepted by the Superintendent and correct curing times for bound layers has been attained.

Any unbound material in a layer that has attained the specified relative compaction but subsequently becomes wetted up ~~shall~~must be dried out and, if necessary, uniformly recompacted and trimmed to meet the specified density requirements and level tolerances.

(2) Curing of bound materials

The curing of the surface layer of a lot ~~shall~~must commence after compaction is completed and must be in accordance with the SC6.4.6.19 Attachment A Stabilisation mix design.

The stabilised work ~~shall~~must be protected against rapid drying out by keeping it continuously wet or damp during

the period prior to the provision of a subsequent layer or the application of a prime or primer-seal. Also refers to the requirements of SC6.4.6.12.2 (5) (e) Curing of final layer.

~~Moist curing of the final layer process has the potential to "wash" the cementitious paste from the upper surface, which leaves an unbound, non cohesive soft pavement matrix with high embedment potential for the subsequent sealing aggregate. Therefore, the completed pavement shall~~must ~~not be moist cured within 72 hours of placing. After 72 hours, moist curing shall~~must ~~be carried out using equipment fitted with spray jets that deliver water to the pavement as a fine mist. The use of conventional spray bars or high pressure water nozzles with large aperture sprays holes will not be permitted. Conventional bituminous surface curing may be used within 72 hours.~~

SC6.4.6.12.6 Acceptance of compaction

(1) Lots for acceptance

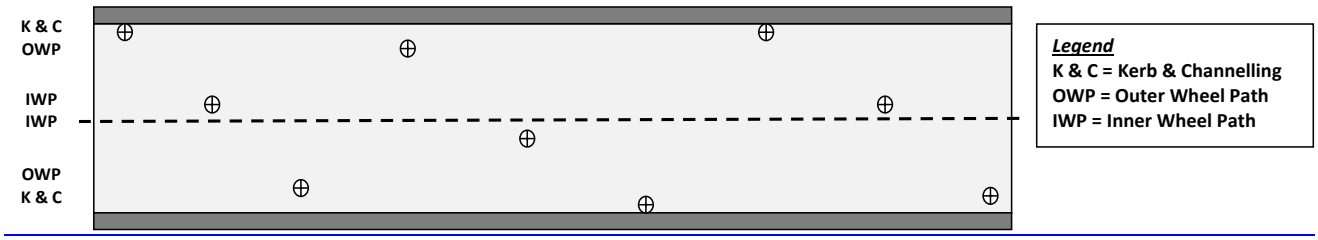
Acceptance of work, as far as compaction is concerned, ~~shall~~must be based on density testing of the work in lots. A lot ~~shall~~must be nominated by the Contractor, but ~~shall~~must conform to the following:

(a) cover only a single layer of work which has been constructed under uniform conditions in a continuous operation and not crossing any transverse construction joints; and

(b) for unbound materials, it may equal a day's output using the same material.

(2) Compaction assessment

The Superintendent ~~shall~~must assess compaction for each lot based on an arranged ~~random sampling~~ of test locations for in-situ dry density testing in line with the following diagram. The intention is that one in every three density tests ~~shall~~must be positioned against the inner line of the kerb and channel on either side. This arrangement ~~shall~~must be repeated or truncated as appropriate depending on the number of tests required per lot.



Similar arrangement ~~shall~~must be adopted for roads with no kerb and channel or edge constraint, with the test locations at the edge shifted to the OWP position. A random arrangement for test locations at intersection is acceptable, provided that one in every three density test is positioned along the inner kerb and channel / edge line.

The Contractor ~~shall~~must arrange for testing to assess compaction on the basis of a pro rata testing frequency of 10 tests per 5,000 ~~sq m~~ with a minimum of three tests per lot~~, and present the results to the Superintendent for approval~~.

The elastic rebound deflection ~~shall~~must be taken as the maximum deflection in accordance with Test Method Q701 utilising the Benkelman Beam or equivalent. The average maximum deflection for any lot ~~shall~~must not exceed 1~~.0~~ mm, and the co-efficient of variation (CV) in recorded deflections ~~shall~~must not exceed 30% ~~per cent~~.

(3) Measurements ~~shall~~must be taken at the rate of 4 per 1,000 ~~square metres~~, with a minimum of ten measurements per lot.

Proof rolling ~~shall~~must be undertaken with the use of a single drive axle truck with a~~n~~ rear single axle/dual wheels load of 8.2 ~~t~~ or tandem rear axle/dual wheels carrying a load of 13.8t. Proof rolling must cover~~ing~~ all lanes of the carriage way including parking bays and must show ~~having~~ no evident movement.

Relative compaction

The relative compaction of pavement material at each location tested for in-situ dry density ~~shall~~must be calculated in accordance with AS 1289.5.4.1 as follows:

$$\text{Relative Compaction (per cent)} = \frac{\text{In-situ dry density}}{\text{Comparative dry density}} \times 100$$

Note—the comparative dry density ~~shall~~must be the maximum dry density determined in the laboratory.

The council Superintendent may approve some or all of the in-situ dry density testing to be carried out with a single probe Nuclear Density Meter in the direct transmission mode in accordance with AS 1289.5.8.1. Council reserves the right to request additional testing at the discretion of the Inspector.

Each day that material is produced for placement in a layer or layers, a sample of the material ~~shall~~must be taken by the Contractor for maximum dry density testing to represent that day's production.

For unbound layers, the sample ~~shall~~must be tested in accordance with AS 1289.5.1.1 to determine the maximum dry density (standard compactive effort) for the material.

For bound layers the sample ~~shall~~must be tested within two hours after the addition of stabilising agent to the mix in accordance with Test Method Q142A to determine the maximum dry density (standard compactive effort) for

the material. This test method ~~shall~~must also be used to determine the standard optimum moisture content.

The maximum dry density so determined ~~shall~~must be used as the comparative dry density in relative compaction calculations for all like material from that lot or day's production placed in a single layer of work whichever is the lesser.

(4) Compaction requirements and acceptance

All compaction test results must exceed the minimum requirements in accordance with:

(a)	Unbound pavement	MRTS05
(b)	Insitu stabilised subgrade using lime	MRTS07A
(c)	Insitu stabilised pavement using cement	MRTS07B
(d)	Insitu stablised pavement using foam bitumen	MRTS07C
(e)	Plant mixed stabilised pavement	MRTS08

(5) Reworking of rejected unbound layers

Lots or areas of pavement that have been rejected in regard to compaction ~~shall~~must be reworked before resubmission for compaction assessment.

Material that has become degraded, segregated or otherwise reduced in quality by reworking ~~shall~~must be rejected. The rejected material ~~shall~~must be removed, disposed of and replaced with fresh material complying with this Sub- section in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses. When a lot or area of pavement is resubmitted for compaction assessment, testing ~~shall~~must be carried out in accordance with clauses SC6.4.6.12.6(2) Compaction assessment and SC6.4.6.12.6(3) Relative compaction.

All corrective work ~~shall~~must be carried out by the Contractor before the resubmission of a lot for compaction assessment, including rewatering, rerolling, removal and replacement of material as well as reworking. All costs associated with corrective work carried out before the resubmission of a lot for compaction assessment, including rewatering, rerolling, removal and replacement of material as well as ~~as~~ reworking ~~shall~~must be borne by the Contractor.

Reworking of rejected modified or stabilised material is not accepted.

(6) Tolerances

(a) General

The tolerances stated are the acceptable limits of departure from the dimensions shown on the drawings, which may occur during construction.

Areas for assessment of conformity with tolerance requirements ~~shall~~must be divided into lots and presented to the Superintendent together with survey reports covering line and level.

(b) Width

At any cross section without kerb and /or guttering channel or a dish drain, and for pavement layers extending under the kerb and channel or dish drain/or guttering , the horizontal dimension measured from the design centre line to the edge of the constructed pavement surface ~~shall~~must be neither less than 50 mm less than the dimension nor more than 300 mm greater than the dimension shown on the drawings. The average width of the layer determined from measurements at three sites selected at random by the Superintendent over any 200 m road length, or part thereof, ~~shall~~must be not less than the specified width.

(c) Levels and surface trim

The levels of the finished surface of the top of the unbound subbase course ~~shall~~must not vary from the design levels by more than ± ~~(10)~~ 15 mm.

Level tolerances at the top of the unbound base course ~~shall~~must not exceed those stated above for subbase. In addition, where kerb and channel exists or is being constructed, the level of the top of the base course adjacent to the kerb and channel ~~shall~~must not vary by more than ±~~ ~~5~~ ~~~~mm from the lip level of the gutter

minus the design thickness of the wearing surface.

The design level of the top of the subbase course ~~shall~~must be determined from the design level of the finished road surface less the thickness of the base course and the wearing course, including an allowance for any flush seal layer in the pavement design.

The pavement surface after trimming and immediately prior to sealing ~~shall~~must be of a quality such that the deviation under a 3 m straight edge placed in any direction does not exceed 12 mm. Measurements for conformance ~~shall~~must be taken in accordance with the maximum lot size and minimum test frequencies in SC6.4.5 Construction management.

(7) Action on rejection

(a) Unbound materials

A lot that has not complied with the requirements for width or level tolerance as set out in clauses SC6.4.6.12.6(6)(b) Width and SC6.4.6.12.6(6)(c) Levels and surface trim respectively ~~shall~~must be rejected except as otherwise provided in this clause. Rejected lots ~~shall~~must be removed, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses.

Notwithstanding the above, where the rejected lot can be corrected by further trimming, the Superintendent may allow the surface to be corrected without complete removal and replacement with fresh material. Such trimming ~~shall~~must be undertaken in a manner that produces a uniform, hard surface and ~~shall~~must be achieved by cutting only without filling. After any such cutting, the level tolerances in clause SC6.4.6.12.6(6)(c) Levels and surface trim ~~shall~~must apply.

The required surface correction or replacement work ordered in accordance with this clause including removal of material, disposal and supply and transport of replacement material, ~~shall~~must be borne by the Contractor.

(b) Bound materials

An area of bound material that has not complied with the requirements for width or level tolerance as set out in clauses SC6.4.6.12.6(6)(b) Width and SC6.4.6.12.6(6) Levels and surface trim respectively ~~shall~~must
be rejected except as otherwise provided for in this clause. Rejected areas ~~shall~~must be removed, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses.

The removal and disposal of rejected material and its replacement with fresh material ~~shall~~must be borne by the Contractor.

Notwithstanding the above, the Superintendent may allow the Contractor to rectify the area in the following cases:

(i) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a subbase course and rejection is due to departures from design level being too far below the design level, the Contractor may increase the thickness of the base course to make up such deficiency in thickness.

(ii) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a subbase course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course, to allow for its design thickness to be laid, up to a maximum of 20 mm above the original design level. Approval by the Superintendent ~~shall be~~is subject to the following requirements:

(A) the rate of change of grade from the original finished design surface level ~~shall~~must be less than 3 mm per metre;

(B) the regrading ~~shall~~must not interfere with the proper design functioning of the drainage system;

(C) the regrading ~~shall~~must not interfere with levels at the property boundary, or increase or decrease footpath or footpath crossover levels or grades beyond council's allowable design limits; and

(D) the regrading ~~shall~~must not interfere with clearances.

(iii) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a base course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course. Approval by the Superintendent ~~shall be~~is subject to the requirements of this clause in (ii) above.

(8) Removal and replacement of rejected courses

Sections of work that have been rejected by the superintendent are to be removed from the work site and replaced with fresh material.

Any rejected pavement sections are to be removed and replaced over the full length of the rejected lot for a minimum length of 20 m of the pavement layer. Any damage to underlying or abutting layers or structures ~~shall~~must be made good by the Contractor using methods approved by the Superintendent.

The Superintendent may approve removal for less than the full width as constructed if the cause of the rejection of the work can be isolated transversely to the Superintendent's satisfaction. In this case, the new longitudinal cold joint ~~shall~~must be formed and located along the centreline of the road pavement.

After removal of rejected base or subbase course material, the section ~~shall~~must be presented for inspection by the Superintendent before replacement work is commenced.

Materials used as replacement materials, and the subsequent spreading, compaction, trimming, curing and testing of the replacement materials, ~~shall~~must comply with the requirements of this sub-section.

The removal, replacement and correction of base and subbase courses required under this clause ~~shall be~~is the responsibility of the Contractor in respect of delays caused by such removals, replacements and corrections ~~shall~~must be borne by the Contractor.

All costs associated with the corrective work ~~shall~~must be borne by the Contractor.

(9) Maintenance before completion of wearing surface

Following the Superintendent's acceptance of any section of the work, the Contractor ~~shall~~must maintain the prepared surface of the base in the condition specified for acceptance until the wearing surface is completed. The preparation work ~~shall~~must be carried out in a manner which will promote the adhesion of the bituminous material to the surface of the pavement. Preparation work ~~shall~~must include:

(a) Removal of all foreign and loose material from the surface.

(b) Light watering on dr~~a~~y and dusty surface

Ball Penetration testing on inner and outer wheelpaths ~~shall~~must be carried out on all pavements before application of bituminous material. Where a ball penetration result exceeds 4.0mm the surface ~~shall~~must not be sprayed until Council is advised and approval to proceed granted.

The base course of sections of the accepted work ~~shall~~must be covered with a primerseal over the full width of pavement in accordance with sub-section SC6.4.6.16 Sprayed bitumen surfacing within 7 days of the date of the acceptance of such sections, unless otherwise approved by the Superintendent.

Should the pavement condition deteriorate before the application of the primerseal and consent to proceed with the bitumen surfacing work is withdrawn by the Superintendent, the Contractor ~~shall~~must re-prepare the pavement and re-present the pavement for inspection by the Superintendent.

The maintenance and re preparing areas of the deteriorated pavement ~~shall be~~is the responsibility of the Contractor.

The Contractor ~~shall~~must maintain adequate drainage of the pavement, and remove any ponded water within 12 hours of its creation if free drainage cannot be achieved, prior to the completion of the wearing course.

SC6.4.6.12.7 Opening pavement to traffic

General requirements

For unbound pavement layers, construction plant and vehicles not involved in the current construction or testing of the work ~~shall~~must not be permitted to use the pavement until the primerseal has been applied, unless otherwise approved.

For bound pavement layers, construction plant and vehicles not involved in the current construction or testing of the work ~~shall not be permitted to~~should not use the pavement until the primerseal has been applied and seven days have elapsed since placement of the base. In any case only vehicles registered for legal road usage and loaded within legal limits will be allowed to use the pavement.

~~For bound pavement layers, traffic shall not be allowed to use the constructed pavement until a minimum of seven days after completion of the full pavement depth and the primerseal.~~

SC6.4.6.12.8 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.12.1 below.

Table SC6.4.6.12.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Stockpile Sites**	(i) Relative Compaction >97% (ii) Stockpile height <3m (iii) Stockpile batter <1.5:1 and >3:1	SC6.4.6.12.3(2) SC6.4.6.12.3(2)
2.	**Spreading Pavement Materials**		
	(i) Compacted Layer Thickness	≥150mm (modified material) ≥125mm (unmodified material) ≤250mm (all material)	SC6.4.6.12.4
3.	**Compaction Acceptance**		
	Minimum value of all calculated relative compaction results	All compaction test results must exceed the minimum referenced requirements	SC6.4.6.12.6(4)
4.	**Width of Pavement**	-50mm to +300mm of dimensions on drawings	SC6.4.6.12.6(6)(b)
	(i) Design centre-line to edge of constructed pavement		
	(ii) Average Width	The average width determined from 3 random sites over any 200m road length, or part thereof, ~~shall~~must be not less than the specified width.	SC6.4.6.12.6(6)(b)
5.	**Surface Level**		
	(i) Subbase levels	<± 15mm from design level	SC6.4.6.12.6(6)(c)
	(ii) Base levels	<± 15mm from design level	SC6.4.6.12.6(6)(c)
	(iii) Base levels adjacent to kerb and channel	<±5mm from the lip levels of adjacent gutter minus design thickness of wearing surface.	SC6.4.6.12.6(6)(c)
	(iv) Shape	Deviation from a 3m long straightedge on base surface immediately prior to sealing ~~shall~~must be less than 12mm	SC6.4.6.12.6(6)(c)
	(v) Ball Penetration	>4.0mm	SC6.4.6.12.6(9)

SC6.4.6.11 Clearing and grubbing

SC6.4.6.11.1 Introduction

(1) Scope

This sub-section provides standards, advice and guidelines for the clearing of all vegetation, both living and dead, all minor man- -made structures (such as fences and livestock yards), all rubbish and other materials, including the chipping of the crowns of trees and the branches of shrubs, and the grubbing of trees stumps from the area. The work also includes the disposal, in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation and SC6.4.6.11.3(3) Disposal of materials, of all materials that have been cleared and grubbed.

~~(2) Reference and source documents~~

~~Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.~~

~~(a) Australian Standards~~

~~AS/NZS 4671(As amended) - *Steel reinforcing materials*~~

~~AS 1744 (As amended) - *Forms of letters and numerals for road signs (known as Standard alphabets for road signs).*~~

(~~3~~2) General requirements

Site works shall take all measures to prevent damage to existing underground and overhead utility services.

Before commencing earthworks, locate and mark existing underground services in the areas to be affected by the works including clearing, excavating and trenching.

All existing utilities, natural landscape features, including natural rock outcrops, natural vegetation, trees to be preserved, soil and watercourses are to remain undisturbed.

Explosives shall not be permitted to be used in clearing, grubbing or other demolition activities.

Editor's note—DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, through which underground pipes and cables are located (possible within two working days). For more information go to the Dial 1100 Before you Dig website.

SC6.4.6.11.2 Clearing

(1) Clearing operations

The area within the limits of clearing shall be cleared of all vegetation, both living and dead, all minor ~~man~~ man-made structures (such as fences and livestock yards), all rubbish and other materials which, are unsuitable for use in the works with the exception of certain trees marked for preservation. The contractor shall plan clearing operations such that wherever possible, clearing is carried out progressively and only the minimum area of land is left disturbed at any time.

The contractor shall give the superintendent written notice of seven days of the intention to clear any area of the work. The superintendent shall mark or indicate to the contractor the trees that shall be preserved. The contractor shall arrange for an inspection by an authorised council officer and shall obtain council's approval to proceed with clearing and grubbing. The contractor must conform to the requirements of SC6.4.5.2(18) when protecting identified trees and bushland within or adjacent to the construction site.

The erection of structures, excavation and filling, changes to soil profiles, stockpiling of spoil, storage of other materials and driving or parking of any vehicle or machinery within 4 m of the trunks of trees to be retained shall not be permitted unless they form part of the works as approved by the council.

The Contractor shall plan all operations to ensure that there is no damage to any trees outside the limits of clearing specified or directed by the Superintendent. No growing trees shall be destroyed or damaged by the Contractor other than those specified and those indicated by the Superintendent.

Any tree remaining within the road reserve but outside the limits of clearing which is, in the opinion of the Superintendent, unsound and likely to fall upon the roadway shall be cleared and disposed of in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation, subject to prior approval of council.

If directed by the Superintendent, any branch, which overhangs the road formation, shall be cut back to within 0.5 m of the tree trunk and disposed of in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation.

(2) Fallen timber and tree damage

Every precaution shall be taken to prevent timber from falling onto private property. The Contractor shall dispose of any timber that has fallen onto private property or produce written consent from the property owner to its remaining there.

The cost of disposal of such fallen timber shall be borne by the Contractor. Prior to entering the private property, the Contractor shall obtain consent from the Superintendent and the property owner. Damage of any kind, including damage to trees, fencing, occurring during clearing operations shall be made good by the Contractor. The cost of making good such damage shall be borne by the Contractor. Any damage to trees or vegetation which in councils opinion, will require its removal, is to be in rectified in accordance with SC6.4.5.2.1(19)(d).

SC6.4.6.11.3 Grubbing

(1) Grubbing

All trees and stumps, on or within the limits of clearing, unable to be felled and removed by the clearing methods used by the Contractor shall be removed by grubbing.

Grubbing operations shall be carried out to a depth of 0.5m below the natural surface or 1.5 m below the finished surface level, whichever is the lower.

Holes remaining after trees and stumps have been grubbed shall be backfilled promptly with sound material to prevent the infiltration and ponding of water. The backfilling material shall be compacted to at least the relative density of the material existing in the adjacent ground.

(2) Chipping of cleared vegetation

The Contractor shall produce a wood-chip mulch derived from crowns of trees and branches of shrubs cleared under this sub-section. The wood-chip mulch produced shall be stockpiled for subsequent use or for use at other locations as appropriate.

The wood-chip mulch shall be produced from branches having a maximum diameter of 100 mm and the chipped material produced shall not have two orthogonal dimensions exceeding 75 mm and 50 mm.

(3) Disposal of surplus materials

Unless otherwise specified elsewhere, all surplus materials cleared and grubbed in accordance with this sub-section shall either be removed from the site or used for landscaping within the site in accordance with the approved plans and any conditions set by council.

Unless otherwise approved by council in writing, disposal of timber and other combustible materials by burning shall not be permitted.

SC6.4.6.10 Earthworks (construction)

SC6.4.6.10.1 Introduction

(1) Scope

(a) This sub-section provides standards, advice and guidelines for earthworks and associated construction, including:

(i) removal of topsoil;

(ii) all activities and quality requirements associated with site regrading, the excavation of cuttings, the haulage of material and the construction of embankments to the extent defined in the drawings and sub-section;

(iii) removal and replacement of any unsuitable material;

(iv) any spoil or borrow activities associated with earthworks; and

(v) any additional processing of selected material for the selected material zone.

(b) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section one as follows:

SC6.4.6.30 Control of traffic
SC6.4.6.11 Clearing and grubbing
SC6.4.6.4 Stormwater drainage

(b) Australian Standards

AS1141.11	*- Soil classification test – Determination of the particle size distribution of a soil – Standard method of analysis by sieving*
AS1289.3.3.1	*- Calculation of the plasticity index of a soil.*
AS1289.5.1.1	*- Determination of the dry density/moisture content relation of a soil using standard compactive effort.*
AS1289.5.4.1	*- Compaction control test - Dry density ratio, moisture variation and moisture ratio.*
AS1289.5.7.1	*- Compaction Control Test Hilf density ratio and Hilf moisture variation (Rapid Method).*
AS1289.6.1.1	*- Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.*
AS1289.7.1.1	*- Soil reactivity tests – Determination of the shrinkage index of a soil*
AS2187.0	*- Explosives - Storage, transport and use - Terminology*
AS2187.1	*- Explosives - Storage, transport and use - Storage*
AS2187.1	*- Explosives - Storage, transport and use - Use of explosives*

(c) QLD Government Legislation

Environmental Protection Act 1994
Environmental Protection (Noise) Policy 2008
Explosives Act 1999
Explosives Regulation 2003
Sustainable Planning Act 2009
Work Health and Safety Act 2011

(d) Other

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

Workplace Relations Ministers' council, *Australian Code for the Transport of Explosives by Road and Rail*
MRTS55 Use of Explosives in Roadworks

(3) Natural surface and earthworks materials

(a) Natural surfaces

The Contractor must verify the accuracy of the model by field surveys. If the Contractor considers any areas of the model not to be representative of the approved plans, the Contractor shall give not less than seven days' notice, prior to commencement of Works to the Superintendent to allow checking. If the subsequent check survey reveals the ground model to be incorrect, any plans that are affected are to be resubmitted for approval.

(b) Earthworks materials

The Contractor shall be responsible for any assumptions made by the contractor in relation to the nature and types of the materials encountered in excavations and the bulking and compaction characteristics of materials incorporated in embankments.

The estimated quantity for general earthworks at any cutting includes all types of materials which may be encountered in the cutting.
Where material from excavations is acceptable for use in embankments, but the Contractor elects to:

(i) spoil it; or

(ii) use it for the Contractor's own purposes; or

(iii) use it as a source of pavement materials; or

(iv) construct embankments with dimensions in excess of those specified.

and a deficiency of material for embankment construction is thereby created, the Contractor shall make good that deficiency from sources of material meeting the quality requirements specified in clause SC6.4.6.10.6(2). The cost of making good such deficiency of material shall be borne by the Contractor.

(4) Protection of earthworks

The Contractor's responsibility for care of the Works shall include the protection of earthworks.
The Contractor shall install effective erosion and sedimentation control measures in accordance with accepted *Best Practice Erosion and Sediment Control* procedures, prior to commencing the earthworks, and shall maintain these control measures for the duration of the contract.

Details of the proposed sediment and erosion control measures and procedures are to be documented by a suitably qualified person in accordance with council's soil and sediment erosion control standards. The proposed measures and procedures are to be approved by council prior to implementation on site.

Adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of a planned erosion and sedimentation control system.

When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimise ingress of any excess water into earthworks material. Ripped material remaining in cuttings and material placed on embankments shall be sealed off by adequate compaction to provide a smooth tight surface.

Should insitu or stockpiled material become wet as a result of the Contractor not providing adequate protection of earthworks, the Contractor shall be responsible for replacing and/or drying out the material and for any consequent delays to the operations.

(5) Setting out of earthworks

Before earthworks operations commence and after survey controls are in place, batter profiles shall be established by the Contractor and the necessary pegs driven at 25m intervals, at each cross section shown on the drawings or at each change in batter slope, whichever is the lesser. The chainage/station, offset from control line and slope distance to finished surface level, shall be clearly marked on each peg.

The batter profiles shall be repositioned by the Contractor at each change in the slope of the batter and at

intervals of not more than 5m of vertical height.

All pegs and batter profiles shall be maintained in their correct positions. Additional pegs and profiles may be required to suit the Contractor. These shall not be painted with the same colours used for the specified setting out pegs and stakes.

The position and extent of all transitions from cuttings to embankments and foundations for shallow embankments shall be marked with clearly labelled stakes in accordance with Clauses SC6.4.6.10.3(5) and SC6.4.6.10.6(3).

(6) Stockpile sites

The Contractor shall obtain the written consent of the Superintendent to the use of any stockpile site which is not shown on the drawings. Proposals in this regard shall be submitted at least three working days before stockpiling is due to commence and shall specify the maximum dimensions of the proposed stockpile.

Any clearing and grubbing required for these sites shall be carried out in accordance with SC6.4.6.11 Clearing and grubbing. Temporary erosion and sedimentation control measures shall be taken in accordance with *Best Practice Erosion and Sediment Control.*

Restoration of stockpile sites following completion of the work shall be carried out in accordance with IECA *Best Practice Erosion and Sediment Control.*

SC6.4.6.10.2 Removal of topsoil

(1) Scope

Topsoil is surface soil which is reasonably free from subsoil, refuse, clay lumps and stones.

Removal of topsoil from any section of the Works shall only commence after erosion and sedimentation controls have been implemented and when clearing, grubbing and disposal of materials have been completed on that section of the works in accordance with relevant parts of *Best Practice Erosion and Sediment Control* and SC6.4.6.11 Clearing and grubbing.

Topsoil throughout the length of the Work shall be removed and stockpiled separately clear of the Work with care taken to avoid contamination by other materials. The work shall include the following:

(a) Cuttings

Removal of the topsoil to a depth quoted in SC6.4.6.10 Attachment A Earthworks supplementary information, or as directed by the Superintendent.

(b) Embankments

Removal of topsoil over the base of embankments up to the depth below the natural surface quoted in SC6.4.6.10 Attachment A Earthworks supplementary information, or as directed by the Superintendent. For those embankments or sections of embankment where the height of embankment from natural surface to underside of pavement is less than two metres, topsoil which is deeper than the depth quoted in SC6.4.6.10 Attachment A Earthworks supplementary information shall be removed to its full depth as directed by the Superintendent.

(c) Other locations

Removal of topsoil as directed by the Superintendent.

(2) Topsoil stockpiles

The maximum height of stockpiles shall not exceed 2.5m and the maximum batter slope shall not exceed 2h:1v.

Topsoil stockpiles shall not contain any timber or other rubbish and shall be trimmed to a regular shape.

Keep topsoil and underburden stockpiles separate.

Stabilise stockpiles and batters that will remain bare for more than 28 days by covering with mulch or anchored

fabrics or seeding with sterile grass.

Establish sediment controls around unstabilised stockpiles and batters. Locate stockpiles away from drainage lines, at least 10m away from natural waterways and where they will be least susceptible to wind erosion.

To minimise erosion, stockpile batters shall be track rolled or stabilised by other means acceptable to the Superintendent.

Where seeding of stockpiles to encourage vegetation cover is specified, such work shall be carried out in accordance with SC6.4.6.26 Landscaping.

SC6.4.6.10.3 Cuttings

(1) Scope

Construction of cuttings shall include all operations associated with the excavation of material within the limits of the batters including benching, treatment of cutting floors and transition from cut to fill.

(2) Excavation

Materials encountered in cuttings shall be loosened and broken down as required so that they are acceptable for incorporation in the Works. In this regard, the Contractor's attention is drawn to clauses SC6.4.6.10.5 Unsuitable material, SC6.4.6.10.6(1) Scope and SC6.4.6.10.6(2) Embankment material.

Cuttings shall have batter slopes as shown on the drawings or as redetermined by the Superintendent on the basis of site inspection and investigation during the excavation.

The tops of all cuttings shall be neatly “rounded”.

In all cuttings, undulations in the general plane of the batter shall not be permitted except that batters may require progressive flattening at the ends of cuttings due to the presence of less stable material.

Cut faces shall be cleaned of loose or unstable material progressively as the excavation proceeds.

Where, after the removal of topsoil as specified in clause SC6.4.6.10.2(1) Scope, material of variable quality or moisture content is encountered, the Contractor shall adjust his excavation methods to ensure blending of the materials, to obtain material meeting the requirements of clause SC6.4.6.10.6(2) Embankment material.

(3) Batter tolerances

If the Contractor excavates the batter beyond the batter slope line and the tolerance applicable thereto, the Superintendent may authorise a minor change in the general slope of the batter to suit the convenience of theContractor, but such a change shall not be regarded as a redetermination of the batter slope under clause SC6.4.6.10.3(2) Excavation. Alternatively the Contractor shall submit details of the material and/or methods proposed to restore the specified slope and stability of the batter for the Superintendent's approval.

For batters steeper than 1:1, if any section of the batter up to a height of 3m above the table drain level has been over excavated beyond the tolerance limit specified, the Superintendent may direct that the batter be restored to the average batter slope using randomly mortared stone. The stone shall be similar to the sound rock in the cutting and the mortar shall be coloured to match the colour of the rock.

The tolerances for the excavation of batters, measured at right angles to the design grade line, are given in Table SC6.4.6.10.1 Excavation tolerances for batters.

Table SC6.4.6.10.1 Excavation tolerances for batters

Location	Tolerance (mm)	
	Slope 1:1 or flatter	Steeper than 1:1
Toe of batter and level of table drain	+ 0 - 150	+ 0 - 200
2m above table drain and higher	+ 300 - 300	+ 300 - 600
Between level of table drain and 2m above table drain	pro rata basis	pro rata basis

Note—tolerances are measured normal to the batter surface with (+) measured towards the roadway.

(4) Benching in cuttings

Cut batters shall be benched as shown on the drawings to provide drainage and erosion control. Notwithstanding the tolerances permitted under clause SC6.4.6.10.3(3) Batter tolerances, bench widths shall not be less than those shown on the drawings.

Benches shall be maintained and cleaned of loose stones and boulders regularly throughout the Contract period. The cost of such maintenance and cleaning of benches shall be borne by the Contractor.

(5) Subgrade of cuttings

The subgrade of cuttings shall be excavated, parallel to the designed grade line, to a designed subgrade level. The subgrade ~~shall~~ must then be trimmed to a level of not more than +0mm, ~~±~~-50mm from the designed subgrade level. Prior to ripping or removal of the cut material, the Contractor shall determine the CBR of the material in at the subgrade level in accordance with AS1289.6.1.1, Plasticity Index AS1289.3.3.1 and Shrink-Swell Index AS1289.7.1.1. Sufficient tests shall be taken to represent all the various materials which may exist within the subgrade.

Adequate sampling and testing shall be undertaken to satisfy all necessary requirements to verify the intended pavement design. Where the Superintendent considers that any underlying material is unsuitable for pavement support, the Superintendent may direct that it be removed in accordance with clause SC6.4.6.10.5 Unsuitable material.

The Contractor shall rip or loosen all material in the subgrade to a minimum depth of 200mm below the designed subgrade level for the width of the selected material zone (or subbase layer, where no selected material zone), including areas of rock. The maximum dimension of any particles in the ripped or loosened zone shall not exceed 150mm.

After recompaction, the subgrade within cuttings shall be re-trimmed parallel with the finished wearing surface so that their levels do not vary more than +0mm, ~~±~~-50mm from the designed subgrade level. It shall be recompacted in accordance with Clause SC6.4.6.10.7(1).

Horizontal tolerance – the width of the cutting at subgrade level for support of the pavement shall not be less than that specified.

Prior to placing any subsequent layers over the completed subgrade level, the Contractor shall present the completed surface to the Superintendent for inspection. The Contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects to relevant specifications.

In placing subsequent layers, the Contractor shall use equipment and techniques to avoid surface heaving or other damage to the subgrade surface.

(6) Transition from cut to fill

After the removal of topsoil and before the excavation of any cutting commences the contractor shall survey and mark the position of the intersection line between cutting and embankment occurring at the underside of

the selected material zone or pavement subbase.

The contractor is to ensure that the transition from cut to fill is undertaken in accordance with best practice geotechnical procedures and guidelines.

SC6.4.6.10.4 Blasting general

(1) When explosives are permitted to be used by council, the contractor shall obtain all necessary licences from the appropriate authorities, and shall comply with all government and council regulations relating to transport, storage, handling and the use of explosives and also to the rules set out in AS2187.1 and AS2187.2. The transport of explosives shall be in accordance with the *Australian Code for the Transport of Explosives by Rail and Road. The requirements of the Explosives Act 1999* and *Explosives Regulation 2003* and Local laws, if applicable, shall be complied with.

The contractor shall be liable for any accident, damage or injury to any person, property or thing, resulting from the use of explosives.

Before the start of blasting operations, the contractor, in the presence of the superintendent, shall conduct a dilapidation survey to determine and record the existing condition of all structures likely to be affected by any blast.

The survey shall include all structures including public utilities within 500m of any blast but shall be extended where the maximum instantaneous charge proposed is likely to produce peak particle velocities greater than allowable at structures more remote from a blast site. A written report of the survey, supported by photographs where necessary, together with a list of any existing defects in the structures, shall be submitted to the owner of each structure, to the superintendent and council before blasting commences.

The contractor shall advise the superintendent of the proposed maximum instantaneous charge and the contractor's validation of the adequacy of the proposed structural survey at least three working days before the survey is due to commence. The superintendent may direct amendments to the scope of the survey as a result of blast monitoring during the work. All costs associated with the surveys and reports shall be borne by the contractor.

Before each blasting operation, the contractor shall submit to the Superintendent written details of the proposed blasting procedure including the quantity and type of explosive to be detonated, the blasting pattern to be used and measures proposed to limit noise and to ensure that vibration from blasting does not adversely affect nearby structures.

Ground vibration caused by blasting shall not exceed the values of peak particle velocity listed in Table SC6.4.6.10.2 Limiting peak particle velocity.

Table SC6.4.6.10.2 Limiting peak particle velocity

Point of Potential Damage (within 1km of blasting site)	**Peak Particle Velocity**
Completed and cured bridge structures or subDstructures (e.g. completed abutment)	25mm/sec
Bridgeworks and structural retaining walls under construction	20mm/sec
Residential premises, schools, hospitals and other buildings	5mm/sec (with 10% not to exceed 10mm/sec)
Buildings or monuments of historical significance	2mm/sec

The contractor shall advise all residents within a radius of 1km, by letter drop before blasting operations

commence, of the likely times, frequency and duration of blasting and precautions being taken to ensure that damage to property will not result.

Unless otherwise approved, blasting operations shall be confined to the periods Mondays to Fridays (excluding public holidays), 9am to 3pm.

When blasting operations are being carried out, precautions shall be taken relating to the safety of persons and animals and the road shall be closed to traffic and the appropriate signs erected in accordance with the sub-section SC6.4.6.30 Control of traffic. A standard warning procedure such as that given in the AS2187.2 shall be established and observed at all times.

(2) Presplitting

Where presplitting is carried out the spacing of presplit drill holes shall not exceed 750mm centre to centre.

(3) Blasting records

The Contractor shall maintain accurate records of each blast showing the details listed below:

(a) date and time of blast;

(b) location, number and diameter of holes loaded;

(c) depth of each hole loaded;

(d) inclination of holes;

(e) maximum and minimum burden;

(f) types of explosives used;

(g) charge distribution in each hole;

(h) maximum instantaneous charge;

(i) delay periods and sequence;

(j) total amount of charges in the blast;

(k) length and type of stemming in each hole.

The records shall be prepared as holes are loaded and signed by the Powder man. A copy shall be provided to the Superintendent on the day of the blast.

(4) Control of air blast over-pressure

This clause shall apply only where a noise sensitive location exists within 1km of the blasting site.

The Contractor's attention is drawn to the recommendations given in the *Environmental Protection (Noise) Policy 2008* or as amended - for the reduction of air blast over-pressure.

The noise emanating from blasting operations shall not exceed an over-pressure level of 115dB (linear peak) at any noise sensitive location (such as residential premises, schools or hospitals). Up to 10% of the total number of blasts may exceed this value provided a level of 120dB is not exceeded at any time.

The Contractor shall arrange for the monitoring of air blast over-pressure to ensure compliance with the specified limits. All monitoring shall be carried out by personnel possessing current NATA registration for such monitoring. All test results shall be reported on NATA endorsed test certificates which shall include a clear statement as to compliance or non-compliance with the requirements of this sub-section. In general, a monitoring location will be near the perimeter of the noise sensitive location at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Superintendent.

In the event that the measured air blast over-pressure exceeds the specified limits, the Contractor shall suspend further blasting work and shall submit to the Superintendent proposals detailing any additional steps and precautions the Contractor shall take to ensure that for any future blast, the limiting over-pressure shall not be exceeded. The Contractor shall not resume any blasting until such proposals have been submitted.

(5) Control of ground vibration

The Contractor shall arrange for the monitoring of ground vibrations to ensure compliance with the peak particle velocity limits shown in Table SC6.4.6.10.2 Limiting peak particle velocity. All monitoring shall be carried out by personnel possessing current NATA registration for such monitoring. All test results shall be reported on NATA endorsed test certificates which shall include a clear statement as to compliance or non-compliance with the requirements of this part of the sub-section. In general a monitoring location shall be near the perimeter of the structure or building at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Superintendent.

To minimise the risk of peak particle velocity limits being exceeded, the Contractor shall develop a blasting site relationship between peak particle velocity, distance and blasting charge.

For the first blast, monitors shall be set up at not less than five points at varying distances away from the blasting site. The Maximum Instantaneous Charge for the first blast shall not exceed that calculated from the following formula:

$$MIC = 0.5\left[\frac{D}{\left[\frac{PPV}{1140}\right]^{-0.625}}\right]^2$$

where MIC = Maximum Instantaneous Charge in kilograms
D = Distance in metres from charge to the point of potential damage
PPV = limiting peak particle velocity from Table SC6.4.6.10.2.

A log-log (base 10) graph of measured peak particle velocity (vertical axis) versus Scaled Distance (horizontal axis) shall be plotted, where

$$\text{Scaled Distance} = \frac{D}{\sqrt{MIC}}$$

The mean regression line shall be obtained by the least squares method.

For subsequent blasts, the MIC and other aspects of blast design may be adjusted provided that further ground vibration monitoring is undertaken and the mean regression line redetermined to demonstrate that peak particle velocity limits are not exceeded. The Contractor shall make the regression line plots available to the Superintendent, if so requested.

SC6.4.6.10.5 Unsuitable material

Unsuitable material is that occurring below the designed floor level of cuttings and below the nominated depth for stripping topsoil beneath embankments, which the Superintendent deems to be unsuitable for embankment or pavement support in its present position. Unsuitable material also includes material in cuttings which the Superintendent deems to be unsuitable for embankment construction.

Such material shall be excavated to the extent directed by the Superintendent. Material removed as unsuitable, as directed by the Superintendent, shall be incorporated in embankments in accordance with SC6.4.6.10.6(2) Embankment material or spoiled in accordance with clause SC6.4.6.10.6(13) Spoil.

After removal of the unsuitable material, the floor of the excavation shall be re-presented to the Superintendent for inspection, prior to backfilling with replacement material, to determine whether a sufficient depth of unsuitable material has been removed. Prior to placing replacement material the excavated surface shall be compacted in accordance with SC6.4.6.10.7(1) Compaction and moisture requirements.

The unsuitable material which has been removed shall be replaced with material from cuttings, or with material borrowed in accordance with clause SC6.4.6.10.6(14) Borrow, of the quality specified in clause SC6.4.6.10.6(2)

Embankment materials. Replacement material is deemed to form part of embankment construction. It shall be placed in accordance with clause SC6.4.6.10.6(5) Placing Fill for embankment construction and compacted in accordance with clause SC6.4.6.10.8(1) Construction management.

Reworking or replacing any material which the Superintendent deems to have become unsuitable because of inappropriate construction activities shall be borne by the Contractor.

Excavate and dispose of all contaminated material in an environmentally responsible manner including the following:

(1) assay material uncovered on-site prior to disposal. If the wastes include putrescibles wastes, then also analyse leachate and landfill gases;

(2) excavate material in a manner which avoids off-site environmental problems;

(3) seal remaining contaminated material or wastes, where only part of the tip has been excavated, to ensure than there is no off-site effect now or in the future;

(4) transport odorous wastes in covered vehicles; and

(5) dispose of contaminated material in a landfill licensed to take the type of contaminated material or wastes uncovered.

SC6.4.6.10.6 Embankment construction

(1) Scope

Embankment construction includes all operations associated with the preparation of the foundation areas on which fill material is to be placed, the placing and compacting of approved material within areas from which unsuitable material has been removed in accordance with clause SC6.4.6.10.5 Unsuitable material, the placing and compacting of fill material and of materials of specified quality in nominated zones throughout the Works and all other activities required to produce embankments as specified to the alignment, grading and dimensions shown on the drawings. It also includes any pre-treatment such as breaking down or blending material or drying out material containing excess moisture.

(2) Embankment material

Material for embankment construction shall be obtained from the cuttings within the Works in accordance with clause SC6.4.6.10.3(2) Excavation supplemented by borrow in accordance with clause SC6.4.6.10.6(14) Borrow and from other sources as approved by the Superintendent if necessary. The material shall be free of tree stumps and roots, clay, topsoil, steel, organic material and other contaminants and shall be capable of being compacted in accordance with clause SC6.4.6.10.7(1) Compaction and moisture requirements.

The work shall be programmed so that material of the quality specified in clause SC6.4.6.10.6(5) Placing fill for embankment construction and SC6.4.6.10.6(9) Selected material zone for the upper zones of the formation is available when required.

(3) Foundations for embankments

(a) Following removal of topsoil in accordance with clause SC6.4.6.10.2 Removal of top soil, the embankment foundation area shall be made available for inspection by the Superintendent.
Where the Superintendent considers that any underlying material is unsuitable, the Superintendent may direct that it be removed and replaced in accordance with clause SC6.4.6.10.5 Unsuitable material.

(b) Foundations for Shallow Embankments
Shallow embankments are those embankments of a depth less than 1.0 metre from the top of pavement to natural surface. After removal of topsoil the Contractor shall survey and work out the extent of the area of shallow embankments.

Material in the foundations for shallow embankments which does not meet the requirements specified in SC6.4.6.10 Attachment A Earthworks – supplementary information, shall be deemed unsuitable in

accordance with clause SC6.4.6.10.5 Unsuitable material and shall be replaced by material of the specified quality.

Foundations for shallow embankments shall be prepared for embankment construction after removing topsoil and unsuitable material, by loosening the material exposed to a depth of 200mm, adjusting the moisture content of the loosened material and compacting as specified in clause SC6.4.6.10.7(1) Compaction and moisture requirements. The Contractor shall use equipment and techniques to minimise surface heaving or other foundation damage.

(c) Other embankments

For all other embankments the foundation shall be prepared by grading and levelling the general area, adjusting the moisture content where necessary and compacting the top 200mm as specified in clause SC6.4.6.10.7(1) Compaction and moisture requirements.

The bridging layer shall consist of free-draining granular material with or without geofabric interlayer as specified on the drawings. The granular material shall be end-dumped and spread in a single layer and in sufficient depth to allow the passage of earthmoving equipment with minimal surface heaving. The compaction requirements of clause SC6.4.6.10.7(1) Compaction and moisture requirements shall not apply to the bridging layer.

A bridging layer may also be employed, subject to the approval of the Superintendent, where ground water or seepage is encountered in the foundation area or where the Contractor demonstrates that it is impracticable to achieve the degree of compaction specified for the foundation in clause SC6.4.6.10.7(1) Compaction and moisture requirements. A bridging layer shall not be acceptable if its proximity to the pavement is likely to affect the pavement design. As an alternative to a bridging layer, approval of a working platform created by the chemical stabilisation of in situ material to conform with sub-section SC6.4.6.19 Stabilisation may be required.

(4) Hillside embankments

Where embankments are to be constructed on or against any natural slopes or the batters of existing embankments, the existing slope or batter, if it is steeper than 4 horizontal to 1 vertical in any direction, shall be cut in the form of horizontal terraces over the whole area to be covered by new filling. The existing slope or batter shall be stepped in successive terraces, each at least 1m in width, the terraces to be cut progressively as the embankment is placed. Wherever possible terraces shall coincide with natural discontinuities. Subsoil drainage may be required in some instances. Material thus excavated shall be compacted as part of the new embankment material.

(5) Placing fill for embankment construction

The methods of excavation, transport, depositing and spreading of the fill material shall be selected so as to ensure that the placed material is uniformly mixed.
The embankment shall be constructed so as to derive its stability from the adequate compaction of the fine material embedding the large rock pieces rather than mechanical interlock of the rock pieces. The fine material shall be compacted to meet the requirements of clause SC6.4.6.10.7(1) Compaction and moisture requirements.

Fill material for embankment construction shall be placed in layers parallel to the grade line and compacted in accordance with clause SC6.4.6.10.7(1) Compaction and moisture requirements. The layers shall be of uniform compacted thickness not exceeding 200mm, except that where more than 25% by volume of the filling consists of rock with any dimension larger than 150mm, the Superintendent may approve an increase in the compacted layer thickness to 300mm, provided that the relative compaction specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements is attained.

The maximum dimension, measured in any direction, of rock pieces in the fill material for embankment construction shall not exceed two-thirds of the approved compacted layer thickness. Any larger rock pieces shall be reduced in size for incorporation in the embankment layers.

Rock material shall be broken down and evenly distributed through the fill material, and sufficient fine material

must be placed around the larger material as it is deposited to fill the voids and produce a dense, compact embankment. Where the Superintendent considers insufficient fine material is present to fill the voids, additional fine material shall be obtained from other places in the work or by a change in the method of winning fill material.
Stony patches with insufficient fine material to fill the voids shall be reworked with additional fine material being blended in to achieve a dense, compact layer.

In placing embankment layers, the Contractor shall use equipment and techniques to avoid surface heaving or other damage to the foundations and underlying embankment layers.
After compaction, embankment material in the zone(s) below the selected material zone (or subbase layer, where no selected material zone) shall have a CBR value not less than that quoted in and for the depth(s) specified in SC6.4.6.10 Attachment A Earthworks Supplementary Information.

For the purpose of this clause, the CBR value of the material shall be determined by Test Method AS1289.6.1.1.

The Contractor shall be responsible for determining suitable sources of material and for any processing to satisfy these quality requirements.

(6) Embankment batters

The batter slopes shown on the drawings represent the estimated requirements for the expected types of materials, and may be subject to redetermination by the Superintendent according to the Superintendent's assessment of the materials encountered.

When completed, the slope of embankment batter shall conform to those shown on the drawings and conform to the following tolerances:

(a) for a vertical distance to 1m below the shoulder, no point on the completed batter to vary from the specified slope line by more than 150mm when measured at right angles to the slope line;

(b) at distances greater than 1m vertically below the shoulder, no point on the completed batter to vary from the specified slope line by more than 300mm when measured at right angles to the slope; and

(c) in no case is the edge of the formation at the underside of the pavement to be nearer to the roadway than shown on the drawings and the batter slope at no point be steeper than the specified slope.

However, in no case shall the edge of the formation at the underside of the pavement be nearer to the roadway than shown on the drawings.
Undulations in the general plane of the batter shall not be permitted.

(7) Rock facing of embankments

Where shown on the drawings, embankment batters (including embankments at bridge abutments) shall be provided with a facing of clean, hard, durable rock.

The rock facing shall be built up in layers ahead of each layer of filling. Rock may be placed by hand or plant but shall be placed in such a manner that its least dimension is vertical and that mechanical interlock between the larger stones occurs. Any rock deposited in the rock facing which has an excess of fine material surrounding it shall be removed together with the excess fine material and replaced.

The Contractor shall adjust its working methods and programme the work so as to obtain hard and durable rock of the specified dimensions as it is required. The space between larger batter rocks shall be filled with progressively smaller rocks to form a 'graded filter' which prevents the leaching out of fines from the fill material but which does not overfill the voids between larger rocks, or cause the larger rocks to lose contact with one another. Fine material shall not cover the outside of the rocks on the face of the batter.

The Contractor shall exercise extreme caution whilst placing the rock facing. Where embankment material is placed above other roads in use the outer rock layer shall be placed in such a manner as to prevent spillage down the batter.

The Contractor shall ensure that, under no circumstances, could any rock be dislodged and roll onto any adjacent roadway or track in use.

(8) Trimming tops of embankments

The tops of embankments shall be trimmed parallel to the designed grade line at levels equal to the finished surface level less the thicknesses of pavement courses and the selected material zone.

The tops of embankments at these levels shall be compacted to meet the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements and trimmed so that they do not vary by more than ±50mm from the calculated level. The width of the embankment at subgrade level shall not be less than that specified

Prior to placing any subsequent pavement layers over the completed top of embankment filling, the contractor shall present the completed surface to the superintendent for inspection. The contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects of the relevant specifications.

(9) Selected material zone

A selected material zone must be provided in accordance with the following quality requirements:

(a) it shall be free from stone larger than 75mm maximum dimension and have no less than 50% passing the 19mm AS sieve.

(b) a CBR value not less than the specified in SC6.4.6.10 Attachment A Earthworks Supplementary Information for the fraction passing AS 19mm sieve.

(c) Plasticity Index of 15maximum

If chemical stabilisation is specified these requirements must apply to the selected material immediately prior to incorporating the stabilising agent.

The Contractor shall use working methods to yield material for the selected material zone by breaking down oversize rock or by other means, including processing through a crusher, to ensure that the resulting material conforms to the requirements of this clause.

The Contractor shall ensure that any material encountered of the quality specified for the selected material zone shall be either placed directly in the selected material zone or stockpiled at locations approved by the Superintendent for future use by the Contractor in the selected material zone until at least sufficient material is reserved to complete the selected material zone over the whole work. Should the Contractor fail to conserve material of the specified quality, the Superintendent may direct that material of equivalent quality be provided.

The selected material zone shall be placed and compacted in layers with the compacted thickness of each layer not exceeding 150mm. The selected material shall be homogeneous and free from patches containing segregated stone or excess fines. There shall be no areas containing material which does not comply with the specified requirements of this clause and compaction shall be as specified in clause SC6.4.6.10.7(1) Compaction and moisture requirements.

The top of the selected material zone shall be compacted and trimmed parallel with the designed grade line at a level equal to the finished surface level minus the thickness of pavement layers adopted. The tolerances for the trimmed levels are given in SC6.4.6.10 Attachment A Earthworks – Supplementary Information.

Prior to placing any subsequent pavement layers over the completed select material zone surface, the Contractor shall present the completed surface to the Superintendent for inspection. The Contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects of relevant Specification.

(10) Fill adjacent to structures

For the purpose of this clause, structures shall include bridges, precast and cast-in-situ box culverts and retaining walls. Fill adjacent to other culverts and drainage structures to be provided in accordance with

SC6.4.6.4 Stormwater Drainage, SC6.4.6.6 Pipe Drainage, SC6.4.6.7 Precast Box Culverts and SC6.4.6.5 Drainage Structures.

No filling shall be placed against structures, retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, unless the walls are effectively supported by struts to the satisfaction of the Superintendent, or when the contractor can demonstrate that 85% of the design strength of the concrete has been achieved. This includes concrete in bridge decks and fill placement that impacts the position, stability and serviceability of bridge deck member bearings.

(11) Treatment at weepholes

Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:

(a) the maximum particle dimension shall not exceed 50mm; and

(b) no more than 5% by mass shall pass the 9.5mm A.S. sieve.

The broken stone or river gravel shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend from 200mm below to at least 450mm vertically above the level of the weepholes, where practicable.

Alternatively the Contractor may provide a synthetic membrane (geotextile) of equivalent drainage characteristics. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane (geotextile) shall be subject to the Superintendent's approval.

(12) Selected backfill

(a) Selected backfill shall be placed adjacent to structures in accordance with Table SC6.4.6.10.3 Selected backfill, width and height. The selected backfill shall consist of a granular material having a maximum dimension not exceeding 50mm and a Plasticity Index, determined by AS1289.3.3.1, neither less than 2 nor more than 12.

Table SC6.4.6.10.3 Select backfill, width and height

Structure Type	Selected Backfill	
	Width	Height
Bridge abutments	2m	H
Cast-in-situ Box Culverts and Precast Culverts	H/3	H + 300mm
Corrugated Steel Pipes and Arches	0.5m	H + 500mm
Retaining Walls	H/3	H

(Where H = height of structure)

The selected backfill shall be placed in layers, with a maximum compacted thickness of 150mm. Layers shall be placed simultaneously on both sides of box culverts to avoid differential loading. Compaction shall start at the wall and proceed away from it, and shall meet the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements.

The existing embankment slope behind the structure shall be cut in the form of successive horizontal terraces, each terrace being at least 1 metre in width, and the selected backfill shall be placed in accordance with clause SC6.4.6.10.6(5) Placing fill for embankment construction.

Where a bridge deck is being concreted adjacent to an abutment, no filling shall be placed against the abutment within 21 days after placing concrete in the bridge deck, unless approved by the Superintendent.

In the case of spill-through abutments, rocks shall not be dumped against the columns or retaining walls but shall be built up evenly by individual placement around or against such structures.

In the case of framed structures, embankments at both ends of the structure shall be brought up

simultaneously, the difference between the levels of the embankments at the respective abutments, shall not exceed 500mm.

(13) Spoil

Spoil is surplus material from excavations which is not required to complete the Works as specified or other material from excavations whose quality the Superintendent deems to be unacceptable for incorporation in the Works.

Where there is surplus material the Superintendent may direct that flatter batter slopes be provided on embankments which have not been commenced, and/or direct that the excess material be used in the uniform widening of embankments, the surface of which shall be shaped so as to provide a tidy appearance and effective drainage. The surplus material shall be spread and compacted as specified in clauses SC6.4.6.10.6(5) Placing fill for embankment construction and SC6.4.6.10.8(1) Compaction and moisture requirements for material in embankments.

Alternatively, spoil shall be disposed of in the manner and at locations approved by the Superintendent within the specified working area for the Works or be removed and disposed of off site by the Contractor. Surplus material so deposited shall be compacted as specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements for material in embankments or to such lesser extent as may be approved by the Superintendent.

(14) Borrow

Borrow will only be authorised by the Superintendent if, in constructing cuttings and embankments to the batter slopes specified or directed by the Superintendent or in providing materials of the quality specified, and not by reason of excess widening of embankments or wastage by the Contractor of material of the quality specified in clauses SC6.4.6.10.6(2) Embankment material, SC6.4.6.10.6(7) Rock facing of embankments, SC6.4.6.10.6(8) Trimming tops of embankments or SC6.4.6.10.6(10) Fill adjacent to structures, there is an overall deficiency in either the quantity or the quality of material required to complete the Works.

Where borrow material is required to complete the Works as specified, the location of borrow sites shall be as approved by the Superintendent, and the quality of material shall be acceptable to the Superintendent in accordance with clauses SC6.4.6.10.6(2) Embankment material, SC6.4.6.10.6(7) Rock Facing of Embankments or SC6.4.6.10.6(10) Fill Adjacent to Structures as appropriate. The edges of borrow sites must be no closer than 3m from any fence line, or edge of excavation or embankment. Adequate clearance shall be provided for the construction of catch drains. Borrow sites shall have drainage outlets acceptable to the Superintendent, cut batter slopes not steeper than 4h to 1v, and shall be left by the Contractor in a tidy and safe condition (i.e. stabilising disturbed areas).

For borrow within the defined working area for the Works as specified, site preparation shall be in accordance with SC6.4.6.11 Clearing and grubbing and clause SC6.4.6.10.2 Removal of top soil. Restoration of borrow sites shall be carried out by Contractor in accordance with Best Practice Erosion and Sediment Control.

If borrow material is obtained by uniformly widening a cutting, the requirements of Clauses SC6.4.6.10.3(2) Excavation, SC6.4.6.10.3(3) Batter tolerances and SC6.4.6.10.3(5) Treatment of floors of cuttings as to the redetermination of batter slopes, the trimming of batters and the compaction of floors of cuttings respectively shall apply to the borrow area.

The Contractor shall be responsible for obtaining any permits required for entry on land and for the payment of any royalty for such borrow material. The Contractor shall also comply with any requirements of the *Sustainable Planning Act 2009* – as amended, Townsville City Plan, Local laws and land owners, as appropriate.

SC6.4.6.10.7 Acid sulfate soils

(1) Objective

To minimise disturbance to areas of potential acid sulphate soils (PASS) and/or actual acid sulphate soils (ASS). If disturbance of PASS/ASS cannot be avoided, appropriate treatment is required to minimise the potential for environmental harm.

PASS and ASS are soils that have the potential to generate acid through oxidation of iron sulphides when exposed to air. ASS and PASS are generally found in coastal areas, and generally in soils at an elevation of 5m AHD or lower.

(2) References

Dept of Environment and Resource Management, *Nov 2002*
Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines
State Planning Policy
EF006: Daily Dredging Checklist Form
CE020: Regulated Waste Transport Procedure
QAF004 Incident, Hazard, Improvement reporting form

(3) Safety requirements

Works shall comply with provisions of the Work Health and Safety Act 2011 and subsequent regulations. Personnel are responsible for their own Personal Protective Equipment (PPE) and the safety of the surrounding workplace during works.

Care is to be taken when using hydrogen peroxide, including gloves and eye protection.

(4) Environmental Requirements

Compliance with Environmental Protection Act 1994 and subordinate legislation.
Compliance with *Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines*
Compliance with the State Planning Policy.
Compliance with all other environmental legislation.
Compliance with TCC Environmental Policy.

(5) Equipment and materials

Testing should be undertaken by a suitably qualified laboratory.

(6) Method

(a) Identifying ASS/PASS on site

The following points can assist in determining if soil has a likelihood of containing ASS/PASS. Affirmative answers to the following questions may indicate the presence of ASS/PASS. Field observations and tests should be complemented by laboratory testing.

(i) Is the site elevation 5m AHD or less?

(ii) Are mangroves, she-oaks or melalueca species (i.e. paper barks) present on site?

(iii) Is there other vegetation that is stunted or dying?

(iv) Does the soil have a dark grey to grey appearance?

(v) Is there a rotten egg smell (hydrogen sulphide) to disturbed soil?

(vi) Is there a mottled-yellow mineral present in the soil (Jarosite)?

(vii) Is there water bodies nearby that have a very clear blue-ish appearance, or does it appear to be reddish (rust) in colour?

(viii) Is the pH of the excavated sediment, or water, below 4?

(b) Managing and treating ASS and PASS

(i) Determine if works can be undertaken without disturbing ASS/PASS material.

(ii) If ASS/PASS is to be disturbed as a result of project activities then undertake testing to determine the severity of the potential acidification and extent of ASS/PASS material.

(iii) ASS/PASS material excavated on site must either be treated on site or transported to a treatment location. A treatment pad should be set up as per the *Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines.*

(iv) ASS material should be transported as regulated waste as it has the potential to be generating acid while exposed to the atmosphere.

(v) All treatment of PASS/ASS must be undertaken in compliance with the *Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines.*

(vi) ASS/PASS treatment must be undertaken as per the laboratory recommendations.

(c) Corrective/Emergency Actions

If PASS and/or ASS are identified through site inspection and confirmed through lab testing, follow procedure outline in (6) above.

If corrective actions are identified, an Incident, Hazard, Improvement Report is to be completed and subsequent review of this procedure undertaken in accordance with these guidelines.

(d) Waste Control

Treat PASS and ASS in accordance with guidelines (State Planning Policy

Ensure wastes generated as a result of field testing or work activities are disposed of correctly.

(e) Responsibilities

(i) Site foreperson/works controller is responsible for:

(A) monitoring and testing soils; and

(B) Minimising disturbance to PASS/ASS.

(ii) The Environmental Engineer is responsible for ensuring any environmental non-compliances are reported.

(iii) The Executive Manager Engineering Services is responsible for:

(A) notifying relevant personnel of changes to this procedure; and

(B) delivering training to personnel (if required).

(f) Monitoring and reporting

The foreperson will monitor and test soils prior to commencement of works and record results of field tests on daily dredging checklist.

SC6.4.6.10.8 Compaction and quality control

(1) Compaction and moisture requirements

In areas listed below, all layers shall be uniformly compacted to not less than the relative compaction specified before the next layer is commenced. Each layer of material shall be trimmed prior to and during compaction to avoid bridging over low areas. A smooth surface shall be presented at the top of each layer.

(a) The following areas shall be compacted to provide a relative compaction, determined by AS1289.5.1.1 using AS1289.5.4.1 or AS1289.5.7.1 for standard compactive effort, of not less than 95%.

(i) each layer of material replacing unsuitable material as detailed in clause SC6.4.6.10.5 Unsuitable material

(ii) each layer of material placed in embankments, up to 300mm from the top of the sub-grade;

(iii) fill placed adjacent to structures up to 300mm from the top of sub-grade;

(iv) material in unsealed verges and within medians up to the level at which topsoil is placed;

(v) spoil (excluding unsuitable material); and

(vi) all other areas except those where a higher relative compaction is specified.

Unsuitable material shall be stockpiled as directed by the Superintendent and compacted by track rolling.

(b) The following areas shall be compacted to provide a relative compaction of not less than 97% as determined by AS1289.5.1.1 using AS1289.5.4.1 or AS1289.5.7.1 for standard compactive effort:

(i) foundations for shallow embankments;

(ii) foundations other than shallow embankments

(iii) the whole area on the floors of cuttings;

(iv) each layer of the embankment or cutting within 300mm from the top of sub-grade;

(v) each layer of the selected material zone as specified in clause SC6.4.6.10.6(9) Selected material zone;

(vi) any areas of material of specified quality which may be shown on the drawings or specified elsewhere behind kerbs and/or gutters or adjacent to rigid pavements; and

(vii) the fill material placed adjacent to structures as specified in clauses SC6.4.6.10.6(10) Fill adjacent to structures and SC6.4.6.10.6(12) Selected backfill in each layer within 300mm from the top of the sub-grade.

Where the vertical alignment design is such that a substantial portion of the road is required to be built at or close to the natural surface, cut the prepared subgrade to a depth below natural surface of less than 0.5m. Approval is required when shallow cutting conditions occur, the specified transition from cut to fill may be modified such that the depth of terrace excavation at the transition from cut to fill is reduced from 900mm to 250mm.

Treat the floor of shallow cutting as specified in clause SC6.4.6.10.3(5) Treatment of floors of cuttings and clause SC6.4.6.10.3(6) Transition from cut to fill and compact to provide a relative compaction of not less than 100% for a depth of 200mm determined by AS1289.5.4.1, for standard compactive effort.

At the time of compaction the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is within the range set out in SC6.4.6.10 Attachment A Earthworks Supplementary Information of the optimum moisture content as determined by AS1289.5.1.1 or AS1289.5.7.1. Material which becomes wetted up after placement shall not be compacted until it has dried out so that the moisture content is within this range. The drying process may be assisted by aeration, or where approved by the Superintendent, by the use of hydrated or quick lime. Alternatively the Contractor may transport the wet material to a stockpile site for drying out and later use as fill material. If there is insufficient moisture in the material for it to be compacted as specified, water shall be added. The added water shall be applied uniformly and thoroughly mixed with the material until a homogeneous mixture is obtained.

Compaction shall be undertaken to obtain the specified relative compaction for the full depth of each layer in embankments and for the full width of the formation over the entire length of the work. Compaction shall be completed promptly to minimise the possibility of rain damage.

Any material placed by the Contractor that has attained the specified relative compaction but subsequently becomes wetted up so that the moisture content is greater than the apparent optimum, determined by AS1289.5.4.1, shall be dried out and uniformly recompacted to the required relative compaction in accordance with this clause before the next layer of material is placed. Alternatively, the Contractor may remove the layer of wetted material to a stockpile site for drying and later re-use.

(2) Test locations

The specified compaction and moisture tests shall be taken at the random test locations established in each lot in accordance with the specified minimum testing frequency. Prior to testing the Contractor shall work the lot to ensure uniform moisture content and compaction of all material within the lot.

The test/s then taken shall be considered to represent the total volume of material placed within the lot.

Where the Superintendent considers that the material which is present has not achieved uniformity required by this clause or clause SC6.4.6.10.6(5) Placing fill for embankment construction, the Superintendent may take or

direct further testing. The Superintendent shall nominate the area represented by the additional testing.

If such testing confirms that material not conforming to the Specification, the Contractor shall carry out remedial work as necessary to achieve conformance to the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements.

(3) Deflection monitoring

Following completion of the formation to the underside of the selected material zone in accordance with clause SC6.4.6.10.6(3) Foundations for embankments and SC6.4.6.10.6(5) Placing fill for embankment construction, completion of the selected material zone in accordance with clause SC6.4.6.10.6(9) Selected material zone and SC6.4.6.10.3(5) Treatment of floors of cutting, the Contractor shall make the work available in lots, for the Superintendent or council to carry out deflection monitoring.

A lot for deflection testing shall consist of a continuous length of formation, in compliance with council requirements, and a single carriageway width which is generally homogeneous with respect to material and appearance. The contractor shall identify the boundaries of each lot with stakes clearly labelled to the satisfaction of the Superintendent.

Prior to the release of the lot, a proof roll is to be performed with a single drive axle truck with an axle load of 8.2 t covering all lanes of carriage way including parking bays having no evident movement.

(4) Widening of formation

Road shoulders and formation shall be widened to accommodate footpaths, guard fence, streetlight plinths, emergency telephone bays and vehicle standing areas as shown on the drawings.

(5) Subgrade testing and treatment

Refer to SC6.4.4.2.4

SC6.4.6.10.9 Summary of limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.10.4 Summary of limits and tolerances below.

Table SC6.4.6.10.9 Summary of limits and tolerances

Item	Activity	Limits/Tolerances
1.	**Batter Slopes**	± 300mm
	a) Excavation	
	b) Embankment	± 300mm
2.	**Subgrade**	Parallel to designed grade line. Tolerance is to be
	Vertical Tolerance	within +0mm, ±-50mm of the levels specified.
	Horizontal Tolerance	The width of the cutting at subgrade level for support of the pavement shall not be less than that specified on the drawings or documentation.
3.	**Tops of Embankments**	Parallel to the designed grade line. Tolerance is to be
	Vertical Tolerance	within, ±50mm from the levels specified
	Horizontal Tolerance	The width of an embankment at subgrade shall not be less than that specified on the drawings or documentation.
4.	**Selected Material**	SC6.4.6.10 Attachment A: Earthworks – Supplementary Information

Note—tolerances are measured at right angles to design surfaces.

SC6.4.6.10.10 Attachment A: Earthworks - supplementary information

Clause	Description	Value
SC6.4.6.10.2(1)	The depth below natural surface up to which the removal and measurement of top soil shall apply: (a) Cutting area (b) Embankment area	75mm
SC6.4.6.10.3(5)	Minimum CBR value in cutting floors used for design of pavement	3%
SC6.4.6.10.6(3)	Requirements of material in foundations for shallow embankment Moisture Content - within the range of 60% to 90% of optimum	
SC6.4.6.10.6(5)	Upper Zones of Formation and SC6.4.6.10.6 (9) Select Material Zone Material within each zone shall have a CBR value of not less than the following, under the nominated test conditions:	

Location	Minimum CBR Value	Depth	Nominated Soaking Period (Days)
a. Select Material Zone	10	200	4
b. Material below Selected Material Zone to 1.5 metre from top of pavement	3	N/A	4

SC6.4.6.10.6(9) Construction tolerances for selected material zones is to be ±50mm of the designed grade and crossfall profile

SC6.4.6.10.8(1) Moisture content of material placed in embankments:

(a) Material in upper zones of formation - within the range of 60% to 90% of optimum

(b) All other embankment material - within the range of 60% to 90% of optimum

SC6.4.6.11 Clearing and grubbing

SC6.4.6.11.1 Introduction

(1) Scope

This sub-section provides standards, advice and guidelines for the clearing of all vegetation, both living and dead, all minor man- -made structures (such as fences and livestock yards), all rubbish and other materials, including the chipping of the crowns of trees and the branches of shrubs, and the grubbing of trees stumps from the area. The work also includes the disposal, in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation and SC6.4.6.11.3(3) Disposal of materials, of all materials that have been cleared and grubbed.

~~(2) Reference and source documents~~

~~Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.~~

~~(a) Australian Standards~~

~~AS/NZS 4671(As amended) - *Steel reinforcing materials*~~

~~AS 1744 (As amended) - *Forms of letters and numerals for road signs (known as Standard alphabets for road signs).*~~

(~~3~~2) General requirements

Site works shall take all measures to prevent damage to existing underground and overhead utility services.

Before commencing earthworks, locate and mark existing underground services in the areas to be affected by the works including clearing, excavating and trenching.

All existing utilities, natural landscape features, including natural rock outcrops, natural vegetation, trees to be preserved, soil and watercourses are to remain undisturbed.

Explosives shall not be permitted to be used in clearing, grubbing or other demolition activities.

Editor's note—DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, through which underground pipes and cables are located (possible within two working days). For more information go to the Dial 1100 Before you Dig website.

SC6.4.6.11.2 Clearing

(1) Clearing operations

The area within the limits of clearing shall be cleared of all vegetation, both living and dead, all minor ~~man~~ man- made structures (such as fences and livestock yards), all rubbish and other materials which, are unsuitable for use in the works with the exception of certain trees marked for preservation. The contractor shall plan clearing operations such that wherever possible, clearing is carried out progressively and only the minimum area of land is left disturbed at any time.

The contractor shall give the superintendent written notice of seven days of the intention to clear any area of the work. The superintendent shall mark or indicate to the contractor the trees that shall be preserved. The contractor shall arrange for an inspection by an authorised council officer and shall obtain council's approval to proceed with clearing and grubbing. The contractor must conform to the requirements of SC6.4.5.2(18) when protecting identified trees and bushland within or adjacent to the construction site.

The erection of structures, excavation and filling, changes to soil profiles, stockpiling of spoil, storage of other materials and driving or parking of any vehicle or machinery within 4 m of the trunks of trees to be retained shall not be permitted unless they form part of the works as approved by the council.

The Contractor shall plan all operations to ensure that there is no damage to any trees outside the limits of clearing specified or directed by the Superintendent. No growing trees shall be destroyed or damaged by the Contractor other than those specified and those indicated by the Superintendent.

Any tree remaining within the road reserve but outside the limits of clearing which is, in the opinion of the Superintendent, unsound and likely to fall upon the roadway shall be cleared and disposed of in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation, subject to prior approval of council.

If directed by the Superintendent, any branch, which overhangs the road formation, shall be cut back to within 0.5 m of the tree trunk and disposed of in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation.

(2) Fallen timber and tree damage

Every precaution shall be taken to prevent timber from falling onto private property. The Contractor shall dispose of any timber that has fallen onto private property or produce written consent from the property owner to its remaining there.

The cost of disposal of such fallen timber shall be borne by the Contractor. Prior to entering the private property, the Contractor shall obtain consent from the Superintendent and the property owner. Damage of any kind, including damage to trees, fencing, occurring during clearing operations shall be made good by the Contractor. The cost of making good such damage shall be borne by the Contractor. Any damage to trees or vegetation which in councils opinion, will require its removal, is to be in rectified in accordance with SC6.4.5.2.1(19)(d).

SC6.4.6.11.3 Grubbing

(1) Grubbing

All trees and stumps, on or within the limits of clearing, unable to be felled and removed by the clearing methods used by the Contractor shall be removed by grubbing.

Grubbing operations shall be carried out to a depth of 0.5m below the natural surface or 1.5 m below the finished surface level, whichever is the lower.

Holes remaining after trees and stumps have been grubbed shall be backfilled promptly with sound material to prevent the infiltration and ponding of water. The backfilling material shall be compacted to at least the relative density of the material existing in the adjacent ground.

(2) Chipping of cleared vegetation

The Contractor shall produce a wood-chip mulch derived from crowns of trees and branches of shrubs cleared under this sub-section. The wood-chip mulch produced shall be stockpiled for subsequent use or for use at other locations as appropriate.

The wood-chip mulch shall be produced from branches having a maximum diameter of 100 mm and the chipped material produced shall not have two orthogonal dimensions exceeding 75 mm and 50 mm.

(3) Disposal of surplus materials

Unless otherwise specified elsewhere, all surplus materials cleared and grubbed in accordance with this sub-section shall either be removed from the site or used for landscaping within the site in accordance with the approved plans and any conditions set by council.

Unless otherwise approved by council in writing, disposal of timber and other combustible materials by burning shall not be permitted.

SC6.4.6.12 Flexible pavements

SC6.4.6.12.1 Introduction

(1) Scope

This policy sub-section provides standards, advice and guidelines for the supply, spreading, compaction and trimming of base and subbase courses of flexible ~~and semi-rigid~~ (bound) pavements.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

Editor's note - A reference to drawings is a reference to construction drawings.

(2) Pavement structures

Flexible ~~or semi-rigid~~ pavement material types and layer thicknesses ~~shall~~must be as per design requirements.

(3) Activity plan

Prior to commencement of work, the Contractor must provide the Superintendent a Pavement construction plan and detail the following activities:

(a) allocation of plant and personnel for the contract period;

(b) work programming to meet the constraints of all inspection points; and

(c) prepare and submit a Pavement construction plan for the flexible base and subbase construction consistent with the drawings and subject to direction by the Superintendent. Include the following:

(i) a time based program;

(ii) a drawn sectional plan showing lots and sequence;

(iii) site availability, assumptions on weather, plant and materials;

(iv) a list of activities requiring approvals or notification of local authorities, statutory bodies, and local residents; and

(v) off-site storage of plant, personnel and maintenance facilities.

(4) Inspection, sampling and testing

Inspection, sampling and testing of the pavement ~~shall~~must be undertaken by the Contractor in accordance with the requirements of this sub-section before, during and after the construction of the pavement. Testing ~~shall~~must be carried out by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel.

The Contractor ~~shall~~must provide the Superintendent with written notice when testing is being carried out and copies of all test reports for approval to proceed.

Field density tests ~~shall~~must be carried out in accordance with AS 1289.5.3.1, or, with the Superintendent's concurrence, with a Nuclear Density Meter in accordance with Clause SC6.4.6.12.6(3).

(5) Terminology

Base material	materials designated as Base are of a suitable quality that form the uppermost structural element of a pavement and on which the surfacing may be placed.
Bound material	bound material incorporates binder/s to produce structural stiffness (UCS > 1.5 MPa at ~~7~~ 28 days in accordance with TMR Test Method Q115).

Flexible pavement	a flexible pavement consists of a base and a subbase constructed of unbound granular materials or modified material, obtaining its load spreading properties from intergranular pressure, mechanical interlock and cohesion between the particles of the pavement material.
Modified material	modified material incorporates small amounts of stabilising binder to improve the properties of the material without significantly affecting structural stiffness. A modified material must have sufficient stabilising binder to achieve a UCS range of 0.8 MPa - 1.5 MPa at ~~7~~ 28 days in accordance with TMR Test Method Q115.
Subbase material	materials designated as Subbase are laid on the subgrade (or selected material), below the base, either for the purpose of making up additional pavement thickness, to prevent intrusion of the subgrade into the base, or to provide a working platform.
Unbound material	unbound materials are granular materials with no significant capacity to resist tensile stresses.

(6) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.6.16 - Sprayed bitumen surfacing

SC6.4.6.19 - Stabilisation

SC6.4.4.2 – Pavement design

(b) Queensland Department of Transport and Main Roads specifications

MRTS05 - Unbound Pavement

(c) Queensland Department of Transport and Main Roads Test Methods

Q142A - Dry Density - Moisture Relationship (Standard Compaction).

Q115 - Unconfined Compressive Strength of Compacted Materials.

Q701 - Benkelman Beam Deflections.

(d) Australian Standards

AS 1141.14	*- Particle shape, by proportional calliper*
AS 1141.22	*- Wet/dry strength variation*
AS 1289.3.1.1	*- Determination of the liquid limit of a soil - Four point Casagrande method*
AS 1289.3.3.1	*- Calculation of the plasticity index of a soil*
AS 1289.3.6.1	*- Determination of the particle size distribution of a soil - Standard method of analysis by sieving*
AS 1289.3.6.3	*- Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer*
AS 1289.5.1.1	*- Determination of the dry density/moisture content relation of a soil using standard compactive effort*
AS 1289.5.3.1	*- Determination of the field density of a soil - Sand replacement method using a sand-cone pouring apparatus*
AS 1289.5.4.1	*- Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.8.1	*- Determination of field density and field moisture content of a soil using a nuclear surface moisture - density gauge - Direct transmission mode*
AS 1289.6.1.1	*- Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen*

SC6.4.6.12.2 Materials

(1) General

The Contractor ~~shall~~must submit details of all constituents of the proposed base and subbase materials, including sources of supply and the proposed type and proportion of any binder including targeted 28 days unconfined compressive strength (UCS). These details ~~shall~~must be submitted to the Superintendent, supported with test results from a nominated NATA registered laboratory confirming that the constituents comply with the requirements of this sub-section.

If the proposed base or subbase is a bound material, the Contractor ~~shall~~must submit a completed SC6.4.6.19 Attachment A Stabilisation mix design contained in the sub-section SC6.4.6.19 Stabilisation.

No material ~~shall~~ may be delivered until the Superintendent has approved the source of supply.

If, after the Contractor's proposals have been approved, the Contractor wishes to make changes in any of the material constituents the Contractor ~~shall~~must inform the Superintendent in writing of the proposed changes. No delivery of material produced under the altered proposal ~~shall~~must take place without the approval of the Superintendent.

At least 2 weeks before placement of the material on site, the Contractor ~~shall~~must submit a Certificate from a laboratory with appropriate NATA registration demonstrating and stating that the unbound material or the mix and its constituents comply with the requirements of this sub section.

Ongoing testing of materials during delivery and construction ~~shall~~must be undertaken on samples taken from the site.

(2) Unbound base and subbase

Base materials ~~shall~~must comply with the requirements of type 2.1 materials as per clause 7.2 of MRTS05, grading B or C.

Sub-base materials ~~shall~~must comply with the requirements of type 2.3 materials as per clause 7.2 of MRTS05, grading B or C.

Lower sub-base ~~shall~~must comply with the requirements of type 2.4 materials as per clause 7.2 of MRTS05, grading B or C.

Unbound materials, including blends of two or more different materials, ~~shall~~must consist of granular material which does not develop significant structural stiffness when compacted. Material produced by blending ~~shall~~must be uniform in grading and physical characteristics.

(a) **Surface Evenness**

Townsville City Council reserves the rights to carry out the necessary test procedure and supply results to the Contractor.

(b) **Layer Thickness**

Unbound pavement material ~~shall~~must be laid at a minimum thickness of 125mm and a maximum thickness of 250mm.

(c) **Longitudinal Joins**

Longitudinal joins for paving runs for the top layer of the base courses ~~shall~~must be aligned to coincide with the position of the traffic lane markings, except where approved otherwise in writing by the Superintendent.

(d) **Segregation**

Segregation is the uneven distribution of particle sizes. The construction process ~~shall~~must minimise segregation. There ~~shall~~must be no visible signs of segregation on each lot. Samples ~~shall~~must be taken from each lot to check that segregation of the material in the lo~~s~~t has not occurred. Additional samples ~~shall~~must be taken from any areas which show visible signs of segregation. Each sample ~~shall~~must be tested in accordance with Test Method Q103A.

(3) Lime modified base and subbase materials

Modification of unbound base and subbase materials to meet the requirements of clause SC6.4.6.12.2(2) Unbound base and subbase by the addition of hydrated lime or quicklime ~~shall be~~is subject to approval by the Superintendent and to the additional requirements of this clause. After modification, the material ~~shall~~must meet the requirements of clause SC6.4.6.12.2(2) Unbound base and subbase.

Modification of materials must be by means of blending either hydrated lime through a stationary mixing plant or by hydrated lime or quicklime utilising in-situ operations.

Material requirements of hydrated lime and quicklime ~~shall~~must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The method of incorporating lime through the stationary mixing plant ~~shall~~must ensure that the lime is mixed uniformly through the material.

In-situ operations ~~shall~~must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The proportion of lime ~~shall~~must be not less than 1.5% ~~per cent~~ nor more than 4% ~~per cent~~ by mass. The material prior to lime treatment ~~shall not~~must contain ~~any~~ no added pozzolanic material.

The lime treated material ~~shall~~ must yield an unconfined compressive strength not exceeding 1~~.0~~ MPa, when tested in accordance with Test Method Q115 where sampling is undertaken within 24 hours of adding the lime and testing is after ~~7~~ 28 days ~~accelerated~~ curing.

(a) **Curing Final Layer**

Moist curing process has the potential to "wash" the cementitious paste from the upper surface, which leaves an unbound, non-cohesive, soft pavement matrix with high embedment potential for the subsequent sealing aggregate. Therefore, wherever possible the completed pavement ~~shall~~ should not be moist cured within ~~72~~ 48 hours of placing. ~~After 72 48 hours, m~~Moist curing ~~shall~~ must be carried out using equipment fitted with spray jets that deliver water to the pavement as a fine mist. The use of conventional spray bars or high pressure water nozzles with large aperture sprays holes will not be permitted. Conventional bituminous surface curing may be used within ~~72~~ 48 hours.

~~(4) Insitu lime stabilisation of subgrade~~

~~Lime stablisitation of subgrade material shall be carried out as a two day operation to a minimum depth of 250mm, except for natural subgrades of CBR 0.5% where stabilisation depth shall be a minimum of 300mm. The stabilising agent shall be spread using a purpose built spreader and the stabilising agent and water shall be incorporated into the material using a reclaimer/stabiliser. Alternatively, a reclaimer/stabiliser with a calibrated integrated spreader/applicator may be used to incorporate the stabilising agent and water directly into the material to be stabilised. Where a reclaimer/stabiliser with calibrated integrated spreader/applicator is used, quicklime shall not be used as the stabilising agent.~~

~~**Day 1:** A single lime pass at a rate of up to half the required rate shall be applied. Where quicklime is spread over the subgrade, it shall be slaked in accordance with the requirements in this document. In situations where hydrated lime is used, slaking is not required mixing the stabilising agent into the soil. The hydrated lime or lime slurry formed from the slaking of quicklime shall then be mixed into the material in accordance with the requirements in this document. The depth of mixing shall not exceed 90% of the specified stabilisation thickness. The material shall be lightly rolled to seal the surface prior to the completion of work on that particular day.~~

~~**Day 2:** After the overnight amelioration period, the balance of the required lime shall be spread in accordance with the requirements in this document. Where quicklime is spread over the subgrade, it shall be slaked in accordance with the requirements in this document. In situations where hydrated lime is used, slaking is not required before mixing the stabilising agent into the soil. The hydrated lime or lime slurry formed from the slaking of quicklime shall then be mixed into the material in accordance with the requirements in this document. Notwithstanding this a minimum of two mixing passes shall be completed.~~

~~Lime shall be spread at a maximum spread rate of 12 kg/m2. The number of passes shall be calculated to comply with this requirement. The stabilising agent shall be uniformly spread over the insitu material at a controlled rate (mass per unit area, kg/m2). The total rate of spread shall be such that the stabilising agent spread rate for the compacted material is within the specified tolerances. Once the stabilising agent has been spread, no traffic, other than the construction plant employed for the stabilisation work, shall travel over it. After each spreading run at least one mixing run, and trimming and/or compaction as required, shall be completed. Further mixing operations between spreading runs shall comply with requirements in this document.~~

~~Quicklime shall be slaked with sufficient water to allow complete hydration such that the material remains friable after slaking and no further exothermic reaction occurs when further water is added to the lime. All through traffic shall be stopped during any slaking operation.~~

~~The entire stabilisation process shall not proceed in any of the following situations: during rainfall;~~

- ~~when rainfall appears to be imminent;~~
- ~~during periods when the wind is strong enough to cause particles of the stabilising agent to become airborne;~~
- ~~during conditions that may result in the work causing nuisance or danger to people, property, the environment, or live stock;~~
- ~~when the pavement temperature, measured 50 mm below the surface, drops below 10ºC; and when the air temperature, measured in the shade, exceeds 40ºC .~~

(4~~5~~) Bound base and subbase materials (Including Modified Material)

Bound material for a UCS ~~>~~ 1.5 MPa (~~7~~ 28 days) to be used as subbase generally or base layer may be supplied as a pugmill quarry product with stabilising agent and ~~layed~~ laid using a paving machine or grader laid ~~pugmill~~. Alternatively it may be produced by the in- situ stabilisation of natural or blended gravel where stabilisation is undertaken by mobile plant at the site.

Prior to stabilisation, the ~~base~~ layer ~~material~~to be stabilised ~~shall~~must meet the appropriate requirements for subbase material. Material requirements for the stabilising agent ~~shall~~must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The stabilisation process ~~shall~~must meet the requirements of sub-section SC6.4.6.19 Stabilisation.

The unconfined compressive strength (UCS) of the material after 28 days curing as determined by Test Method Q115 ~~shall~~must be not less than ~~3.0~~2.5 MPa for stabilised pavements and not less than ~~1.0~~0.8 MPa for modified pavements. Sampling and test specimen compaction of the material ~~shall~~must be undertaken within one hour of the incorporation of the stabilising agent.

The maximum period (working time) between mixing cement with the gravel material and the completion of compaction ~~shall~~must be ~~3.5~~3 hours. Council reserves the rights to reject the work if working time is not achieved and the material must be removed from site.

(a) **Surface Evenness**
Townsville City Council reserves the rights to carry-out the necessary test procedure and supply results to the contractor.

(b) **Layer Thickness**
Bound pavement material (including Modified Material) ~~shall~~must be laid at a minimum thickness of 150mm and a maximum thickness of 250mm. If bound layers are placed with a paving machine, Council may approve thinner layers.

(c) **Longitudinal Joins**
Longitudinal joins for paving runs for the top layer of the base courses ~~shall~~must be aligned to coincide with the position with the traffic lane markings, except where approved otherwise in writing by the Superintendent.

(d) **Segregation**
Segregation is the uneven distribution of particle sizes. The construction process ~~shall~~must minimise segregation. There ~~shall~~must be no visible signs of segregation of the material in the lot has not occurred. Additional samples ~~shall~~must be taken from any areas which show visible signs of segregation. Given the presence of cement additive in the material, the relevant test for segregation ~~shall~~must be as specified in AS 1289.3.6.1.

(e) **Curing Final Layer**
Moist curing process has the potential to “wash” the cementitious paste from the upper surface, which leaves an unbound, non-cohesive soft pavement matrix with high embedment potential for the subsequent sealing aggregate. Therefore, the completed pavement ~~shall~~must not be moist cured within ~~72~~ 48 hours of placing. After ~~72~~ 48 hours, moist curing ~~shall~~must be carried out using equipment fitted with spray jets that deliver water to the pavement as a fine mist. The use of conventional spray bars or high pressure water nozzles with large aperture sprays holes will not be permitted. Conventional bituminous surface curing may be used within ~~72~~ 48 hours.

SC6.4.6.12.3 Delivery, stockpiling and processing of pavement material

(1) Delivery to site
Materials must be supplied sufficiently damp to avoid segregation and loss of fines during transit.

(2) Stockpiling of unbound materials
Stockpile sites ~~shall~~must be located as shown on the drawings or as approved by the Superintendent.

Stockpile sites, which ~~shall~~must be cleared of all vegetation and extraneous matter, ~~shall~~must be shaped to form a crown so as to be free draining and compacted over the whole area to provide a relative compaction, determined by
AS 1289.5.4.1 for standard compactive effort, of not less than 95% ~~per cent~~.

Stockpiles and stockpile sites ~~shall~~must be maintained so as to prevent the stockpiled materials from becoming intermixed or contaminated with foreign material.

The total height of any stockpile ~~shall~~must not exceed 3 m.

Stockpiles ~~shall~~must be of uniform shape with side slopes neither steeper than 1.5h to 1v nor flatter than 3h to

1v. The worked face of any stockpile ~~shall~~must be the full face of the stockpile. The stockpiled material

~~shall~~must be
maintained at a moisture content sufficiently damp to avoid loss of fines.

(3) At the completion of the works, stockpile sites ~~shall~~must be cleared of all surplus material and left in a clean and tidy condition.

Delivery of modified or bound materials
Modified or bound materials ~~shall~~must be delivered in vehicles fitted with covers of canvas or other suitable material to prevent loss of moisture during transport.

The time between mixing and conveyance by delivery trucks to the site, ~~shall~~must be such as to allow incorporation into the works including trimming and compaction within the nominated field working period.

Each truck load of bound material ~~shall~~must be identified by delivery dockets, indicating the time and date of mixing and registration or fleet number of the delivery truck, and such dockets ~~shall~~must be made available to the Superintendent at the point of delivery.

Bound materials ~~shall~~must comply with the requirements of sub-section SC6.4.6.19 Stabilisation.

SC6.4.6.12.4 Spreading pavement materials
The contractor must present the underlying layer to the Superintendent prior to placement of subsequent layers and must ensure~~ing~~ that moisture content of the underlying layer does not exceed 90% ~~per cent~~ of the laboratory optimum moisture content as determined by AS 1289.5.1.1. If the underlying layer ~~or which~~ has become rutted or mixed with foreign matter, it. ~~The underlying layer~~ ~~shall~~must be corrected to comply with this Sub-section before spreading of the next layer of pavement.

Where the underlying layer was constructed by the Contractor, or where the Contractor’s activities caused the

underlying layer constructed by others to become non-complying with this sub-section, ~~the~~ correcting the underlying layer to comply ~~shall be~~is the responsibility of the Contractor.

Each layer of material ~~shall~~must be deposited and spread in a concurrent operation and, after compaction, the finished surface levels on the base and subbase courses ~~shall~~must be within the permitted tolerances stated in Clause SC6.4.6.12.6(6)(c) Levels and surface trim without subsequent addition of material. The thickness of each compacted layer ~~shall~~must be neither less than ~~150~~ 125 mm nor more than ~~300~~ 250 mm for all pavement layer types, unless otherwise approved by the Superintendent.

At all work boundaries in bound materials the Contractor ~~shall~~must provide vertical faces to provide for transverse and longitudinal joints.

When spread for compaction processes the moisture content of the unbound and bound base materials must be in the range of 60-90% and ~~or~~ subbase materials ~~shall~~must be in the range of ~~60-90 per cent and~~ 75-100% ~~per cent respectively~~ of laboratory optimum moisture content in accordance with AS 1289.5.1.1.

Bound materials with UCS > 1.5 MPa (~~7~~ 28 days) ~~shall~~must not be spread with a self-propelled paver when the ambient air temperature in shade is either below 5 °C or above 35 °C ~~with a self-propelled paver~~. ~~The working time shall not exceed 3 hours (i.e. materials must be trimmed and compacted within 3 hours from the time the cement is added to the material at the quarry).~~ Where the materials are to be spread outside the required ambient air temperature range, the Contractor must submit a work proposal to the Superintendent for approval.

SC6.4.6.12.5 ~~Trimming and c~~Compaction

(1) General requirements

Each layer of the base and subbase courses ~~shall~~must be uniformly compacted over its entire area and depth to satisfy the requirements of relative compaction set out in clauses SC6.4.6.12.6(3) Relative compaction and SC6.4.6.12.6(4) Compaction requirements and acceptance.

On sections of pavement with one way crossfall, compaction ~~shall~~must begin at the low side of the pavement and progress to the high side. On crowned sections, compaction ~~shall~~must begin at the sides of the pavement and progress towards the crown. Each pass of the rollers ~~shall~~must be parallel with the centreline of the roadway and uniformly overlap each preceding pass. The outer metre of both sides of the pavement ~~shall~~must receive at least two more passes by the compaction plant than the remainder of the pavement.

At locations where it would be impracticable to use self propelled compaction plant, the pavement material ~~shall~~must be compacted by alternative hand operated plant approved by the Superintendent.

Watering and compaction plant ~~shall~~must not be allowed to stand on the pavement being compacted.
If any unstable areas develop during rolling, the unstable material ~~shall~~must be rejected. The rejected material ~~shall~~must be removed for the full depth of the layer, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses. This operation will be at cost to the Contractor.

The placement of subsequent layers ~~shall~~must not be allowed until the requisite testing has been completed and the test results for each layer have been accepted by the Superintendent and correct curing times for bound layers has been attained.

Any unbound material in a layer that has attained the specified relative compaction but subsequently becomes wetted up ~~shall~~must be dried out and, if necessary, uniformly recompacted and trimmed to meet the specified density requirements and level tolerances.

(2) Curing of bound materials

The curing of the surface layer of a lot ~~shall~~must commence after compaction is completed and must be in accordance with the SC6.4.6.19 Attachment A Stabilisation mix design.

The stabilised work ~~shall~~must be protected against rapid drying out by keeping it continuously wet or damp during

the period prior to the provision of a subsequent layer or the application of a prime or primer-seal. Also refers to the requirements of SC6.4.6.12.2 (5) (e) Curing of final layer.

~~Moist curing of the final layer process has the potential to "wash" the cementitious paste from the upper surface, which leaves an unbound, non cohesive soft pavement matrix with high embedment potential for the subsequent sealing aggregate. Therefore, the completed pavement shall~~must ~~not be moist cured within 72 hours of placing. After 72 hours, moist curing shall~~must ~~be carried out using equipment fitted with spray jets that deliver water to the pavement as a fine mist. The use of conventional spray bars or high pressure water nozzles with large aperture sprays holes will not be permitted. Conventional bituminous surface curing may be used within 72 hours.~~

SC6.4.6.12.6 Acceptance of compaction

(1) Lots for acceptance

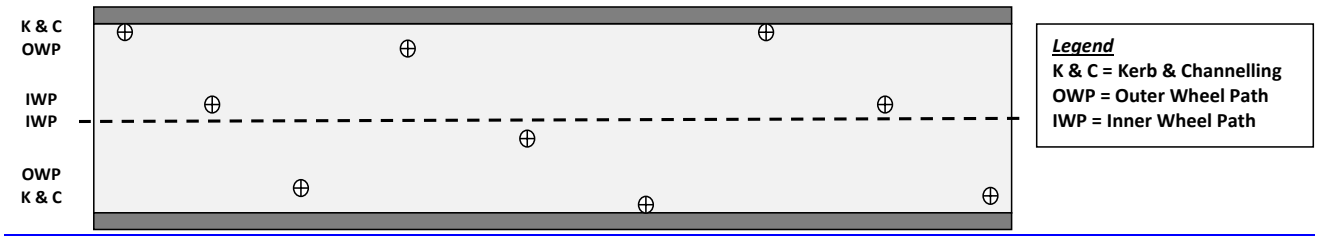
Acceptance of work, as far as compaction is concerned, ~~shall~~must be based on density testing of the work in lots. A lot ~~shall~~must be nominated by the Contractor, but ~~shall~~must conform to the following:

(a) cover only a single layer of work which has been constructed under uniform conditions in a continuous operation and not crossing any transverse construction joints; and

(b) for unbound materials, it may equal a day's output using the same material.

(2) Compaction assessment

The Superintendent ~~shall~~must assess compaction for each lot based on an arranged ~~random sampling~~ of test locations for in-situ dry density testing in line with the following diagram. The intention is that one in every three density tests ~~shall~~must be positioned against the inner line of the kerb and channel on either side. This arrangement ~~shall~~must be repeated or truncated as appropriate depending on the number of tests required per lot.



Similar arrangement ~~shall~~must be adopted for roads with no kerb and channel or edge constraint, with the test locations at the edge shifted to the OWP position. A random arrangement for test locations at intersection is acceptable, provided that one in every three density test is positioned along the inner kerb and channel / edge line.

The Contractor ~~shall~~must arrange for testing to assess compaction on the basis of a pro rata testing frequency of 10 tests per 5,000 ~~sq m~~ with a minimum of three tests per lot~~, and present the results to the Superintendent for approval~~.

The elastic rebound deflection ~~shall~~must be taken as the maximum deflection in accordance with Test Method Q701 utilising the Benkelman Beam or equivalent. The average maximum deflection for any lot ~~shall~~must not exceed 1~~.0~~ mm, and the co-efficient of variation (CV) in recorded deflections ~~shall~~must not exceed 30% ~~per cent~~.

(3) Measurements ~~shall~~must be taken at the rate of 4 per 1,000 ~~square metres~~, with a minimum of ten measurements per lot.

Proof rolling ~~shall~~must be undertaken with the use of a single drive axle truck with a~~n~~ rear single axle/dual wheels load of 8.2 ~~t~~ or tandem rear axle/dual wheels carrying a load of 13.8t. Proof rolling must cover~~ing~~ all lanes of the carriage way including parking bays and must show ~~having~~ no evident movement.

Relative compaction

The relative compaction of pavement material at each location tested for in-situ dry density ~~shall~~must be calculated in accordance with AS 1289.5.4.1 as follows:

$$\text{Relative Compaction (per cent)} = \frac{\text{In-situ dry density}}{\text{Comparative dry density}} \times 100$$

Note—the comparative dry density ~~shall~~must be the maximum dry density determined in the laboratory.

The council Superintendent may approve some or all of the in-situ dry density testing to be carried out with a single probe Nuclear Density Meter in the direct transmission mode in accordance with AS 1289.5.8.1. Council reserves the right to request additional testing at the discretion of the Inspector.

Each day that material is produced for placement in a layer or layers, a sample of the material ~~shall~~must be taken by the Contractor for maximum dry density testing to represent that day's production.

For unbound layers, the sample ~~shall~~must be tested in accordance with AS 1289.5.1.1 to determine the maximum dry density (standard compactive effort) for the material.

For bound layers the sample ~~shall~~must be tested within two hours after the addition of stabilising agent to the mix in accordance with Test Method Q142A to determine the maximum dry density (standard compactive effort) for

the material. This test method ~~shall~~must also be used to determine the standard optimum moisture content.

The maximum dry density so determined ~~shall~~must be used as the comparative dry density in relative compaction calculations for all like material from that lot or day's production placed in a single layer of work whichever is the lesser.

(4) Compaction requirements and acceptance

All compaction test results must exceed the minimum requirements in accordance with:

(a)	Unbound pavement	MRTS05
(b)	Insitu stabilised subgrade using lime	MRTS07A
(c)	Insitu stabilised pavement using cement	MRTS07B
(d)	Insitu stablised pavement using foam bitumen	MRTS07C
(e)	Plant mixed stabilised pavement	MRTS08

(5) Reworking of rejected unbound layers

Lots or areas of pavement that have been rejected in regard to compaction ~~shall~~must be reworked before resubmission for compaction assessment.

Material that has become degraded, segregated or otherwise reduced in quality by reworking ~~shall~~must be rejected. The rejected material ~~shall~~must be removed, disposed of and replaced with fresh material complying with this Sub- section in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses. When a lot or area of pavement is resubmitted for compaction assessment, testing ~~shall~~must be carried out in accordance with clauses SC6.4.6.12.6(2) Compaction assessment and SC6.4.6.12.6(3) Relative compaction.

All corrective work ~~shall~~must be carried out by the Contractor before the resubmission of a lot for compaction assessment, including rewatering, rerolling, removal and replacement of material as well as reworking. All costs associated with corrective work carried out before the resubmission of a lot for compaction assessment, including rewatering, rerolling, removal and replacement of material as well as ~~as~~ reworking ~~shall~~must be borne by the Contractor.

Reworking of rejected modified or stabilised material is not accepted.

(6) Tolerances

(a) General

The tolerances stated are the acceptable limits of departure from the dimensions shown on the drawings, which may occur during construction.

Areas for assessment of conformity with tolerance requirements ~~shall~~must be divided into lots and presented to the Superintendent together with survey reports covering line and level.

(b) Width

At any cross section without kerb and /or guttering channel or a dish drain, and for pavement layers extending under the kerb and channel or dish drain/or guttering , the horizontal dimension measured from the design centre line to the edge of the constructed pavement surface ~~shall~~must be neither less than 50 mm less than the dimension nor more than 300 mm greater than the dimension shown on the drawings. The average width of the layer determined from measurements at three sites selected at random by the Superintendent over any 200 m road length, or part thereof, ~~shall~~must be not less than the specified width.

(c) Levels and surface trim

The levels of the finished surface of the top of the unbound subbase course ~~shall~~must not vary from the design levels by more than ± ~~(10)~~ 15 mm.

Level tolerances at the top of the unbound base course ~~shall~~must not exceed those stated above for subbase. In addition, where kerb and channel exists or is being constructed, the level of the top of the base course adjacent to the kerb and channel ~~shall~~must not vary by more than ±~~ ~~5~~ mm from the lip level of the gutter

minus the design thickness of the wearing surface.

The design level of the top of the subbase course ~~shall~~must be determined from the design level of the finished road surface less the thickness of the base course and the wearing course, including an allowance for any flush seal layer in the pavement design.

The pavement surface after trimming and immediately prior to sealing ~~shall~~must be of a quality such that the deviation under a 3 m straight edge placed in any direction does not exceed 12 mm. Measurements for conformance ~~shall~~must be taken in accordance with the maximum lot size and minimum test frequencies in SC6.4.5 Construction management.

(7) Action on rejection

(a) Unbound materials

A lot that has not complied with the requirements for width or level tolerance as set out in clauses SC6.4.6.12.6(6)(b) Width and SC6.4.6.12.6(6)(c) Levels and surface trim respectively ~~shall~~must be rejected except as otherwise provided in this clause. Rejected lots ~~shall~~must be removed, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses.

Notwithstanding the above, where the rejected lot can be corrected by further trimming, the Superintendent may allow the surface to be corrected without complete removal and replacement with fresh material. Such trimming ~~shall~~must be undertaken in a manner that produces a uniform, hard surface and ~~shall~~must be achieved by cutting only without filling. After any such cutting, the level tolerances in clause SC6.4.6.12.6(6)(c) Levels and surface trim ~~shall~~must apply.

The required surface correction or replacement work ordered in accordance with this clause including removal of material, disposal and supply and transport of replacement material, ~~shall~~must be borne by the Contractor.

(b) Bound materials

An area of bound material that has not complied with the requirements for width or level tolerance as set out in clauses SC6.4.6.12.6(6)(b) Width and SC6.4.6.12.6(6) Levels and surface trim respectively ~~shall~~must
be rejected except as otherwise provided for in this clause. Rejected areas ~~shall~~must be removed, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses.

The removal and disposal of rejected material and its replacement with fresh material ~~shall~~must be borne by the Contractor.

Notwithstanding the above, the Superintendent may allow the Contractor to rectify the area in the following cases:

(i) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a subbase course and rejection is due to departures from design level being too far below the design level, the Contractor may increase the thickness of the base course to make up such deficiency in thickness.

(ii) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a subbase course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course, to allow for its design thickness to be laid, up to a maximum of 20 mm above the original design level. Approval by the Superintendent ~~shall be~~is subject to the following requirements:

(A) the rate of change of grade from the original finished design surface level ~~shall~~must be less than 3 mm per metre;

(B) the regrading ~~shall~~must not interfere with the proper design functioning of the drainage system;

(C) the regrading ~~shall~~must not interfere with levels at the property boundary, or increase or decrease footpath or footpath crossover levels or grades beyond council's allowable design limits; and

(D) the regrading ~~shall~~must not interfere with clearances.

(iii) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a base course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course. Approval by the Superintendent ~~shall be~~is subject to the requirements of this clause in (ii) above.

(8) Removal and replacement of rejected courses

Sections of work that have been rejected by the superintendent are to be removed from the work site and replaced with fresh material.

Any rejected pavement sections are to be removed and replaced over the full length of the rejected lot for a minimum length of 20 m of the pavement layer. Any damage to underlying or abutting layers or structures ~~shall~~must be made good by the Contractor using methods approved by the Superintendent.

The Superintendent may approve removal for less than the full width as constructed if the cause of the rejection of the work can be isolated transversely to the Superintendent's satisfaction. In this case, the new longitudinal cold joint ~~shall~~must be formed and located along the centreline of the road pavement.

After removal of rejected base or subbase course material, the section ~~shall~~must be presented for inspection by the Superintendent before replacement work is commenced.

Materials used as replacement materials, and the subsequent spreading, compaction, trimming, curing and testing of the replacement materials, ~~shall~~must comply with the requirements of this sub-section.

The removal, replacement and correction of base and subbase courses required under this clause ~~shall be~~is the responsibility of the Contractor in respect of delays caused by such removals, replacements and corrections ~~shall~~must be borne by the Contractor.

All costs associated with the corrective work ~~shall~~must be borne by the Contractor.

(9) Maintenance before completion of wearing surface

Following the Superintendent's acceptance of any section of the work, the Contractor ~~shall~~must maintain the prepared surface of the base in the condition specified for acceptance until the wearing surface is completed. The preparation work ~~shall~~must be carried out in a manner which will promote the adhesion of the bituminous material to the surface of the pavement. Preparation work ~~shall~~must include:

(a) Removal of all foreign and loose material from the surface.

(b) Light watering on dr~~a~~y and dusty surface

Ball Penetration testing on inner and outer wheelpaths ~~shall~~must be carried out on all pavements before application of bituminous material. Where a ball penetration result exceeds 4.0mm the surface ~~shall~~must not be sprayed until Council is advised and approval to proceed granted.

The base course of sections of the accepted work ~~shall~~must be covered with a primerseal over the full width of pavement in accordance with sub-section SC6.4.6.16 Sprayed bitumen surfacing within 7 days of the date of the acceptance of such sections, unless otherwise approved by the Superintendent.

Should the pavement condition deteriorate before the application of the primerseal and consent to proceed with the bitumen surfacing work is withdrawn by the Superintendent, the Contractor ~~shall~~must re-prepare the pavement and re-present the pavement for inspection by the Superintendent.

The maintenance and re preparing areas of the deteriorated pavement ~~shall be~~is the responsibility of the Contractor.

The Contractor ~~shall~~must maintain adequate drainage of the pavement, and remove any ponded water within 12 hours of its creation if free drainage cannot be achieved, prior to the completion of the wearing course.

SC6.4.6.12.7 Opening pavement to traffic

General requirements

For unbound pavement layers, construction plant and vehicles not involved in the current construction or testing of the work ~~shall~~must not be permitted to use the pavement until the primerseal has been applied, unless otherwise approved.

For bound pavement layers, construction plant and vehicles not involved in the current construction or testing of the work ~~shall not be permitted to~~should not use the pavement until the primerseal has been applied and seven days have elapsed since placement of the base. In any case only vehicles registered for legal road usage and loaded within legal limits will be allowed to use the pavement.

~~For bound pavement layers, traffic shall not be allowed to use the constructed pavement until a minimum of seven days after completion of the full pavement depth and the primerseal.~~

SC6.4.6.12.8 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.12.1 below.

Table SC6.4.6.12.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Stockpile Sites**	(i) Relative Compaction >97% (ii) Stockpile height <3m (iii) Stockpile batter <1.5:1 and >3:1	SC6.4.6.12.3(2) SC6.4.6.12.3(2)
2.	**Spreading Pavement Materials**		
	(i) Compacted Layer Thickness	≥150mm (modified material) ≥125mm (unmodified material) ≤250mm (all material)	SC6.4.6.12.4
3.	**Compaction Acceptance**		
	Minimum value of all calculated relative compaction results	All compaction test results must exceed the minimum referenced requirements	SC6.4.6.12.6(4)
4.	**Width of Pavement**	-50mm to +300mm of dimensions on drawings	SC6.4.6.12.6(6)(b)
	(i) Design centre-line to edge of constructed pavement		
	(ii) Average Width	The average width determined from 3 random sites over any 200m road length, or part thereof, ~~shall~~must be not less than the specified width.	SC6.4.6.12.6(6)(b)
5.	**Surface Level**		
	(i) Subbase levels	<± 15mm from design level	SC6.4.6.12.6(6)(c)
	(ii) Base levels	<± 15mm from design level	SC6.4.6.12.6(6)(c)
	(iii) Base levels adjacent to kerb and channel	<±5mm from the lip levels of adjacent gutter minus design thickness of wearing surface.	SC6.4.6.12.6(6)(c)
	(iv) Shape	Deviation from a 3m long straightedge on base surface immediately prior to sealing ~~shall~~must be less than 12mm	SC6.4.6.12.6(6)(c)
	(v) Ball Penetration	>4.0mm	SC6.4.6.12.6(9)

SC6.4.6.13 Asphaltic concrete

SC6.4.6.13.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the production and placing of asphalt including the supply of materials, sampling, testing and any other operations necessary to provide asphalt. . The extent of the policy sub-section ~~shall~~ includes:

(i) manufacture/supply of the production mix;

(ii) provision of a testing laboratory;

(iii) preparation of the surface on which asphalt is to be placed;

(iv) transport of asphalt;

(v) laying and compaction of asphalt; and

(vi) sampling and testing.

(b) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editors note - A reference to drawings is a reference ~~and~~ to construction drawings.

(2) Plant

The Contractor ~~shall~~ must provide all the plant, equipment and labour necessary for carrying out the work in accordance with this sub-section.

All plant and equipment used on the work ~~shall~~ must be in accordance with the submitted quality documentation and kept in good operating condition. The Contractor ~~shall~~ must not use in the work any plant or equipment demonstrated to be faulty in operation so as to effect the product quality or unsafe in operation as assessed by the Superintendent.

All plant ~~shall~~ must be registered and insured as appropriate to its use on a public road and ~~shall~~ must comply with statutory environmental regulations.

(3) Protection of services and road fixtures

The Contractor ~~shall~~ must take all necessary precautions to prevent asphalt or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, access chamber covers, bridge or culvert decks and other road fixtures. Immediately after the asphalt has been spread the Contractor ~~shall~~ must clean off or remove any such material as directed by the Superintendent and leave the services and road fixtures in a condition satisfactory to the Superintendent.

(4) Control of traffic

The Contractor ~~shall~~ must provide for traffic control in accordance with the requirements of sub-section SC6.4.6.30 Control of traffic while undertaking the work.

The Contractor ~~shall~~ must take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the road users or employees.

(5) Work records

Particulars of the work performed ~~shall~~ must be recorded by the Contractor on the Asphalt Work Record at SC6.4.6.13 Attachment A Asphalt Work Record or as per the Contractor's own procedures where equivalent. The Contractor ~~shall~~ must complete the Asphalt Work Record, which ~~shall~~ must be countersigned by the Superintendent each day as a true record of the work performed. ~~A copy shall be supplied to the Superintendent.~~

Delivery dockets stating the mass of each truck load of asphalt ~~shall~~ must be attached to the Asphalt Work Record.

(6) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections

SC6.4.6.30 - Control of traffic

(b) Australian Standards

AS 1141.11	*- Particle size distribution by dry sieving*
AS 1141.14	*- Particle shape, by proportional calliper*
AS 1141.17	*- Voids in dry compacted filler*
AS 1141.18	*- Crushed particles in coarse aggregate derived from gravel*
AS 1141.22	*- Wet/dry strength variation*
AS 1141.42	*- Pendulum friction test (PAFV)*
AS 1160	*- Bitumen emulsions for the construction and maintenance of pavements*
AS 2008	*- Residual bitumen for pavements*
AS 2150	*- Hot mix asphalt*
AS 2758.5	*- Asphalt aggregates*
AS 2891.1	*- Sampling of Asphalt*
AS 2891.3.1	*- Bitumen content and aggregate grading - Reflux method*
AS 2891.5	*- Determination of stability and flow - Marshall procedure*
AS 2891.8	*- Voids and density relationships for compacted asphalt mixes*
AS 2891.9.3	- Determination of bulk density of compacted asphalt - Mensuration method
AS 2891.10	- Water and volatile oils content

(c) Queensland Department of Transport and Main Roads Specifications

MRS17 ~~(11/11)~~	*- Bitumen*
MRS18 ~~(11/11)~~	*- Polymer Modified Binder*
MRS21 ~~(06/09)~~	*- Bituminous Emulsion*
MRS30 ~~(06/13)~~	*- Dense Graded and Open Graded Asphalt*
~~*MRS31 (06/13)*~~	~~*- Heavy Duty Asphalt*~~

(d) Austroads

AGPT03-2009 *Guide to Pavement Technology Part 3 – Pavement surfacings*
AGPT04B-2007 *Guide to Pavement Technology Part 4B - Asphalt*

SC6.4.6.13.2 Materials

Materials and mix ingredients ~~shall~~ must be in accordance with MRTS30. Binder ~~shall~~ must be in accordance with MRTS17 and polymer modified binder in accordance with MRTS18.

SC6.4.6.13.3 Asphalt mix design

(1) Approved mix

The supply only of an approved mix in accordance with MRTS 30.

The Contractor ~~shall~~ may not make any changes to the approved mix, or constituent materials without the prior written approval of the Superintendent.

Notwithstanding any approval given by the Superintendent to a proposed asphalt mix, the Contractor ~~shall be~~is responsible for producing asphalt which satisfies all requirements of this policy sub-section.

Asphalt produced in the plant and delivered to the site ~~shall~~ must be known as the "production mix".

(2) Production

(a) Asphalt production ~~shall~~ must comply with the requirements of MRTS30.
The Superintendent, upon provision of notice to the asphalt supplier or the supplier's representative, ~~shall~~ must have access to the mixing plant for purposes of inspection to verify production procedures and the supplier's compliance with the Contractor's Quality Management Manual and Project Quality Plan. The Superintendent ~~shall~~ must have the right to declare any non-conformance and ~~shall~~ be entitled to request

correction of either the Contractor's Quality Management Manual or the Project Quality Plan or both.

(b) Storage of asphalt

Asphalt may be stored in an insulated storage bin prior to delivery. Asphalt which has been stored for more than twenty four hours or is below the minimum temperature specified ~~shall~~ must not be used. Binder manufacturer's instructions must be followed when polymer modified asphalt is stored.

(c) Contractor's laboratory

The Contractor ~~shall~~ must maintain and operate an appropriately registered NATA testing laboratory at or near the mixing plant to control the quality of the asphalt produced.

The Contractor will make the laboratory available for inspection by the Superintendent at any time during the course of the works.

All documented test results ~~shall~~ must be submitted to the Superintendent for inspection and approval in a format and to a timetable suitable to the Superintendent.

The Contractor ~~shall be~~is responsible for taking samples and ~~shall~~ must supply all facilities, equipment and labour for that purpose. The samples ~~shall~~ must be taken by the Contractor.

(d) Frequency of sampling

For the purpose of testing production mix the Contractor ~~shall~~ must sample production lots at the minimum frequencies set in MRTS30. This testing frequency requirement ~~shall~~ must apply to each asphalt mix type. The test results ~~shall~~ must be related to production intervals with samples representing the full lot of production of the relevant mix for the production interval.

Test results from this production control sampling are acceptable as representative of deliveries made under this contract subject to the traceability of production from specific production intervals to the location at the paving site.

Such traceability shall include registration of lot number and time of production on the delivery docket system. The size of any production lot shall be limited to production from a 12 hour "shift".

Sampling shall be performed in accordance with Test Method Q301. Samples shall be identified so as to allow traceability of the mix to the paving site. Each sample or sample portion as appropriate sampled as a referee sample shall be stored in an airtight container labelled so as to be traceable to the job and paving site location.

Testing required shall be arranged by the Contractor at an appropriately registered NATA laboratory. Test reports will be made available to the Superintendent as soon as they are available and always within 7 days of delivery of material.

Dense graded asphalt that does not include modified bitumen may include a proportion of RAP up to but not exceeding 20% ~~per cent~~ by mass. The resultant asphalt shall meet all requirements for the Nominated Mix.

The RAP to be utilised shall be nominated by source and/or stockpile. Testing of the Nominated Mix shall include RAP sampled from the stockpile and of similar physical properties as that to be utilised for the contract. Any change in RAP supply shall be brought to the attention of the Superintendent prior to proposed usage in asphalt under this contract.

(3) Delivery

The bodies of haulage trucks shall be kept clean and coated with a thin film of an approved release agent to prevent asphalt sticking to the body of the truck. Any surplus release agent shall be removed before loading.

During transport asphalt shall be covered with a canvas or other suitable cover which is held down securely.

When transported to site until delivery to the hopper, the mix must be covered with a heavy duty canvas or similar waterproof cover which shall overlap the sides of the truck body by at least 250 mm and shall be tied

down securely. The bodies of all trucks shall be suitably insulated.

Delivery of the asphalt shall be at a uniform rate within the capacity of the spreading and compacting equipment.

The mass of all truck loads of asphalt shall be measured on a registered weighbridge.

(4) Placing

Placing of asphalt shall not be permitted when the surface of the road is wet or while rain appears imminent, or when cold winds chill the asphalt to such an extent that, in the opinion of the Superintendent, spreading and compaction will be adversely affected. The Superintendent may order work to cease temporarily on account of adverse weather, unsatisfactory pavement surface condition, or other circumstance which the Superintendent feels may adversely affect the subsequent operations.

(5) Preparation of pavement

The existing surface shall be dry, clean and free from any loose stones, dirt and foreign matter. The surface shall be swept beyond the edge of the proposed asphalt layer by at least 300 mm. Any foreign matter adhering to the pavement and not swept off shall be removed by other means. Any areas significantly affected by oil contamination shall be cleaned to the satisfaction of the Superintendent.

Surface preparation shall be in accordance with AS 2734. Thermoplastic linemarking or other linemarking, where indicated necessary by the Superintendent will be removed prior to paving. Raised pavement markers shall be removed prior to paving.

The Contractor, when paving over existing road pavement, shall be responsible for the recording of lane marking positions including the extent of barrier line. After paving the Contractor will mark up the pavement to re-establish such positions using conventions agreed with the Superintendent and to a standard adequate to allow accurate re-establishment of line marking.

The Contractor shall repair any damage to the existing pavement surface caused by the Contractor's activities. Affected areas designated by the Superintendent shall be removed and reinstated to the Superintendent’s satisfaction.

A corrector course shall be used to correct irregularities in an existing surface and/or modify the shape of an existing surface. Any surface depressions greater than 25 mm in depth and any uneven surface shall be brought to the general level of the surrounding pavement/deck surface. Where a corrector course is used to modify the shape of an existing surface, the course shall be laid to the reduced levels and/or shape specified in the documents.

The Contractor shall mark out, in the presence of the Superintendent, the areas where corrector course is to be applied and shall not lay corrector course prior to receiving acceptance of the proposed areas from the Superintendent.
The asphalt in these patches shall be compacted to comply with the general level of the existing surface to the Superintendent’s satisfaction.
Back filling and stress absorbing fabric strips is to be carried out in accordance MRTS30 where indicated on the drawings or directed by the superintendent.
Preparation of the prepared surface is to be to the satisfaction of the Superintendent. Subsequent inspection and Superintendent’s approval of surface condition shall be required prior to the release of the hold point.

(6) Tack coat

Only on multiple courses shall tack coat be used between each course unless directed otherwise by the Superintendent. The whole of the area to be sheeted with asphalt shall be tack coated with a light and even coat of bitumen emulsion. Bitumen emulsion shall comply with the requirements of MRTS21.

The bitumen emulsion shall be applied at a rate of between 0.10 litres per square metre and 0.20 litres per square metre of undiluted bitumen unless otherwise specified.

The bitumen emulsion shall be applied by a mechanical sprayer with spray bar. Where the areas to be sprayed are small, irregular or inaccessible to mechanical sprayers, such areas shall be tack coated by hand spraying or brushing.

The bitumen emulsion may be warmed or diluted with water to facilitate spraying. Adequate time shall be allowed for the emulsion to break before asphalt is laid. Over application of tack coat, due to surface depressions, shall be removed or dispersed by brushing.

All contact surfaces of kerbs and other structures and all cold joints shall be coated with a thin uniform application of tack coat.

Care shall be taken to ensure that bitumen emulsion is not sprayed on, or allowed to coat, any services or exposed fixtures including concrete kerbs, guardfence or bridge handrails. Appurtenances susceptible to overspray shall be protected with suitable paper.

When trucks or other vehicles are likely to move from tack coated areas onto adjacent finished surfaces, the Superintendent may require that the finished surfaces be suitably protected from carryover of bituminous material.

In locations of heavy pedestrian traffic, such as shopping areas, the Contractor shall take appropriate precautions in accordance with sub-section SC6.4.6.30 Control of traffic to keep pedestrians off tack coated areas.

(7) Laying

(a) Paver

The paver(s) shall be expected to have a minimum spreading capacity of 50 ~~t~~~~onnes~~ of asphalt per hour and be capable of spreading a width of at least 3.7 m to the requirements of this sub-section. It shall be expected to have automatic screed control operated from joint matching shoe, fixed line, travelling straight edge or levelling beam. The Contractor shall provide the Superintendent with notice of proposed pavers without these capabilities and obtain Superintendent's agreement to their use.

(b) Laying operations

The work shall be so arranged as to keep the number of joints, both longitudinal and transverse to a minimum.

The paver shall operate at a uniform speed and the delivery of asphalt shall match the output of the paver such that continuous laying of asphalt is achieved.

When laying asphalt in echelon the distance between pavers shall be such that the temperature of the asphalt at the edge of the asphalt laid by the advance paver is not less than 80 °C by the time the following paver matches the longitudinal joint.

In the event of faulty operation of the paver causing irregularities in the spread asphalt, work shall cease until the fault is rectified.

Unless otherwise approved by the Superintendent, asphalt shall not be spread by hand behind the paver. Workers shall not stand or walk on the hot surface until compaction has been completed except where necessary for correction of the surface.

The Superintendent may approve spreading asphalt by hand for minor correction of the existing surface and in areas inaccessible to mechanical pavers.

Asphalt shall not be placed when the surface of the pavement is wet or while rain appears imminent.

AS 2734 shall constitute a valid reference of good practice for asphalt laying practice.

(c) Laying temperature

Weather restrictions and minimum asphalt temperatures at the time of discharge into the paver shall be in accordance with MRTS30. Measurement may be made by calibrated infra-red thermometers when accepted by both Contractor and Superintendent.

The Superintendent may reject that part of any truck load which contains lumps of cooled asphalt which are liable to affect the quality of the finished surface.

The laying temperature shall be measured in the paver hopper. A suitable stem type thermometer readable and accurate to within plus or minus 2 °C with a range from at least 0 °C to 200 °C shall be used. The stem shall be inserted into the asphalt to a depth of approximately 200-mm at a location at least 300-mm from the side of the paver. The average of two readings shall be adopted as the temperature of the mix. Measurements of asphalt and road surface temperatures and wind velocity to comply with this Clause shall be recorded on the Asphalt Work Record Sheet.

(d) Level control

The minimum controls for level set out below shall be used. Additional controls may be necessary to obtain the required finished pavement properties.

Corrective courses shall be automatically controlled by programmed computer control of the paver, joint matching shoe or stringline sensor. Where the correction is only minor, the Superintendent may allow the use of levelling beams at least 10-m long.

Intermediate courses shall be automatically controlled by programmed computer control of the paver or a joint matching shoe.

The wearing course shall be controlled by levelling beams at least 10-m long and, as required by the Superintendent or a joint matching shoe. When identified in the Project Quality Plan and/or approved in writing by the Superintendent, small areas (as defined) may be paved as wearing course without the use of levelling beam to achieve target levels.

(e) Layer thickness

The compacted thickness of each course shall be as shown on the drawings. A course may comprise one or more layers. The nominal compacted layer thickness shall be in accordance MRTS30.

(8) Joints

(a) General

The location of longitudinal and transverse joints shall be as approved by the Superintendent and at the spacing nominated in the drawings. All joints shall be compacted and finished with a smooth, planar surface coinciding with, and being of similar appearance to the remainder of the layer.

(b) Longitudinal joints

An automatically controlled joint matching device shall be used to control the levels of adjacent runs. Care shall be taken to provide positive bond between adjoining runs. Longitudinal joints shall be:

(i) continuous and parallel;

(ii) coincident within 150-mm of line of change in crossfall;

(iii) offset by at least 150-mm from joints in underlying layers;

(iv) located away from traffic wheel paths; and

(v) located beneath proposed traffic linemarkings in the case of a wearing course.

Work shall be arranged to avoid longitudinal joint faces being left exposed overnight.

When pavers are laying asphalt in echelon, the hot joint so produced shall be constructed by leaving an uncompacted strip approximately 150-mm wide along the edge of the first run, and after the adjoining run has been spread, both sides of the joint shall be rolled simultaneously.

A joint shall be considered “cold” when the temperature of the asphalt has dropped below 60ºC for dense graded mix. Cold joints will require tack coating.

(c) Transverse joints

When the end of the asphalt layer has cooled due to disruption of the work, or when resuming work on the next day, a transverse joint shall be formed.

Transverse joints shall be at right angles to the direction of laying. They shall be staggered by at least 1-m between successive layers and between adjacent runs.

Runs shall end either against a timber bulkhead to ensure a straight vertical, well compacted edge or by feathering out and compacting. In the latter case, before continuing the run the feathered material shall be cut back to a line where the full layer thickness exists. The surface shape of the end of the run shall be checked by a straight edge to locate the line of cut. The end of the previous run shall be lightly tack coated before the laying of the next run proceeds.

When the asphalt layer is required to join and match the level of an existing pavement surface, bridge deck or other fixture, sufficient of the existing material shall be cut out to achieve the minimum layer thicknesses requirements.

SC6.4.6.13.4 Compaction

(1) Plant and equipment

The proposed compaction fleet and rolling pattern shall be adequate to achieve the specified compaction and finish.

The minimum number of rollers used for compaction of asphalt laid at various rates should be as shown in Table SC6.4.6.13.1 Minimum roller combinations for compaction.

For compaction of confined areas or patching works a small vibrating roller, or hand operated vibrating compactor acceptable to the Superintendent shall be used.

Table SC6.4.6.13.1 Minimum roller combinations for compaction

ASPHALT OUTPUT	ALTERNATIVE ROLLER COMBINATION		
	Dense Graded Asphalt		
Tonnes per hour per paver	Static Steel	Steel Vibrating	Pneumatic Tyred
Up to 45	1	-	1
	-	1	1
45 to 85	1	-	2
	-	1	1
85 to 120	1	-	3
	2	-	2
	-	2	1
Above 120	As for 85 to 120 plus additional rollers as determined by Compaction Trials		

Note— 1. At the discretion of the Superintendent, the minimum number of rollers may be decreased for layer thicknesses in excess of 60-mm.

2. Additional pneumatic tyred rollers to those specified may be required for backrolling asphalt.

(2) Dense graded asphalt

(a) Initial rolling

Initial rolling shall be carried out using steel rollers. Vibratory steel rollers may be used, but they shall be operated in the static mode for the first pass. On deep lift asphalt, pneumatic tyred rollers may be used.

Initial rolling shall commence as soon as possible after laying has commenced. Rollers shall be operated as close as possible to the paver.

The transverse and longitudinal joints and edges shall be compacted first.

The minimum asphalt temperature at the commencement of rolling shall be as detailed in MRTS30.

(b) Secondary rolling
Secondary rolling shall immediately follow initial rolling. In secondary rolling, static steel rollers or pneumatic tyred rollers shall be used. The tyre pressures of pneumatic tyred rollers should equal or exceed 550 kilopascals.

Rolling shall commence at the longitudinal joint side of the run.

Secondary rolling shall be completed before the mix temperature falls below 80 °C.

(c) Final rolling
Final rolling shall be carried out by a pneumatic tyred roller to eliminate all roller marks and to produce a uniform finish. If secondary rolling has been carried out with a pneumatic tyred roller, a steel roller may be used for final rolling instead of the pneumatic tyred roller specified.

Final rolling shall be completed before the asphalt temperature falls below 60 °C.

(3) Acceptance criteria for compaction
The acceptance for compaction shall be on a lot by lot basis where each day's work in one layer is generally one lot. Any defective areas which show cracking, bony material or exhibiting excessive binder shall be excluded from the lot and shall be rectified by the Contractor before being tested.

When directed by the Superintendent the Contractor shall arrange for the determination of the relative compaction of the lot by either of the following methods:

The acceptance for compaction on a lot shall be on the basis of characteristic value of relative compaction in accordance with MRTS30.

(4) Finished pavement properties
Each course of asphalt shall be finished parallel to the finished surface of the wearing course.

(5) Thickness
The thickness of asphalt shall be specified and/or measured in one of the following ways:

(a) No finished surface levels specified
When asphalt is placed over an existing pavement in one or more courses and no corrective course is applied, the calculated average compacted thickness of each course shall be in accordance with the course thickness specified in the Drawings and tolerances indicated in MRTS30.

(b) Finished surface levels specified
When asphalt is placed to specified levels, vertical tolerances and thicknesses shall be in accordance with MRTS30.

(6) Shape
The surface shall not deviate from the bottom of a 3-m long straightedge laid in any direction by more than 5-mm.

(7) Removal and replacement of rejected material
The sections of work that have been rejected under the preceding clauses of this sub-section or as otherwise determined by the Superintendent shall be removed within 15 days from the work and replaced with fresh asphalt mix material corresponding in grade and quality to that material specified in the Approved Mix unless otherwise approved by the Superintendent.

If removal of the single nonconforming pavement strata is impossible, the affected area as determined by the Superintendent shall be removed to subbase or subgrade depth as appropriate to provide a smooth level

surface on which to found the reinstated base and/or subbase course.

The perimeter of the nonconforming area shall be prepared in accordance with the practice pertaining to longitudinal and transverse cold joints (AS 2734).

In rejected sections the material is to be removed over the full length of the affected area except that a minimum length of 5 m and a minimum width equal to the paver width shall be removed.

The Superintendent shall have the right to alter the constitution, quality, grading, or other parameters of the "reinstatement pavement" if it is felt that reconstruction of the affected area with the Approved Mix would produce nonconforming pavement as a result of non-continuous pavement structure.

After removal of the rejected base or subbase course the area shall be made available to the Superintendent for inspection and approval to proceed with the works. Superintendent inspection and approval is required prior to release of hold point.

All materials used in the reinstatement of the nonconforming area shall comply with the requirements of this sub-section unless otherwise directed by the Superintendent.

SC6.4.6.13.5 Limits and tolerances

The limits and tolerances applicable to the various clauses of this sub-section are summarised in Table SC6.4.6.13.2 below:

Table SC6.4.6.13.2 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	Materials and mix ingredients and manufacture	DG AC Asphalt - MRTS 30 and current TMR supplementary specifications. Bitumen - MRTS 17 Polymer modified binder - MRTS 18	SC6.4.6.13.2
2.	**Preparation of Pavement** (a) Cleaning of Surface	>300mm beyond the edge of proposed layer	SC6.4.6.13.3(1)
3.	**Tack Coat** (a) Bitumen Emulsion	Application Rate > 0.10 and < 0.20 litres per square metre	SC6.4.6.13.3(1)
4.	**Laying** (a) Paver Capacity	>50 tonnes asphalt per hour	
	(b) Spread Width	>3.7m	
	(c) Laying in Echelon	Distance between pavers is such that temperature of asphalt at edge (or laid by leading paver) is >80°C when following paver matches the longitudinal joint.	
	(d) Laying Temperature (i) Dense Grade AC	As per MRTS30	
	(e) Level Control	>10m length	SC6.4.6.13.3(7)(d)
	(i) Levelling Beam for Corrective Course		
	ii) Levelling Beam for Wearing Course	>10m length	SC6.4.6.13.3(7)(d)
	(f) Course and Layer Thickness	Nominal size mix and compacted layer thickness as per MRTS30.	
5.	**Longitudinal Jointing** (a) Change in Crossfall	Within 150mm of line of change.	
	(b) Where Underlying Layers	Offset at least 150mm from joints in underlying layers.	
6.	**Transverse Jointing** (a) Where Underlying Layers	Stagger to be >1m between successive layers and adjacent runs.	

Item	Activity	Limits/Tolerances	Clause
7.	**Compaction**	Initial Rolling:	SC6.4.6.13.3(2)(c)
	(a) Dense Graded Asphalt	To be commenced before asphalt temperature falls below 115ºC for layer ≤40mm. Refer to MRTS30	
		Secondary Rolling:	SC6.4.6.13.3(2)(d)
		Tyre pressures on pneumatic rollers to be≥550kPa.	
		Rolling to be completed before the asphalt temperature falls below 80ºC.	
		Final Rolling:	SC6.4.6.13.3(2)(d)
		Rolling to be completed before asphalt temperature falls below 60ºC.	
	(b) Acceptance Criteria for Compaction	On bases of characteristic value of relative compaction as per MRTS30 ~~DG~~ AC7 90% ~~DG~~ AC10 90% ~~DG~~ AC14 91% (92% > 50mm) ~~DG~~ AC20 93%	SC6.4.6.13.3(4)
8.	**Finished Pavement**	Max. compacted thickness tolerance as for Table 12.3.3.2 of MRTS30	
	(a) Thickness	~~DG~~ AC7 ± 5mm ~~DG~~ AC10 ± 5mm ~~DG~~ AC14 ± 7mm Where finished surface levels are specified, thickness and level shall comply with requirements of MRTS30. Reduced level primary tolerance ± 10mm.	
	(b) Shape	Shall not deviate from bottom of 3m straight edge by more than 5mm	SC6.4.6.3(6)

Attachments

SC6.4.6.13 Asphalt Work Record

Click here to obtain a copy of the following form.

SC6.4.6.14 Mass concrete sub-base

SC6.4.6.14.1 Introduction

(1) Scope

This policy sub-section provides standards advice and guidelines for the construction, by mechanical or hand placement of mass concrete sub-base including trial sections and sub-grade beams.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note - A reference to drawings is a reference to construction drawings.

(2) Thickness and levels of subbase

The sub-base thickness and levels shall be as per design requirement.

(3) Provision for base slab anchors

During construction of the sub-base, in advance of concrete base construction the Contractor shall make provision to permit construction of base slab anchors at the locations and to the dimensions shown on the design. Excavation of material, trimming of trenches, compacting of the bottom of the trench, disposal of surplus material and construction of the concrete anchors shall be carried out in accordance with sub-sectionSC6.4.6.15 Plain and reinforced concrete base as part of the concrete base construction.

(4) Reference and source documents

Documents referenced in this Sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.15 - Plain and reinforced concrete base
SC6.4.6.28 - Minor concrete works.

(b) Australian Standards:

AS1012.1 - *Sampling of fresh concrete*
AS1012.3.1
AS1012.4.2 - *Determination of properties related to the consistence of concrete - Slump test*
AS1012.8
AS1012.8 - *Determination of air content of freshly mixed concrete - Measuring reduction in air*
AS1012.9 *pressure in chamber above concrete*
AS1012.13 - *Method of making and curing concrete – Compression and indirect tensile test specimens*
AS1012.14
AS1141.11. - *Method of making and curing concrete – Flexure test specimens*
1
AS1141.14 - *Determination of the compressive strength of concrete specimens*
AS1141.22
- *Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory*
- *Securing and testing cores from hardened concrete for compressive strength*
- *Particle size distribution – Sieving method*
- *Particle shape, by proportional calliper*
- *Wet/dry strength variation*

AS1160 - *Bitumen emulsions for the construction and maintenance of pavements*

AS-1379 - *Specification and manufacture of concrete*
AS-1478.1 - *Chemical admixtures for concrete, mortar and grout – Part 1: Admixtures for concrete*
AS-2758.1
AS3582.1 - *Concrete aggregates*

- *Supplementary cementitious materials for use with portland and blended cement - Flyash*

AS3799 - *Liquid membrane-forming curing compounds for concrete*
AS3972 - *General purpose and blended cements*

(c) Other
Austroads, *Guide to Pavement Technology Part 4G: Geotextiles and Geogrids*

SC6.4.6.14.2 Materials for concrete

(1) Cement
Cement shall be Type GP Portland cement or Type GB blended cement complying with AS-3972. Cement shall be from a source approved under the Queensland Government's State Purchasing Policy.

When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General the Contractor shall nominate the brand and source of the cement. On approval of a nominated mix by the Superintendent, the contractor shall use only the nominated cement in the work.

Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, the Superintendent may require a retest to ensure the cement complies with AS-3972, before the cement is used in the work.

Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

(2) Flyash
Flyash shall be from a source approved under the Queensland Government's State Purchasing Policy. The use and the quality of flyash shall comply with AS-3582.1.

When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General, the Contractor shall nominate the powerhouse source of the flyash. On approval of a nominated mix by the Superintendent, the Contractor shall use only flyash from the nominated powerhouse.

Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

(3) Water
Water used in the production of concrete shall be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.

(4) Admixtures
Chemical admixtures and their uses shall comply with AS-1478.1. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below shall not be used. An air entraining agent may be included in the mix. If an air entrainer is used, the air content of the fresh concrete shall comply with Clause SC6.4.6.14.3(5) Air content.

Fresh concrete with an air content not complying with Clause SC6.4.6.14.3(5) Air content shall be rejected.

During the warm season (October to March inclusive), a lignin or lignin based (“ligpol”) set retarding admixture approved by the Superintendent, shall be used to control slump within the limits stated in Clause SC6.4.6.14.3(4) Consistency. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS-1478.1 shall be submitted to the Superintendent, together with the proposed `dosage chart' in accordance with SC6.4.6.14.4(1) General.

If the Contractor proposes to vary the admixture between the warm and cool seasons such variation shall constitute a proposed change to an approved mix for the purposes of Clause SC6.4.6.14.4(2) Variations to approved mixes.

When submitting details of the nominated mix in accordance with Clause SC6.4.6.14.4(1) General, the Contractor shall nominate the proprietary source, type and name of each admixture to be used. Documentary evidence of the quality shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

(5) Aggregates

(a) General

(i) When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General, the Contractor shall nominate the sources of aggregate to be used and shall submit details of the geological type of each aggregate.

(ii) Aggregates shall all pass the 37.5mm AS sieve and shall comply with AS2758.1 in respect of bulk density, water absorption (maximum 5%), material finer than 75 micrometres, impurities and reactive materials. The proportion of misshapen particles (2:1 ratio) determined by AS1141.14 shall not exceed 35%.

(iii) When submitting details of the nominated mix, the Contractor shall submit to the Superintendent a NATA Certified Laboratory Test Report on the quality and grading of the aggregate proposed to be used. The grading shall be known as the "Proposed Grading".

(iv) If the Contractor proposes to blend two or more aggregates to provide the Proposed Grading the Test Reports for each constituent material shall be submitted separately and the Superintendent advised of the proportions in which the various sizes and constituents are to be combined. The aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

(v) All aggregate used in the production of concrete shall be clean, hard, durable rock fragments free from the inclusion of mineral salts, oils, organic matter or other materials deleterious to the performance of concrete.

(b) Grading

(i) The grading of the combined aggregate used in the work, determined by AS1141.11, shall not deviate from that of the proposed grading by more than the amounts shown in Table SC6.4.6.14.1 Aggregate grading deviation limits.

Table SC6.4.6.14.1 Aggregate grading deviation limits

Australian Standard Sieve	Maximum Deviation Per Cent Passing by Mass of Total Sample
37.5mm	-5
19mm	+ or -10
4.75mm	+ or -10
1.18mm	+ or -5
600mm	+ or -5
150mm	+ or -2

(c) Durability

Any fraction of any constituent and any fraction of combined aggregate shall conform to the following requirements:

(i) Wet Strength AS-1141.22 Shall not be less than 50kN; and

(ii) 10% Fines Wet/Dry Variation AS-1141.22 Shall not exceed 35%.

(d) Storage

(i) Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

(ii) The area surrounding the storage facilities and mixing plant shall be so constructed that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of the Superintendent, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of the Superintendent.

SC6.4.6.14.3 Quality requirements of concrete

(1) Cement and flyash content

When a cement and flyash blend is nominated the minimum acceptable range is 40 – 75-% by mass of the total cementitious material (cement and fly ash) in accordance with AS-3582.1.

(2) Compressive strength

The compressive strength of concrete shall be determined in accordance with AS1012.9. The minimum compressive strength at 7 days shall be 4MPa and at 28 days shall not be less than 5MPa for flyash blended cement. The maximum compressive strength at 28 days shall be less than 15MPa, with the exception that where the nominated mix demonstrates a 28 day shrinkage less than 400 microstrains, then the concrete achieving a strength less than 20MPa shall be accepted.

(3) Shrinkage

The drying shrinkage of the nominated mix, determined by AS1012.13 shall not exceed 450 microstrain after 21 days air drying. The drying shrinkage at the nominated slump plus 10mm shall be taken as the average of the reading or readings within 5% of the median of the three readings obtained in accordance with AS1012.13.

Consistency

(4) The Contractor's nominated slump, determined in accordance with AS1012.3.1, shall be neither less than 25mm nor more than 40mm for mechanically placed concrete and shall be neither less than 50mm nor more than 65mm for hand placed concrete. The compactibility index range shall be between 60 and 80 in accordance with AS1012.3.4.

Air content

(5) If an air entraining agent is used, the air content of the fresh concrete, determined in accordance with AS1012.4.2, shall be neither less than 3% nor more than 7% when discharged from the transport vehicle ready for placement.

SC6.4.6.14.4 Design and control of concrete mixes

(1) General

The Contractor shall submit, for approval by the Superintendent, details of the concrete mix or mixes and the materials, including source, to be used for each of mechanically placed and hand placed subbase, including nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a “nominated mix”.

The Contractor shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The

certificate shall confirm that the required testing has been carried out in the twelve month period before the date of submission to the Superintendent.

In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 1MPa of the median.

These details shall be submitted at least 21 days before using the nominated mix in the work.

(2) Variations to approved mixes
The Contractor shall not make any changes to the approved mix, its method of production or source of supply of constituents without the prior written approval of the Superintendent.

Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with clause SC6.4.6.14.4(1) General. If the variations to the quantities, qualities or sources of the constituents in the approved mix are less than 10kg for Portland cement, 20kg for other cementitious material and 5% by mass for each other constituent, except admixtures, per yielded cubic metre of concrete, the superintendent may approve the changes without new trials being carried out.

Notwithstanding these tolerances, the minimum cement content shall be 90kg per yielded cubic metre of concrete, the minimum flyash content shall be 100kg per yielded cubic metre of concrete.

SC6.4.6.14.5 Conformance for concrete strength and thickness

(1) Concrete cylinders

(a) Test specimens
Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS1012.8.1. The Contractor shall supply a sufficient number of moulds to meet the requirements for the frequency of testing specified in this clause and shall also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to the Superintendent.

Samples of concrete for testing shall be taken in accordance with AS1012.1. The selection of the batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable.

The method of making and curing specimens shall be in accordance with AS1012.8.1 with compaction by internal vibration.

The Contractor shall mark the specimens for identification purposes.

Specimens shall be inspected, capped and crushed in accordance with AS1012.8.1 and AS1012.9.

(b) Frequency of moulding of test specimens
Test specimens shall be moulded as follows:

(i) For the determination of the compressive strength at twenty eight days:

- For each lot of up to 50 cubic metres of concrete placed at the one time -
  One pair of specimens

(ii) For the determination of the compressive strength at seven days:

- For each lot of up to 50 cubic metres of concrete placed at the one time -
  One pair of specimens

(iii) For the determination of compressive strength for any early testing as deemed necessary by the Contractor:

- For each lot of up to 50 cubic metres of concrete placed at the one time -

One pair of specimens

A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed in the subbase.

(2) Compressive strength of concrete

(a) General

The compressive strength of the concrete represented by a pair of specimens moulded from one sample shall be the average compressive strength of the two specimens.

At the time of approving the mix design, the Superintendent shall nominate whether 7 day or 28 day compressive strength or both shall be the acceptance criteria for strength.

(b) Adjustment of test compressive strength for age of specimen

Should any specimen be tested more than 28 days after moulding the equivalent 28 day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table SC6.4.6.14.2 - Concrete age conversion factors.

For intermediate ages the factor shall be determined on a pro rata basis.

Table SC6.4.6.14.2 Concrete age conversion factors

Age of Specimen at time of test (days)	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 or greater	1.25

(c) Conformance for compressive strength

If the compressive strength of test cylinders for any lot is less than the criteria specified in Clause SC6.4.6.14.3(2) Compressive strength, the lot represented by the test cylinders shall be removed and replaced.

In case of non-conformance the Contractor may request permission of the Superintendent to core the in situ subbase for testing of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by the Superintendent. Such locations may be determined by the use of a nuclear density meter, or any alternative method. Testing shall be carried out at the request of the Contractor. Subbase concrete failing to reach the required in situ compressive strength shall not be retested for at least 72 hours after the determination of the value of the in situ compressive strength.

(3) Specimens cut from the work

(a) Specimens cut from the work shall be tested in a NATA registered laboratory nominated by the Contractor. Specimens shall be in the form of cylindrical cores of hardened concrete.

Cores shall be secured, accepted, cured, capped and tested in accordance with AS-1012.14 with the following amendments:

(i) The requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However, concrete must have hardened enough to permit removal without disturbing the bond between the mortar and the coarse aggregate.

(ii) The preferred dimension for cores shall be 100mm diameter but in no case shall the diameter be less than 75mm or two and one half times the nominal size of the coarse aggregate, whichever is the greater.

(iii) When inspected in the uncapped state, cores shall be rejected if any diameter departs by more than 5mm from the mean diameter.

(iv) Cores shall be rejected where the length of the core when ready for capping is less than the diameter. The test strength determined shall be adjusted for form by a factor in accordance with Table SC6.4.6.14.3 Core strength factor.

(v) Wet Conditioning only shall be used.

Table SC6.4.6.14.3 Core strength factor

Length/Diameter Ratio	Correction Factor
2.00	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.89

Note—for intermediate form ratios, the factor shall be determined by interpolation.

Core cutting shall be carried out by the Contractor in the presence of and at the locations nominated by the Superintendent. The frequency of coring shall be such that a core is taken to represent each lot or the area of subbase placed between any two consecutive construction joints whichever is the lesser. The lot represented by each core shall be nominated by the Contractor at the time of sampling and duly recorded prior to testing.

Cores shall be despatched to arrive at the testing laboratory within 24 hours of the core being cut from the subbase. Wet curing shall commence within 24 hours of the receipt of the cores.

The cutting and transporting the cores to the testing laboratory and restoring all holes in the subbase shall be the responsibility of the Contractor. The method of restoration shall be approved by the Superintendent.

(4) Acceptance of cored concrete for compressive strength

Concrete shall achieve an in situ compressive strength of 5MPa within 28 days of placement.
If the specimen cut from the subbase reaches 4MPa for in situ compressive strength, base paving may proceed.

(5) Conformance for thickness

(a) General

No thickness measurements will be carried out if the surface of the subbase is within the level tolerances as specified in Clause SC6.4.6.14.7(5)(b) Surface tolerances.
If scabbling is required to achieve the level tolerance limits, the Superintendent may order thickness checks to be carried out. Where the survey ground model of the subgrade is available, subbase thickness shall be calculated from levels taken on a 5-m grid on the plan area. Alternatively, the Superintendent may authorise coring and measurement at the edges of the layer. Thickness measurements shall be rounded off to the nearest 5mm.

(b) Thickness below specification

After making due allowance for the tolerances, subbase which is more than 20-mm below the theoretical thickness shall be rejected and removed from the site. The removal and disposal from the site shall be the responsibility of the Contractor.

Subbase which is 20-mm or less below the theoretical thickness may be accepted by the Superintendent providing that it represents isolated sections within a lot and such sections comprise less than 10% of the area of the lot.

SC6.4.6.14.6 Productions, transport and consistency of concrete

(1) Production and transport of concrete

At least 3 weeks before commencing work under this sub-section, the Contractor shall submit, for the information of the Superintendent, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport.

(2) Handling, storage and batching materials

The methods of handling, storing and batching materials for concrete shall be in accordance with AS1379, with the following additional requirements:

(a) certificates of calibration issued by a recognised authority shall be made available for inspection by the Superintendent, as evidence of the accuracy of the scales;

(b) cementatious material shall be weighed in an individual hopper, with the cement weighed first;

(c) the moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water; and

(d) where a continuous type mixer is employed, the components shall be measured by a method of continuous weighing approved by the Superintendent, except for liquids which may be measured by volume or flow rate meter.

(3) Mixers and agitation equipment

Details of proposed mixers and agitation methods shall be in accordance with the plant and equipment sections of AS1379, with the following additional requirement that in Appendix A of AS1379 the maximum permissible difference in slump shall be 10mm.

(4) Mixing and transport

Mixing and transport methods shall be in accordance with the production and delivery sections of AS-1379, with the following additional requirements:

(a) The mixer shall be charged in accordance with the manufacturer's instructions.

(b) For the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS-1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15% ~~per cent~~ and 85% ~~per cent~~ along the length of the tray.

(c) For truck mixed concrete, addition of water in accordance with the batch production section of AS-1379 shall be permitted only within ten minutes of completion of batching and within 200-m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water:cement ratio be exceeded. Mixing of the concrete shall be completed at that location.

(d) After addition of the cement to the aggregate, concrete shall be incorporated into the work within:

(i) one and a half hours, where transported by truck mixer or agitator; and

(ii) one hour, where transported by non agitating trucks.

Means of verification, satisfactory to the Superintendent, of the times of addition of cement to the aggregate shall be provided.

The times within which the concrete shall be incorporated into the work may be reduced if the Superintendent considers the prevailing weather, mix type, or materials being used warrant such a change.

(e) The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80% of the gross volume of the drum of the mixer.

(5) Maximum mixing time

Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of 10 minutes except for split drum mixers where the maximum shall be 5 minutes.

For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded.

(6) Consistency

The consistency of the concrete shall be such as to allow the production of a dense, non segregated mass with bleeding limited so as to prevent bleed water flowing over the slab edge under the conditions of placement. If bleed water does so flow, the Contractor shall cease paving until the consistency of the mix is adjusted to prevent flow or the mix is redesigned and approved by the Superintendent. The edge produced shall maintain its shape and shall not sag or tear.

The Contractor shall provide all equipment, materials and labour for consistency testing and shall carry out tests in the presence of the Superintendent.

The consistency of the concrete shall be checked by use of a slump cone in accordance with AS1012.3.1. The test shall be made on concrete samples obtained in accordance with AS1012.1. The compactibility index range shall be between 60 and 80 in accordance with AS1012.3.4. Check tests shall be done on each truckload of concrete or as directed by the Superintendent.

SC6.4.6.14.7 Placing and finishing concrete subbase

(1) General

At least four weeks before commencing work under this Specification, the Contractor shall submit as part of the Quality Plan, for the information of the Superintendent, full details of the equipment and methods proposed for placing and finishing the concrete subbase together with a paving plan showing proposed paving widths, sequence and estimated daily outputs.

The Contractor shall give the Superintendent 7 days written notice of the intention to commence construction of the subbase on any section of work (including the placement of the trial subbase in accordance with Clause SC6.4.6.14.11.

The surface on which concrete subbase is to be placed shall be clean and free of loose or foreign matter and in damp condition.

Submit the work-as-executed survey of the subgrade to the full extent of the works to the Superintendent for confirmation, and highlight any locations where the actual level is higher than the design levels. If the underlying layer is required to be spray sealed, take levels on the top of the seal and after removal of foreign or loose material such as aggregate. Report levels to the nearest millimetre and survey on 5~~.0~~ m grid on a plan area. In the case of non conforming levels, locally redesign the pavement levels as directed by the Superintendent.

Concrete shall not be placed either during rain or when the air temperature in the shade is below 5~~.~~ °C or above 38~~.~~ °C.

The temperature of the concrete placed in the work shall be neither less than 10~~.~~ °C nor more than 32~~.~~ °C.

(2) Rate of evaporation

When the value of Rate of Evaporation, determined from the graph in Figure SC6.4.6.14.1 Rate of evaporation, exceeds 0.5~~0~~kg ~~kilograms~~ per square metre per hour the Contractor shall take precautionary measures, satisfactory to the Superintendent, for the prevention of excessive moisture loss. If, in the opinion of the Superintendent, such precautionary measures prove to be unsatisfactory, the Contractor shall cease work while the evaporation rate is in excess of 0.5kg per square metre per hour.

Should the Contractor elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except minor manual bull floating, are complete.

The Contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement, and for continuously measuring and recording air temperature and relative

humidity daily, at the site throughout the course of the work. The Contractor shall provide and maintain all equipment and shall provide suitable personnel necessary for all such measuring and recording.

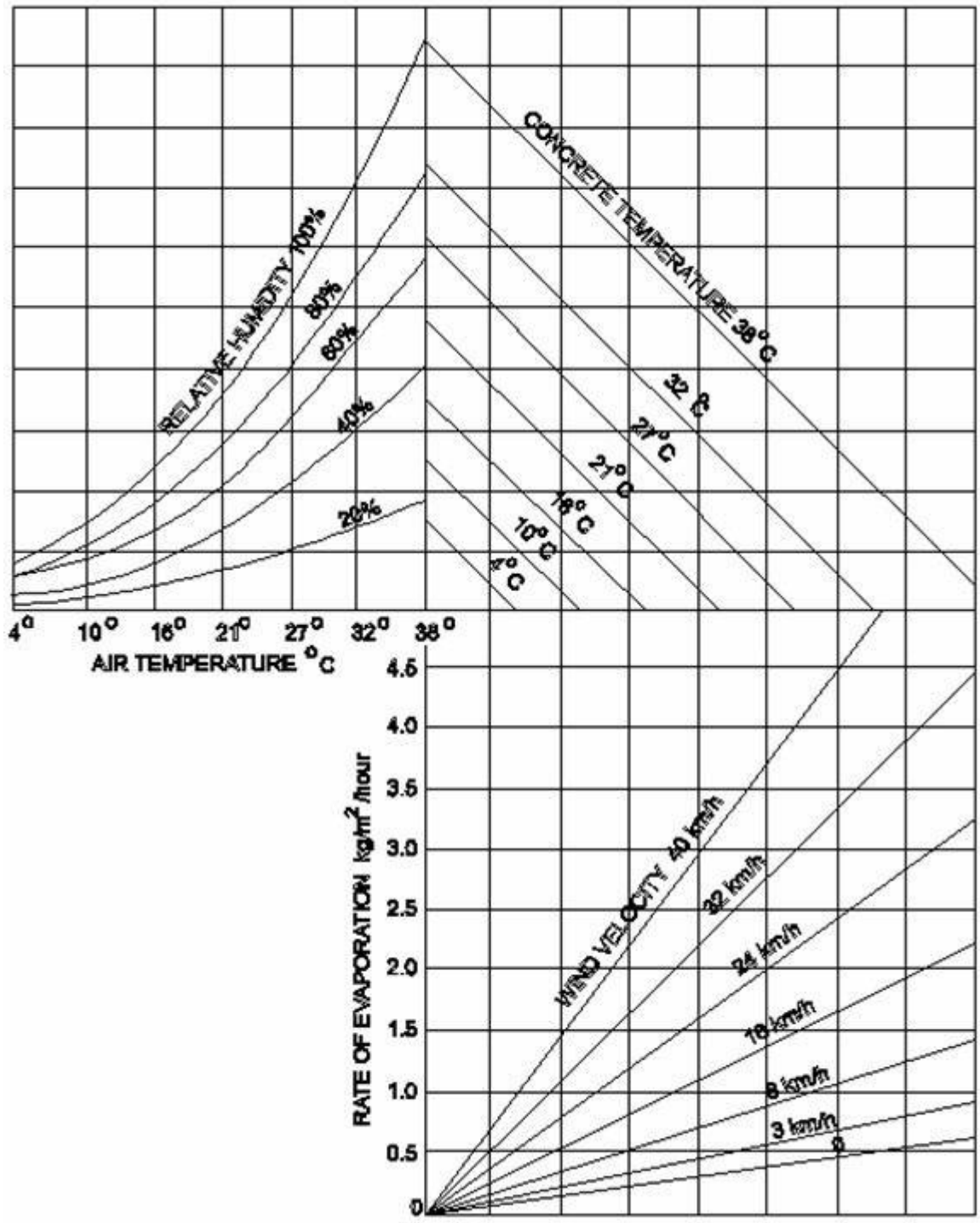


Figure SC6.4.6.14.1 Rate of evaporation

Note—the graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27ºC
- with relative humidity at 40%
- with concrete temperature at 27ºC
- with a wind velocity of 26 km/h

the rate of evaporation would be 1.6 kg/m/hour.

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27ºC), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27ºC. Move vertically down to the respective wind velocity curve - in this case interpolating for 26 km per hour -

and then horizontally to the left to intersect the scale for the rate of evaporation.

(3) Mechanical paving

The mechanical paver shall be a self propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features:

(a) an automatic control system with a sensing device to control line and level to the specified tolerances;

(b) means of spreading the mix uniformly and regulating the flow of mix to the vibrators without segregation of the components;

(c) internal vibrators capable of compacting the full depth of the concrete;

(d) adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces; and

(e) capability of paving in the slab widths or combination of slab widths and slab depths shown on the drawings.

The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that a minimum of finishing by hand will be required. A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be in a smooth and firm condition.

Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations.

(4) Hand placing

Forms shall be so designed and constructed that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and debonded to ensure non adhesion of concrete to the forms.

Concrete shall be delivered in agitator trucks and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two passes of a hand guided vibratory screed traversing the full width of the slab on each pass. Any buildup of concrete between the forms and vibratory screed shall be prevented.

If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations.

A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

(5) Alignment and surface tolerances

(a) Horizontal alignment tolerance

The outer edges of the subbase shall be square to the subgrade and shall be constructed 50mm wider than the plan position of the base formation with a tolerance of 25mm.

Where an edge of a slab is to form a longitudinal construction joint line, the allowable horizontal

alignment tolerances shall comply with clause SC6.4.6.14.8(2) Longitudinal construction joints.

(b) Surface tolerances

The level at any point on the top of the subbase shall not vary by more than 0mm above or 20mm below that shown on the drawings or as directed by the Superintendent. Where the concrete is found to be above the level tolerance, it shall be removed. Where the concrete is found to be below level tolerance, it shall be made up with base concrete.

The top surface of the subbase shall also not deviate from a 3m straightedge, laid in any direction, by more than 5mm.

(6) Curing

The subbase shall be cured by the use of one of the following:

(a) chlorinated rubber curing compound complying with AS3799 Class C Type 1D or resin-based curing compound complying with AS3799 Class B, Type 1D or Type 2, if an asphalt base is used; or

(b) white pigmented wax emulsion curing compound complying with AS3799 Class A Type 2, if a concrete base is used; or

(c) bitumen emulsion Grade CRS/170 complying with AS1160 for either asphalt or concrete base.

The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance for the curing compound from an Australian Laboratory, approved by the Superintendent, showing an Efficiency Index of not less than 90% when tested in accordance with Appendix B of AS3799.

The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the Certificate of Compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.35 litres of residual bitumen per square metre. When applied with a hand lance the rates should be increased by 25%.

The average application rate shall be checked by the Contractor and certified to the Superintendent by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by the Superintendent.

The curing membrane shall be maintained intact for seven days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.

Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

(7) Protection of work

The Contractor shall ensure that the temperature of the concrete does not fall below 5 ºC during the first twenty four hours after placing. The Contractor shall provide, for the information of the Superintendent, details of procedures and equipment proposed to be used for the protection of sections recently placed in the event of low air temperatures. If the Contractor fails to maintain the temperature of the concrete at or above 5ºC and if, in the opinion of the Superintendent, the concrete exhibits any deficiencies, due to failure to comply with this Specification, the concrete shall be rejected.

The Contractor shall protect the work from rain damage and shall provide, for the information of the Superintendent, detailed proposals fro procedures and equipment to be used for such protection.

Neither traffic nor construction equipment, other than that associated with testing, shall be allowed on the subbase until the strength of the subbase has reached at least 4MPa. Thereafter, only construction equipment necessary for the following operations shall be permitted to traffic the subbase:

(a) bond-breaker and spall treatment; and

(b) concrete or asphalt paving;

(c) Notwithstanding the above, any damage caused to the subbase by the Contractor's operations shall be rectified to the Superintendent's satisfaction.

SC6.4.6.14.8 Joints

(1) Transverse construction joints
Transverse construction joints shall:

(a) be provided only at discontinuities in the placement of concrete determined by the Contractor's paving operations;

(b) be constructed normal to the edge line and to the dimensions shown on the drawings;

(c) not deviate from a 3m straightedge placed along the joint by more than 10mm; and

(d) cut back the edge of the previously placed concrete by sawing the concrete, to at least 1/3 the slab depth to expose an even, clean, sound, vertical surface, without disturbing the concrete that is to remain in place.

(2) Longitudinal construction joints
Longitudinal construction joints shall:

(a) be formed no closer than 300mm of the base longitudinal joints as shown in the drawings, unless directed otherwise by the Superintendent;

(b) not deviate from the plan or nominated position at any point by more than 20mm;

(c) not deviate from a 3m straightedge placed along the joint by more than 10mm, having made due allowances for any planned curvature; and

(d) be smooth across the joint.

SC6.4.6.14.9 Bond breaker and spall treatment

(1) General
Subbase to be covered by concrete base shall be provided with a wax emulsion bond breaker. The wax emulsion shall comply with AS3799 Class A Type 2.

Where the base consists of asphaltic concrete, no bond breaker shall be used. In this case bond is essential and wax emulsion curing compounds shall not be permitted.

Subbase with spalled areas shall be treated, where directed by the Superintendent, prior to application of the bond breaker or asphaltic concrete.

(2) Preparation of subbase
Immediately prior to any spalled area treatment and the application of bond breaker, the subbase surface shall be cleaned to the satisfaction of the Superintendent of all loose, foreign and deleterious material.

(3) Treatment of spalling
Where directed by the Superintendent, spalled areas shall be treated before the application of the bitumen bond breaker or asphaltic concrete by infilling with 6:1 sand/cement mortar to provide a surface flush with the surrounding concrete. The area shall be wetted and sprinkled with neat cement before screeding the mortar into the patches.

A spalled area, if directed to be treated, shall have such treatment completed no earlier than five working days before the application of the bond breaker. Treated spalled areas damaged by the Contractor or others shall be made good by the Contractor.

(4) Application of bond breaker
The wax emulsion used as bond breaker should be the same as used for curing compound. This second application shall be applied at a minimum rate of 0.2 litres per square metre and not earlier than 72 hours before the placement of the base concrete.

The method of application shall conform to the requirements of Clause SC6.4.6.14.10(6) Curing.

(5) Treatment of unplanned cracks

The Superintendent shall direct treatment of unplanned cracks whose width exceeds 0.3mm. This may take the form of applying an approved 300mm minimum width geotextile backed polymer modified bitumen strip *(reference Guide to Pavement Technology Part 4G: Geotextiles and Geogrids*) over the crack prior to placement of the first asphalt base layer or concrete base, or an extra application of wax emulsion for a width of 300mm along the crack when a concrete base is required.

The Contractor shall install the Stress Alleviating Membrane strip in accordance with the manufacturer's instructions.

SC6.4.6.14.10 Subgrade beams

(1) General

Subgrade beams shall be provided below the subbase at expansion joints and isolation joints in the concrete base as shown in the drawings or as directed by the Superintendent. They shall extend the full length of joints unless otherwise indicated on the drawings.

(2) Excavation

Excavation for subgrade beams shall be to the dimensions shown on the drawings. All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be recompacted, where required, to the degree of consolidation of the adjacent undisturbed material. Excavated material shall be legally disposed of by the Contractor.

(3) Concrete

Concrete in subgrade beams shall comply with the requirements of sub-section SC6.4.6.28 Minor concrete works. The minimum compressive strength at 28 days shall be 32MPa.

(4) Steel reinforcement

Steel reinforcement shall be of the type and size shown on the drawings and shall be supplied and installed in accordance with sub-section SC6.4.6.15 Plain and reinforced concrete base.

(5) Construction and protection

Subgrade beams shall be constructed before construction of the subbase. The top surface of the subgrade beam shall be level with the top of the subgrade. Any loose subgrade material shall be recompacted to the correct level. If the contractor elects to remove any loose material, the voids shall be filled with mortar or concrete and screeded to provide a surface flush with the top of the subgrade beam and the surrounding subgrade.

A steel float shall be used to produce a smooth surface finish, free of any texture.

The subgrade beams shall be protected from damage by plant, motor vehicles and the paving operation. Any damage shall be made good by the Contractor.

(6) Curing

The top surface of the subgrade beam shall be cured in accordance with clause SC6.4.6.14.7 Curing before placing the subbase.

(7) Bond breaker

The top surface of the subgrade beam shall be treated with a bond breaker which shall consist of a further application of curing compound neither less than twenty four hours nor more than seventy two hours before placing of subbase concrete.

SC6.4.6.14.11 Trial concrete subbase

Before the commencement of paving, the Contractor shall construct a trial section of concrete subbase on the carriageway to demonstrate to the Superintendent the Contractor's capability of constructing subbase in accordance with the sub-section. This section shall be constructed so that it may be incorporated in the finished work.

The trial subbase shall be constructed using the same materials, concrete mix, equipment and methods the Contractor intends to use for the remaining subbase work. The Contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound and the construction of joints.

The trial shall also be used to demonstrate that the Contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum requirements specified.

A trial length of between 100m and 200m or lesser length in compliance with council requirements for mechanical paving equipment or between 20m and 50m for hand placement is required. The trial length shall be the maximum width proposed to be laid, and shall be constructed in one continuous operation.

Unless advised by the Superintendent of any deficiencies in the trial concrete subbase, due to failure to comply with this sub-section, the Contractor may proceed with placing concrete subbase from a time five working days after the completion of the trial concrete subbase or such earlier time as the Superintendent may allow. In the event of deficiencies in the trial concrete subbase, the Superintendent may order the Contractor to construct a further length of trial concrete subbase which shall be treated as the first. If, after three trials, the subbase still is deficient in some way, the Superintendent may require the Contractor to justify to the satisfaction of the Superintendent why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel.

The Superintendent shall have the right to call for a new trial section at any stage of work under the contract when changes by the Contractor in the equipment, materials, mix, plant or rate of paving are deemed by the Superintendent to warrant such procedure or when concrete as placed does not comply with this sub-section.

SC6.4.6.14.12 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.14.4 below:

Item	Activity	Limits/Tolerances	Clause
1.	**Materials for Concrete**		
	a. Misshapen Particles	2:1 ratio < 35%	SC6.4.6.14.3(5)(a)
	b. Aggregates Grading	Deviation from submitted sample not greater than Table C247.1	SC6.4.6.14.2(5)(b)
	c. Durability	Wet Strength > 50 kN 10% Fines < 35%	SC6.4.6.14.2(5)(c)
2.	**Concrete**	Drying Shrinkage <450 microstrain	SC6.4.6.14.3(3)
	a. Shrinkage		
	b. Consistency	Mechanically placed: >25mm<40mm Hand Placed: >50mm <65mm	SC6.4.6.14.3(4)
	c. Air Content	≥3, ≤7%	SC6.4.6.14.3(5)
	d. Thickness	Concrete shall be removed if thickness >20mm below specified thickness.	SC6.4.6.14.5(5)
	e. Mixing and Transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within: (i) One and a half hours where transported by truck mixer or agitator. (ii) One hour where transported by non agitating trucks.	SC6.4.6.14.6(4)

Item	Activity	Limits/Tolerances	Clause
	f. Placing	Concrete shall not be placed when the air temperature in the shade is less than 5ºC or >38ºC. Temperature of concrete shall be >10ºC but <32ºC.	SC6.4.6.14.7(1)
		Concrete shall not be placed when the Rate of Evaporation exceeds 0.5kg per square metre per hour.	SC6.4.6.14.7(2)
3.	**Alignment and Surface Tolerances** a. Horizontal Alignment	Outer edges not to deviate from plan position by more than ±25mm.	SC6.4.6.14.7(5)
	b. Surface	Level on top surface to be no more than +0mm or -20mm to that shown on the drawings.	SC6.4.6.14.7(5)
		The top surface shall not deviate from a 3m straightedge laid in any direction by more than 5mm.	SC6.4.6.14.7(5)
4.	**Joints** a. Transverse Construction	Shall not deviate from a 3m straight-edge placed along the joint by more than 10mm.	SC6.4.6.14.8(1)
	b. Longitudinal Joint	(i) Shall not deviate from the plan or nominated position at any point by more than 20mm. (ii) Shall not deviate from a 3m straightedge placed along the joint by more than 10mm after allowing for any curvature.	SC6.4.6.14.8(2)
5.	**Bond Breaker** a. Wax Emulsion	Minimum 0.2 litres per square metre, not earlier than 72 hours before placement of base.	SC6.4.6.14.9(4)

SC6.4.6.16 Sprayed ~~bitumen~~ bituminous surfacing

SC6.4.6.16.1 Introduction

(1) Scope

This policy sub-section provides standards, advice and guidelines for the supply of all materials and the application of any or all of the following types of sprayed bituminous surfacing:

~~(a)~~ ~~prime~~

a) prime

The application of a primer of field or refinery prepared cutback bitumen without aggregate to provide penetration of the surface (preferably from 5 to 10 mm) and waterproofing;

~~(b)~~

~~a)~~b) primerseal

The application of a primerbinder of field or refinery prepared cutback bitumen to provide surface penetration (preferably from 2mm to 5mm) and incorporation of a light cover of aggregate to provide a temporary wearing surface; and

~~(c)~~

~~b)~~c) seal or reseal

The application of a bituminous binder into which aggregate is incorporated to provide a durable wearing surface (including bitumen emulsion ~~of~~ or polymer modified seals).

d) slurry surfacing

The application of a bituminous emulsion binder with or without polymer modifier and with or without continuous aggregate, mineral fillers, additives and water, properly proportioned to enrich the binder content and refresh the existing wearing course material. This is a preventive maintenance treatment and shall not be used in new construction.

The locations and required types of sprayed bituminous surfacings, including types of binders and aggregate sizes, shall be as shown on the construction drawings and/or as detailed in SC6.4.6.16 Attachment A Details of work.

For multiple application treatments, the binder and aggregate may be required to be laid in one or more separate applications indicated in SC6.4.6.16 Attachment B.

Requirements for adhesion agent in the bitumen and tolerances for binder application rates are set out in SC6.4.6.16 Attachment B Binder details.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note - A reference to drawings is a reference to construction drawings.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

~~(a)~~

~~(b)~~

~~(d)~~

~~(c)~~

~~Development manual planning scheme policy sub-section~~
~~SC6.4.6.30 - Control of traffic~~

~~Australian Standards~~
~~AS 1160 - Bituminous emulsions for the construction and maintenance of pavements~~
~~AS 2008 - *Residual bitumen for pavements*~~
~~AS 2157 - *Cutback bitumen*~~
~~AS 2758.2 - *Aggregate for sprayed bituminous surfacing*~~
~~AS 3568 - *Oils*~~

a) Development manual planning scheme policy sub-section
SC6.4.6.30 - Control of traffic

b) Australian Standards
AS 1160 - *Bituminous emulsions for the construction and maintenance of pavements*
AS 2008 - *Residual bitumen for pavements*
AS 2157 - *Cutback bitumen*
AS 2758.2 - *Aggregate for sprayed bituminous surfacing*
AS 3568 - *Oils for reducing the viscosity of residual bitumen for pavements*

c) Queensland Department of Transport and Main Roads Technical Standards
MRTS11 ~~10/10~~ - *Sprayed Bituminous Surfacing (excluding Emulsion)*
MRTS12 ~~06/09~~ - *Sprayed Bituminous Emulsion Surfacing*
MRTS13 – Bituminous Slurry Surfacing
MRTS17 ~~11/11~~ - *Bitumen*
MRTS18 ~~11/11~~ - *Polymer Modified Binder*
MRTS19 ~~11/11~~ - *Cutter and Flux Oils* MRTS20 11/11 - *Cutback Bitumen*
MRTS21 ~~06/09~~ - *Bituminous Emulsion*
MRTS22 ~~10/10~~ - *Supply of Cover Aggregate*

d) Queensland state legislation
Fire and Rescue Service Act 1990

Fire and Rescue Service Act 1990

(e) Other
Austroads, *Guide to Pavement Technology Part 4K: Seals*
Austroads, *Bituminous Materials Sealing Safety Guide*

(3) Control of traffic
The Contractor shall provide for the control of traffic in accordance with the requirements of policy sub-section SC6.4.6.30 Control of traffic while undertaking the work and shall take all necessary precautions to protect the work from damage until such time as the new seal coat has developed sufficient strength to carry normal traffic without disturbance of the aggregate.

Where early use of the new seal is required to facilitate the movement of traffic, vehicles may be allowed to run on the work after initial rolling has taken place provided that vehicles are controlled to such slow speeds that no lateral displacement of aggregate occurs. Where necessary, the Contractor shall use patrol vehicles to ensure that traffic travels at an acceptable speed.

The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are included in the Contract or are otherwise available, traffic shall be temporarily diverted while the work is in progress.

If facilities for the diversion of traffic are not available, the Contractor may spray part width of the pavement in the one operation and make available to traffic the adjacent strip of roadway, except during the actual spraying operation when all traffic movement through the work shall cease. Traffic shall not be permitted to encroach upon the edge of the sprayed bituminous material until such time as it is covered with aggregate.

SC6.4.6.16.2 Materials

(1) Sampling and testing of materials
Sampling and testing of materials shall be arranged by the Contractor and carried out by a laboratory with appropriate NATA registration in accordance with the requirements of the relevant Queensland Department of Transport and Main Roads (DTMR) Specification.

(2) Bituminous materials and additives
Bituminous materials shall be in accordance with the relevant DTMR Specifications.

(3) ~~Aggregate precoating agent and b~~Bitumen adhesion agent

~~(a) Aggregate pre-coating agents shall be as listed.~~

~~**Acceptable Pre-coating Agents**~~
~~The following products listed in Table SC6.4.6.16.1 may be used subject to testing on each type of cover aggregate and verification of suitability of the product and application rate.~~

~~**Table SC6.4.6.16.1 Preferred pre-coating agents**~~

~~**Product**~~	~~**Manufacturer**~~	~~**Approximate Application Rate (L/m³)**~~
~~1st Preference – Shell Mexkote A~~	~~Shell Company of Aust Ltd~~	~~8~~
~~2nd Preference – Boral ATP2~~	~~Boral Resources (Qld) Pty Ltd~~	~~8~~
~~3rd Preference – Premol E2~~	~~Emoleum (Australia) Ltd~~	~~8~~
~~4th Preference – Emulcoat C~~	~~Pioneer Road Services Pty Ltd~~	~~12~~
~~4th Preference – Precoat 245~~	~~BP Australia Ltd~~	~~8~~
~~4th Preference – Emulsion Precoat~~	~~Emoleum (Australia) Ltd~~	~~17~~

~~Time period between pre-coating and spreading of pre-watered aggregate shall be in accordance with Table 7.1.4 of MRS22.~~

~~(b) Bitumen adhesion agents.~~

Adhesion agents ~~shall~~ must conform to the following requirements:

(i) adhesion agent is to be added to bitumen at the rate of 5 ~~k~~kg for every 1,000 Litres of bitumen CL170 and 10 ~~k~~kg for every 1,000 litres of polymer modified bitumen; and

(ii) adhesion agents approved for use are Diamintol, or Bitumite EXP3995 if Diamintol is unavailable.

(4) Oils for reducing viscosity of bitumen

Cutter Oil shall conform to MRTS 19.

Delivery and storage procedures for cutter oil delivered in drums or in bulk shall ensure that all containers are free from any deleterious material prior to filling with cutter oil, and all drums are stored ~~so as~~ to ensure that entry of water through seals or welds in the drums is prevented.

(5) Aggregate

Aggregate shall conform to MRS22.

The Contractor shall obtain test results for each lot/stockpile of aggregate and certification of compliance from a laboratory with appropriate NATA accreditation, before aggregate from the lot is incorporated in the works.

SC6.4.6.16.3 Design of bituminous surfacing

(1) Before commencing sprayed bituminous surfacing work, the Superintendent will confirm the approved details of the proposed bituminous surfacing design for the work. Additional details are required to be submitted to the Superintendent prior to carrying out the work for check with the proposed bituminous surfacing design. These additional details include:

(a) test results for all nominated materials;

(b) aggregates source, geological type, nominated grading, average least dimension (ALD);

(c) pre-coating agent and bitumen adhesion agent types, proportions and manufacturer (if applicable);

(d) bitumen refinery source and certification of compliance;

(e) cutback bitumen refinery source of bitumen, type of cutter, source of cutter, cutter oil fraction, certification of compliance;

(f) polymer modified bitumen – refinery source of bitumen and manufacturer, class of polymer and fraction, certificate of compliance; and

(g) bitumen emulsion – refinery source of bitumen and manufacturer, grade of emulsion, certificate of compliance.

Design rates of application of binder and aggregate for bituminous surfacing shall be in accordance with *Guide to Pavement Technology Part 4K: Seals*. Design application rates shall be known as “nominated application rates” and materials as “nominated materials”.

SC6.4.6.16.4 Pre-coating of aggregate general

The aggregate pre-coating agent shall be applied to the aggregate in a manner and at a rate and time which will provide a complete, light, uniform, effective cover of all aggregate particles at the time of spreading.

Pre-coating of aggregate shall not be carried out when rain is imminent. If aggregate has been pre-coated and rain appears imminent, the aggregate shall be adequately covered to prevent the pre-coating material being washed from the aggregate particles.

The Contractor shall take precautions, such as covering stockpiles, to prevent settlement of dust, penetration of moisture or drying out of the pre-coating agent on the stockpiled aggregate.

Stockpiles pre-coated more than 14 days in advance of use shall be retreated unless otherwise approved by the

Superintendent and shall not be used if less than 3 days old.

SC6.4.6.16.5 Application of sprayed bituminous surfacing

(1) General

The Contractor shall carry out sprayed bituminous surfacing ~~so as~~ to:

(a) provide a uniform application of binder with adequate adhesion to the underlying surface;

(b) provide a complete cover of interlocking aggregate particles, and

(c) achieve effective bond between binder and aggregate.

Details of equipment and methods to be used for sprayed bituminous surfacing shall be submitted to the Superintendent for approval prior to their use on the works.

(2) Plant

A mechanical sprayer shall be used to apply primer, primerbinder and binder. The sprayer shall have a current Sprayer Certificate issued by the Queensland Department of Transport and Main Roads.

The spray nozzles shall be of the make and type endorsed on the Sprayer Certificate. Any nozzles which may be damaged or become unduly worn or defective shall be replaced by satisfactory nozzles of similar type. A sufficient number of nozzles for this purpose shall be available at all times.

Mechanical spreading equipment shall be used to spread aggregate and shall be capable of achieving a uniform and accurate spreading rate.

Rollers shall be utilised in accordance with Clause SC6.4.6.16.4(9) Application and rolling of aggregate.

The Contractor shall remove from the site any plant or equipment considered by the Superintendent to be not fully operational or not in a satisfactory condition for carrying out work in accordance with this sub-section.

(3) Preparation of pavement surface

Before the application of primer, primerbinder or binder, the pavement surface shall be swept by the use of a mechanically operated rotary road broom or suction broom to provide a uniformly clean surface. If necessary, additional sweeping shall be done by hand, using stiff brooms. Sweeping shall, where possible, extend at least 300 mm beyond each edge of the area to be sprayed.

Adherent patches of foreign material shall be removed from the surface of the pavement.

For the spraying of primer or primerbinder, the pavement surface shall be slightly damp ~~so as~~ to impede dust interfering with initial adhesion except where explicit instructions are provided with the seal design.

(4) Surface defects must be repaired prior to laying the wearing course. This may include crack filling, pothole repairs and repair of failed pavements.

Rut-filling and corrector must be applied where necessary to rectify any ruts and uneven surfaces prior to placing the wearing course.

Review of nominated application rates

The Contractor shall select the locations where each lot of aggregate is to be incorporated in the works.

The Superintendent shall review the bituminous surfacing design at each location based on the actual average least dimension (ALD) test result for the lot of aggregate instead of the nominated ALD value of the aggregate adopted at design. Due consideration must also be given to the surface texture of the prepared pavement surface and the likely degree of stone embedment, to establish if any additional minor adjustments to bitumen spray rates should be applied. The revised application rates shall be known as "target application rates".

The Contractor shall give the Superintendent notice of the Contractor's intention to commence sprayed bituminous surfacing. This notice shall confirm spray rates, aggregate size and ALD.

(5) Bitumen temperature requirements

Bitumen temperature requirements are as per MRTS 17, 18, 19, 20 and 21.

Table SC6.4.6.16.2 Cutback bitumen spraying temperatures

Grade	Temperature Range (ºC)
AMC 00	10 - 35
AMC 0	35 - 55
AMC 1	60 - 80
AMC 2	75 - 100
AMC 3	95 - 115
AMC 4	110 - 135
AMC 5	120 - 150
AMC 6	135 - 160
AMC 7	150 - 175

(6) Pavement temperature and weather conditions

The Contractor shall measure and record pavement temperatures at regular intervals during the course of the work. For this purpose, a spirit or mercury in glass thermometer or other suitable type of thermometer shall be placed in direct contact with the pavement and allowed to remain in position until the reading becomes steady. When a spirit or mercury in glass thermometer is used to measure pavement temperature, the bulb of the thermometer shall be covered from direct sunlight with a small heap of grit or similar material. Suitably calibrated infra-red thermometers may be used.

If the pavement is partly in sun and partly in shade, the temperatures for both conditions shall be taken and recorded.

Spraying primers, primerbinders and binders shall be undertaken only if the pavement temperature has been at or above 20° ºC, 25° ºC for PMB, 10° ºC for emulsion for spraying for at least one hour before commencement of spraying and does not fall below 20° ºC, 25° ºC for PMB, 10° ºC for emulsion for spraying during the period of spraying.

Spraying shall not be carried out on a wet pavement, while rain appears imminent or during high winds or dust storms.

(7) Incorporation of cutter oil, flux oil and adhesion agent

(a) Cutting back bitumen

The Contractor shall determine and record the proportion of cutter oil added to each sprayer load, using MRTS 11 and based on the measured pavement temperatures.

The cutter oil, without being previously heated, shall be pumped into the sprayer, followed by the hot bitumen. The full sprayer load of cutback bitumen shall be circulated at a rate of at least 700 litres per minute for 20 minutes to ensure that the mixture is homogeneous.

If a part sprayer load of field cutback bitumen is unused on the date of mixing, and needs to be returned to the heater tanks, it shall be placed in an empty tank reserved for that purpose. No bitumen or cutter shall be added to the returned cutback bitumen unless the tank is fitted with an effective mechanical mixing system. When the returned cutback bitumen is subsequently used as part of a sprayer load, allowance shall be made for the cutter oil contained in the returned cutback bitumen.

(b) Fluxing bitumen

Where flux oil is to be included, it shall be added to the bitumen in the sprayer and the mixture circulated at a rate of at least 700 litres per minute for at least 20 minutes before spraying.

(c) Bitumen adhesion agent

Where bitumen adhesion agent is to be included, it shall be added to the bitumen in the sprayer and the mixture circulated twice at a rate of at least 1,000 litres per minute for at least twenty minutes before spraying. Spraying shall occur within 4 hours.

(8) Application of primer, primerbinder and binder

(a) General

The area to be sprayed with primerbinder or binder shall be limited to the area which can be covered with aggregate at the target application rate within ten minutes of spraying bitumen or cutback bitumen.

(b) Primer and primerbinder

Nominated and target application rates and quantities of primer and primerbinder shall apply to the whole material, including cutter oil, measured at 15°C. Primer, Primerbinder and Binder application rates outside the tolerances indicated in SC6.4.6.16 Attachment B Binder details constitute a non-conformance.

After application of a primer, a period of at least forty eight hours, or such longer period as determined to be necessary for the primer to become completely dry, shall elapse before the binder for a seal is applied. All traffic shall be kept off the primed surface.

After application of a primerbinder, a period of at least fourteen days shall elapse before the binder for a seal is applied.

(c) Binder

The class of bitumen or grade of cutback bitumen shall be as specified in SC6.4.6.16 Attachment A Details of work.

Nominated and target application rates and quantities of binder shall be based on the volumes of bitumen measured at a temperature of 15° °C and shall not include any bitumen adhesion agent and/or cutter oil. If flux oil has been added to the bitumen, the quantity of flux oil shall be included as part of the binder. Binder application rates outside the tolerances provided in SC6.4.6.16 Attachment B Binder details shall constitute a non conformance.

Where bitumen adhesion agent and/or cutter oil have been added to the binder, the application rate of the total binder at 15° °C shall be adjusted to allow for the quantities of bitumen adhesion agent and/or cutter oil in the mixture.

The Contractor shall determine the hot application rate of total binder, including bitumen adhesion agent and/or cutter oil, using MRTS 11.

Where refinery cutback bitumen is used as the binder, the target application rate of binder shall be increased by the Contractor to allow for the cutter oil in the mixture.

(d) Operation of the sprayer

Where the longitudinal edges of spray runs are not required to overlap, special type end nozzles must be used. Where an overlap is required, the overlap of spray between adjacent longitudinal runs shall be in the range 50-100 mm for special type end nozzles. If intermediate nozzles are to be used to overlap adjacent longitudinal sprays the nozzles shall be set in the normal manner for intermediate nozzles and the overlap shall be in the range 250-350 mm.

The spraying of primer, primerbinder or binder for each run of the sprayer shall commence on a protective strip of heavy paper weighing not less than 120 grams per square metre laid across and held securely to the pavement surface beforehand by addition of cover aggregate. The sprayer shall commence moving at a sufficient distance in advance of the protective strip to ensure that the road speed for correct application and correct alignment is attained at the commencement of spraying.

The sprayer shall maintain a uniform rate of application throughout the length of each sprayer run.

The spraying for each run shall terminate on a protective strip of paper laid across and held securely to the pavement surface beforehand. The width of paper at the commencement and/or termination of each run shall not be less than that endorsed on the Sprayer Certificate.

Spraying shall cease immediately if any defect develops in the spraying equipment and spraying shall not recommence until the fault has been rectified.

Where any blockage or partial blockage of nozzles occurs, spraying shall cease immediately. If the blockage is due to the condition of the binder being sprayed and is likely to re-occur, that load together with any binder from the same bulk tanker or supply unit shall not be used in the works.

Where a mechanical sprayer is not able to satisfactorily spray small areas or areas of irregular shape, such areas shall be sprayed by means of the hand spray equipment attached to the sprayer. The work shall be planned ~~so as~~ to minimise the area sprayed by hand spray equipment.

After each sprayer run, the quantity of binder sprayed shall be checked against the area covered and any necessary adjustments shall be made to ensure that the target application rate is achieved in subsequent runs. If the actual application rate of binder after three runs differs by more than 5% ~~per cent~~ from the target application rate, the sprayer shall not be used until a new Sprayer Certificate has been obtained.

Areas not within 5% ~~per cent~~ of the target application rate of primer, primerbinder or binder shall constitute a "non-conformance".

(9) Application and rolling of aggregate

The application of aggregate shall proceed immediately after spraying is commenced and shall be completed within ten minutes of spraying bitumen or cutback bitumen. For polymer modified binder spreading and rolling shall start immediately after spraying and continue until adhesion is complete.
Wet aggregate shall not be used.

The Contractor shall apply the aggregate of the specified nominal size and at the target aggregate application rate. Sufficient loaded and measured trucks of dry aggregate shall be at the site to provide full cover for the area sprayed.
The aggregate shall be spread uniformly over the sprayed surface by means of suitable mechanical spreading equipment.

Any bare or insufficiently covered areas shall be re run by the mechanical spreader or covered by hand as necessary to give a uniform and complete coverage. Any aggregate spread in excess of the target aggregate application rate shall be removed before rolling is commenced if it is localised and can be efficiently removed by hand brooming.
After the aggregate has been applied to each section of the work, initial rolling shall be carried out with two or more dual axle smooth pneumatic tyred multi wheel rollers of minimum load of 1 ~~t~~onne per tyre and minimum tyre pressure of 550 kPa. A roller with a rubber surface drum providing equivalent compactive effort may be used in lieu of a multi-wheeled roller. Initial rolling shall continue until the aggregate is firmly embedded in the primerbinder or binder. Roller speed shall be 15-25 km/h subject to safe working conditions.

If the aggregate is not evenly distributed over the surface of the pavement, the surface shall be traversed with a light drag broom after the initial rolling. If the broom has any tendency to dislodge aggregate particles bedded in the primerbinder or binder, the Contractor shall defer or eliminate the drag brooming. Where drag brooming is eliminated, the Contractor shall substitute light hand brooming.

Backrolling shall then be carried out for a minimum period of 1 hour per 1,000 square metres sprayed for roads having a traffic volume of less than 500 vehicles per lane per day and 1 hour per 1,500 square metres sprayed for other roads, up to a maximum of 24 hours after the aggregate has been applied.

Where a bituminous surfacing is specified with separate applications of coarse and fine aggregate on a single application of binder, the coarse aggregate shall be applied first, rolled and any necessary brooming carried out as described above, before application of the fine aggregate and its subsequent rolling and brooming. In this case, the time limits for incorporation of aggregate shall apply only to the application of the coarse aggregate.

After final sweeping, and prior to removal of speed restriction and warning signs, the number of loose aggregate particles remaining on the surface of seals constructed with 10 ~~-~~mm, or larger, aggregates not to exceed the values specified in Table SC6.4.6.16.3.

Table SC6.4.6.16.3 ~~Table heading needed~~Maximum loose aggregate particles

Road type	Loose stones (particles/m²) max
Urban areas	20
Other medium to high traffic (> 250 v/l/d)	30
Low traffic (< 250 v/l/d)	40

Any remaining loose particles of aggregate shall be removed by light sweeping and/or vacuumed from the pavement and disposed of responsibly by the Contractor as per Table SC6.4.6.16.4 below or as directed to by the Superintendent.

Table SC6.4.6.16.4 ~~Table heading needed~~Maximum time limits for sweeping or vacuuming

Traffic volume (vehicles/lane/day)	Maximum time limits
> 2,000	Within 8 hours of sealing
1,000 to 2,000	Within 24 hours of sealing
250 to 1,000	Within 48 hours of sealing
< 250	Within 5 days of sealing

Prior to leaving the work site, ensure that all services are uncovered and cleaned, if necessary. Remove from site all waste paper and rubbish arising from the sprayed sealing operations. Clean the stockpile site and store any excess material in a tidy heap or remove, depending on the requirements of the Superintendent.

(10) Work records

Particulars of the work performed shall be recorded by the Contractor on a spray record sheet. Details of primer, primerbinder, binder and aggregate applied shall be recorded immediately after every sprayer run. Each form shall be signed by the Contractor's representative as a true record of the work performed. The Contractor shall supply to the Superintendent a copy of each completed form.

(11) Protection

(a) New work

Protect the new work by providing warning signs as follows:

(i) provide signs to warn public of loose stones and absence of line marking including provision of temporary raised pavement markers;

(ii) maintain signs until loose aggregate has been removed and linemarking reinstated; and

(iii) if linemarking is to be undertaken by others, erect warning signs indicating the absence of linemarking to be maintained by the organisation responsible for linemarking.

(b) Services and road fixtures

The Contractor shall take all necessary precautions to prevent primer, primerbinder, binder, aggregate or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, access chamber covers, bridge or culvert decks and other road fixtures.

Immediately after aggregate has been spread over the binder, the Contractor shall clean off or remove any sprayed surfacing material and leave the services and road fixtures in a condition equivalent to that existing when the Contractor commenced the sprayed surfacing work.

SC6.4.6.16.6 Nonconformance of materials and work

If any materials supplied or any section of sprayed bituminous surfacing work fail to conform to the requirements whether failure of the work is due to bad workmanship, defective materials supplied by the Contractor or materials made defective by the method of operation adopted, or any other cause then such failure or failures shall constitute a “non-conformance”.

The nonconforming section of sprayed bituminous surfacing work shall be either replaced or corrected as proposed by the Contractor, subject to the approval being obtained.

The ~~rectifying~~ rectified nonconformances, including any restoration work to any underlying or adjacent surface or structure,

which becomes necessary as a result of such replacement or correction, shall be the responsibility of the Contractor. Materials removed from the site by the Contractor shall be replaced with materials which conform to this sub-section.

SC6.4.6.16.7 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.16.5 below.

Table SC6.4.6.16.5 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Design of Bituminous Surfacing**	Contractor to provide details of design to Superintendent before proposed commencement of work	SC6.4.6.16.3
2.	**Commencement of Work**	Contractor to give notice to the Superintendent of intention to commence work	SC6.4.6.16.5(1)
3.	**Sweeping of Pavement Surface**	Sweeping shall extend at least 300mm beyond each edge of the area to be sprayed	SC6.4.6.16.5(3)
4.	**Bitumen Heating** (a) Bitumen Temperature	When incorporated with cutter oil, bitumen shall be in temperature ranges as per MRTS.17 and 18 (06/09)	SC6.4.6.16.5(5)
	(b) Refinery Cutback Bitumen Temperature	At the time of spraying shall be in temperature range as per MRTS 20 (06/09)	SC6.4.6.16.5(5)
	(c) Retention of Temperature	Bituminous materials shall not be held at temperatures within the ranges of MRTS 17, 18 and 20 for periods in excess of 10 hours.	SC6.4.6.16.5(5)
5.	**Spraying Temperature** (a) Pavement Temperature	Bituminous surfacing shall not be undertaken if the pavement temperature has not been at or above 20°C, 25°C for PMB, 10°C for emulsion for at least one hour before commencement of spraying or if the pavement temperature falls below 20°C, 25°C for PMB, 10°C for emulsion during the period of spraying.	SC6.4.6.16.5(6)
6.	Cutting Back Bitumen	Circulation of hot bitumen and cutter oil mixture in the sprayer shall be at the rate of at least 700 litres per minute for 20 minutes.	SC6.4.6.16.5(7)
7.	Fluxing Bitumen or adding Bituminous Adhesion Agent	Circulation of fluxing oil or bituminous adhesion agent with hot bitumen shall be at the rate of at least 1,000 litres per minute for 20 minutes. Spraying to occur within 4 hours.	SC6.4.6.16.5(7)
8.	**Application of Bituminous Material** (a) Spray Area	Area to be sprayed shall be limited to area which can be covered by aggregate at target application rate within 10 minutes of spraying.	SC6.4.6.16.5(8)
	(b) Application Rates	Application rates and quantities shall apply to a temperature of 15°C and have T1 tolerances of ±5% as set out in clause SC6.4.6.16.6 and T2 tolerances as set out in SC6.4.6.16 Attachment B.	SC6.4.6.16.5(8)
	(c) Primer	At least a 48 hour period shall elapse after spraying of primer before binder for a seal is applied.	SC6.4.6.16.5(8)
	(d) Primerbinder	At least a 14 day period shall elapse after spraying of primerbinder before application of binder.	SC6.4.6.16.5(8)

Item	Activity	Limits/Tolerances	Clause
9.	**Application of Aggregate** (a) Spreading Time	Application of aggregate shall be completed within 10 minutes of spraying bitumen or cutback bitumen on each section.	SC6.4.6.16.5(9)
10.	**Rolling** (a) Roller Numbers and Type	Initial rolling shall be carried out with two or more dual axle smooth pneumatic tyred multi-wheeled rollers. Minimum load of 1t ~~one tonne~~ per tyre and minimum tyre pressure 550KPa.	SC6.4.6.16.5(9)
	(b) Backrolling	(i) For traffic volume of <500 vehicles per lane per day, backrolling for minimum of one hour per 1,000 square metres sprayed.	SC6.4.6.16.5(9)
		(ii) For traffic volume >500 vehicles per lane per day, backrolling for minimum of one hour per 1,500 square metres sprayed.	SC6.4.6.16.5(9)

SC6.4.6.16 Attachment A: Details of work

Section		Prime	Primer Seal		Seal or Reseal	
Road Name		Binder Type	Binder Type	Aggregate Nom. Size	Binder Type	Aggregate Nom. Size
From	To					

Note —prime and primer seal binder type shall be indicated in this Attachment using the descriptive terms as follows:

Very Light Prime or Primer - equivalent cut back bitumen to grade AMCOO.

Light/Medium Prime or Primer - equivalent cutback bitumen to grade AMCO or AMC1.

Heavy Prime or Primer - equivalent cut back bitumen to grade AMC1 or AMC2.

Click here to obtain a copy of the following form.

SC6.4.6.16 Attachment B: Binder details

BINDER TYPE	**ADHESION AGENT** (At 0.5% of binder) **(YES/NO)**

Primer, Primerbinder and Binder Application Tolerance Thresholds T2

(Refer to clause SC6.4.6.16.6)

Nominal Aggregate Size (mm)	**Tolerance Thresholds T2 expressed as ± percentages**

SC6.4.6.17 Bituminous micro-surfacing

SC6.4.6.17.1 Introduction

(1) Scope

a) The work to be executed under this sub-section consists of the design, supply, mixing and placement of bituminous microsurfacing for surface correction and wearing surface applications on road pavements, carparks, cycleways and footpaths; or as a preventive maintenance treatment on roads with the objective of enriching the existing wearing course. The treatment must not be used in new road construction.

Bituminous microsurfacing ~~shall~~ must consist of a mixture of emulsified polymer modified bitumen binder, mineral aggregate, mineral filler, additives and water proportioned and mixed to form a slurry which is placed and spread evenly on the road surface. It ~~shall~~ must be capable of being spread in variably thick layers for surface correction and for wearing surface applications.

The size, nominal thickness, and extent of bituminous microsurfacing ~~shall~~ must be as shown on the drawings or as directed by the Superintendent.

For all new works on road and carpark pavements, this sub-section should be read in conjunction with sub-section SC6.4.6.16 Sprayed bitumen surfacing. For new works on road and carpark pavements, bituminous mircrosurfacing ~~shall~~ must be preceded by the application of a sprayed bituminous seal a minimum of 2 weeks prior to the application of the bituminous microsurfacing wearing course.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Terminology

Users of this specification should be aware that where terms are not specifically defined in the following section, AS-1348 should be the default standard.

Bituminous microsurfacing	Is one of two types of bituminous slurry surfacing. It is distinguished from the other type, slurry seals, by the incorporation of polymer and other additives to the bituminous binder to improve the performance of the slurry surfacing. Bituminous microsurfacing is also commonly known under various proprietary names such as “cold overlay”~~,~~“, “microsealing”, “paveseal”, “microasphalt”, etc. The size of the bituminous microsurfacing is based on the nominal largest stone size in the mix. For the purpose of this sub-section, the size ~~shall~~ must be either Size 5 or Size 7.

(3) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy ~~sub-section to be read and applied in conjunction with this sub-section are~~subsections to be read and applied in conjunction with this subsection are as follows:

SC6.4.6.16 Sprayed bitumen surfacing

SC6.4.5 Construction management

(b) Australian Standards

AS-1141.11.1	*Particle size distribution – Sieving method*
AS-1141.12	*Material finer than 75 micrometre in aggregates (by washing)*
AS-1141.22	*Wet/dry strength variation*
AS-1141.23	*Los Angeles value*
AS-1141.25.1	*Methods for sampling and testing aggregates - Degradation factor - Source rock*
AS-1141.25.2	*Methods for sampling and testing aggregates - Degradation factor - Coarse aggregate*
AS-1141.25.3	*Methods for sampling and testing aggregates - Degradation factor - Fine aggregate*
AS-1141.42	*Pendulum friction test*
AS-1160	*Bitumen emulsions for the construction and maintenance of pavements*

AS-1289.3.7.1	*Determination of the sand equivalent of a soil using a power-operated shaker*
AS-1348	*Glossary of terms - Roads and traffic engineering*
AS-2008	*Residual bitumen for pavements*
AS-2350	*Methods of testing Portland and blended cements*
AS-2891.3.1	*Binder content and aggregate grading - Reflux method*

(c) International Slurry Surfacing Association Tests

ISSA TB 100 - *Test method for wet track abrasion of slurry surfaces*

ISSA TB 109 - *Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded Wheel Tester*

ISSA TB 114 - *Wet stripping test for cured slurry seal mixes*

ISSA TB 139 - *Method of classified emulsified asphalt/aggregate mixtures by modified cohesion test measurement of set and cure characteristics*

ISSA TB 144 - *Classification compatibility by Schulze-Breuer and ruck procedure*

SC6.4.6.17.2 Materials

(1) Sampling and testing of materials

Sampling and testing of materials ~~shall~~ must be arranged by the Contractor and carried out by a NATA registered laboratory for the nominated test methods.

(2) Binder

The binder supplied and used in the works ~~shall~~ must be an emulsified polymer modified bitumen, formulated to meet the performance requirements of the mix specified in clauses SC6.4.6.17.3(1) Mix properties and SC6.4.6.17.4(6) Surface texture.

Prior to emulsification, incorporation of polymer and additives, the bitumen ~~shall~~ must comply with AS-2008.

The Contractor ~~shall~~ must provide the Superintendent with sufficient information to verify that the binder supplied is the same as that nominated in the mix design.

(3) Mineral aggregates

Mineral aggregates ~~shall~~ must consist of crushed rock or crushed gravel, or a mixture of crushed rock or crushed gravel and natural sand. It ~~shall~~ must consist of clean, hard, angular, durable particles, and free form clay, dirt, organic material or other deleterious matter.

The aggregate from each source ~~shall~~ must comply with the requirements given in Table SC6.4.6.17.1 Aggregate properties.

Table SC6.4.6.17.1 Aggregate properties

Property	Test Method	Requirement
Degradation Factor	AS-1141. 25.1	50 minimum
Los Angeles Value	AS-1141.23	30 maximum
Aggregate Wet Strength	AS-1141.22	150-kN minimum
Wet/Dry Strength Variation	AS-1141.22	30% maximum
Polished Aggregate Friction Value	AS-1141.42	45 minimum
Sand Equivalent	AS-1289.3.7.1	60 minimum

When tested in accordance with AS-1141.11 and AS-1141.12, the aggregate (including mineral filler) ~~shall~~ must conform with the grading limits given in Table SC6.4.6.17.2 Grading limits for combined aggregate/filler.

Table SC6.4.6.17.2 Grading limits for combined aggregate/filler

Sieve Size	Percent Passing by Mass	
	Size 5	Size 7
13.2 mm	100	100
9.50 mm	100	100
6.70 mm	100	85-100
4.75 mm	90-100	70-90
2.36 mm	50-70	45-70
1.18 mm	30-50	28-50
600 µm	20-35	19-34
300 µm	12-25	12-25
150 µm	7-18	7-18
75 µm	4-10	5-15

The Contractor ~~shall~~ must nominate the source/s of aggregates to the Superintendent, and ~~shall~~ must submit NATA certified test reports on the quality and grading of the combined aggregate proposed to be used.

The Contractor ~~shall~~ must submit test results to the Superintendent for each lot/stockpile of aggregate a minimum of seven days prior to incorporation in the works.

(4) Mineral filler

Mineral filler ~~shall~~ must consist of hydrated lime, flyash, portland cement, or other material approved by the Superintendent.

The mineral filler ~~shall~~ must be dry, free from lumps and any deleterious material, with a minimum of 85% ~~per cent~~ passing a 75 µm sieve. In all other respects, the mineral filler ~~shall~~ must comply with the requirements of AS 2350.

The quantity of filler added to the bituminous microsurfacing during placement ~~shall~~ must not vary by more than 1% ~~per cent~~ of the total aggregate (by mass) from the filler content nominated in the mix design.

(5) Water

Water added to the bituminous microsurfacing ~~shall~~ must be potable and ~~shall~~ must be compatible with the component materials.

(6) Additives

Details of the type, source and nominal proportions of additives ~~shall~~ must be submitted to the Superintendent with the mix design.

SC6.4.6.17.3 Mix design

(1) Mix properties

The nominated mix design ~~shall~~ must satisfy the properties given in Table SC6.4.6.17.3 Mix properties.

Table SC6.4.6.17.3 Mix properties

Mix Property	Test Method	Requirement
Wear Loss	ISSA TB 100 6 day	800 g/m² maximum
Traffic Time	ISSA TB 139 30 minutes 60 minutes	12 kg.cm minimum 20 kg.cm minimum
Adhesion	ISSA TB 114 or ISSA TB 144	≥90% or 11 grade points minimum (AAA, BAA)

(2) Nominated mix

At least 7 days before commencing bituminous microsurfacing work, the Contractor ~~shall~~must submit to the Superintendent for approval, details of the nominated bituminous mircrosurfacing mix design for the work including the target application rate (m³ of mix/m² of road surface) and the corresponding nominal layer thickness, together with NATA certification and test results demonstrating that the nominated mix and its constituents meet the requirements of the specification.

The details of the nominated mix design ~~shall~~ must include the following:

(a) bitumen emulsion content of the mix, and the residual binder content of the emulsion;

(b) target combined aggregate/filler grading;

(c) proportions of constituent materials used;

(d) type and sources of aggregates, filler and binder; and

(e) all relevant compliance certificates.

(3) Approved mix

When a nominated mix has been approved by the Superintendent, it ~~shall~~ must be known as the “approved mix”. Work ~~shall~~ must not commence until a bituminous microsurfacing mix has been approved.

The combined aggregate/filler grading and the binder content of the approved mix will be termed the "approved grading" and the "approved binder content" respectively.

Any changes to the approved mix, its method of production or source of supply of constituents require written approval 21 days prior to proposed implementation.

SC6.4.6.17.4 Production and paving

(1) Requirements of production mix

Bituminous microsurfacing produced in the paving unit at the site ~~shall~~ must be known as the "production mix".

The production mix ~~shall~~ must comply with the requirements given in Table SC6.4.6.17.4 Maximum permitted variations from approved mix and ~~shall~~ must be confirmed by the Contractor as required in SC6.4.6.17.4(2) Sampling and testing of production mix.

The Contractor is responsible for taking samples for testing at a NATA registered laboratory to confirm compliance with Table SC6.4.6.17.4.

Table SC6.4.6.17.4 Maximum permitted variations from approved mix

Production Mix Properties	Maximum Permitted Variations from Approved Mix (by mass)	
	Size 5	Size 7
Grading*	Nil	Nil
Passing 9.50mm AS sieve and larger	Nil	± 7%
Passing 6.70mm	± 6%	± 6%
Passing 4.75mm	± 5%	± 5%
Passing 2.36mm and 1.18mm	± 4%	± 4%
Passing 0.600mm	± 3%	± 3%
Passing 0.300mm	± 2%	± 2%
Passing 0.150mm	± 1.5%	± 1.5%
Passing 0.075mm		
Residual Binder Content	- 0.5% + 1.0%	- 0.5% + 1.0%

Note—*these allowable variations ~~shall~~ must not fall outside the limits for design of nominated mix as given in Table SC6.4.6.17.2 Grading limits for

(2) Sampling and testing of production mix

(a) Lot definition

Compliance sampling and testing of bituminous microsurfacing ~~shall~~ must be undertaken on a lot by lot basis. For this purpose, 50m^3 or one day's production (whichever is the lesser), or such smaller quantity which is considered as representative of consistent production of the paving unit, ~~shall~~ will be considered as representative of consistent production of the paving unit.

(b) Responsibility of sampling

The Contractor ~~shall be~~is responsible for taking samples and ~~shall~~ must supply all facilities, equipment and labour for that purpose.

(c) Frequency of Sampling

For the testing of production mix, two 1.5kg representative samples of bituminous microsurfacing must be taken from each lot at random intervals. The samples must be taken from the discharge of the paving unit and the sample containers immediately sealed.

For the testing of the binder, two 2L samples of bitumen emulsion must be taken from each bulk delivery in accordance with AS1160.

(d) Testing

The samples of bituminous microsurfacing must be treated and tested at a NATA registered laboratory to confirm compliance with Table SC6.4.6.17.4 Maximum permitted variations from approved mix. Prior to testing for Residual Binder Content and Aggregate Gradation, as determined by AS2891.3.1, the samples must be dried to constant weight in an oven at 60ºC for a minimum of 15 hours.

Each delivery of emulsion must be tested for residual binder content in accordance with AS1160 Appendix D and accompanied by a certification of specification compliance traceable to the relevant batch at the supplier's storage tank.

The paving unit to be used must be calibrated for the component materials of the approved mix prior to the commencement of paving. Previous calibration documentation covering the same materials and approved mix will be acceptable provided that calibration has been carried out within the previous 12 months.

The documentation must include an individual calibration for each component material at various settings which can be related to the paving unit's metering devices.

No paving unit is allowed on the work until the calibration has been verified and approved by the Superintendent.

(3) Preparation of pavement

The existing surface must be clean and free from any loose stones, dirt, dust and foreign matter. The surface must be swept beyond the edge of the area to be surfaced by at least 300mm. Any foreign matter adhering to the pavement and not swept off must be removed by other means. Any areas significantly affected by oil contamination must be cleaned to the satisfaction of the Superintendent.

The Contractor must take all necessary precautions to prevent the bituminous microsurfacing or other materials used on the work from entering or adhering to kerbs, gutters, driveways, gratings, hydrants, valve boxes, access chamber covers, bridge or culvert decks or other road fixtures. After the bituminous microsurfacing has been spread the Contractor must clean off any such material and leave such gratings, access chamber covers and other road fixtures, in a clean and satisfactory condition.

(4) Weather limitations

Bituminous microsurfacing must not commence if either the pavement or air temperature is below 10ºC and falling.

Bituminous slurry may be applied when both pavement and air temperatures are above 7ºC and rising, or above 10ºC.

Spreading must not proceed during rain or when rain appears imminent.

The Superintendent must require cease of works, if weather conditions are not appropriate.

(5) Spreading

The surface may be pre-dampened if necessary by fogging ahead of the spreader box. Water used for pre-wetting the surface must be applied so that the entire surface is damp with no apparent flowing water ahead of the spreader box. The application rate of the fog spray must be adjusted to suit temperature, surface texture, humidity and dryness of the surface being covered.

Bituminous microsurfacing must be mixed and applied using a purpose built paver. The mix must be of the desired consistency when deposited in the spreader box, and nothing more may be added other than minor amounts of water for the purpose of overcoming temporary build-up of microsurfacing in the corners of the spreader box.

The mixing time must be sufficient to produce a complete and uniform coating of the aggregate and the resulting mixture must be conveyed into the moving spreader box at a sufficient rate to always maintain an ample supply across the full width of the strike-off.

The strike-off must be adjusted to provide an application rate which will completely fill the surface voids and provide the nominal application rate of bituminous microsurfacing as scheduled.

After the bituminous microsurfacing has been spread, the Contractor must ensure that all kerbs, gutters, driveways, gratings, hydrants, valve boxes, access chamber covers, etc. are uncovered and left in a clean and satisfactory condition.

After the emulsion has broken and the mix is sufficiently stable, rolling must be carried out using pneumatic tyred rollers to produce a dense, even, homogeneous compacted surface where there is insufficient local traffic to achieve satisfactory compaction across the mat.

Bituminous microsurfacing must be capable of carrying slow moving traffic (<40 km/h) within 1 hour of application without permanent damage occurring, such as rutting or ravelling. When the time before the microsurfacing is capable of carrying traffic exceeds 1 hour, work must cease unless specifically approved by the Superintendent.

(6) Surface texture

The resulting surface after spreading must be uniform in appearance, and free of areas exhibiting segregation or

excessive or insufficient binder.

The surface texture must be demonstrated on a short test run for approval by the Superintendent. If the surface texture is acceptable to the Superintendent, then all subsequent work must be finished to an equivalent surface texture.

Where increased surface texture is required, a fabric skirt may be trailed behind the spreader box.

(7) Joints

Longitudinal joints in the wearing course must be straight and placed at either the edge or the centre of a traffic lane. If necessary, the edges and joints must be lightly screeded with a hand squeegee to achieve a smooth uniform appearance and to remove excess build-up of material.

(8) Shape and levels

Where a correction and wearing course have been placed, the finished surface level may not vary from the design level at any point by more than ±10mm. Additionally, immediately adjacent to any kerb and/or gutter the finished surface level is not to be below nor more than 10mm above the level of the lip of the adjacent gutter.

Notwithstanding the above, the deviation from a 3m long straight edge placed anywhere on the top of the finished surface may not exceed 10mm when assessed within 24 hours of work completion.

(9) Non-conformance of materials and finished surfacing

If any materials supplied fail to conform to the requirements in this sub-section or if any section of bituminous microsurfacing fails to conform to the requirements of this sub-section - whether failure of the work is due to bad workmanship, defective materials supplied by the Contractor or materials made defective by the method of operation adopted - then such failure or failures will constitute a “Notice of Non Conformance”. Such non-conforming sections of bituminous microsurfacing work must be either replaced or corrected.

The rectification of non-conformances, including any restoration work to any underlying or adjacent surface or structure, which becomes necessary as a result of such replacement or correction, is the Contractor’s responsibility. Materials removed from the site by the Contractor must be replaced with materials which conform to this sub-section.

(10) Control of traffic

The Contractor must provide for traffic in accordance with the requirements of sub-section SC6.4.6.30 Control of traffic while undertaking the work and must take all necessary precautions to protect the work from damage until such time as the new work has developed sufficient strength to carry normal traffic without damage.

The Contractor must take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are included in the Contract or are otherwise available, traffic must be temporarily diverted while the work is in progress.

SC6.4.6.17.5 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.17.5 below.

Table SC6.4.6.17.5 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Spec Clause
1.	**Mineral Aggregate**	As per Table SC6.4.6.17.1	SC6.4.6.17.2(3)
2.	**Combined Aggregate/filler**	As per Table SC6.4.6.17.2	SC6.4.6.17.2(3)
3.	**Mineral Filler**	> 85% passing a 75 µm Sieve	SC6.4.6.17.2(4)
4.	**Mix Properties**		
	(a) Design properties	As per Table SC6.4.6.17.3	SC6.4.6.17.3(1)
	(b) Permitted variations	As per Table SC6.4.6.17.4	SC6.4.6.17.4(1)
5.	**Surface Preparation** SC6.4.6.17.4(3)	Sweeping ~~shall~~ must extend at least 300mm beyond edge of area to be surfaced	
6.	**Weather Limitations**	Microsurfacing must not commence if either air or pavement temperature is below 10°C and falling, and may only commence if both air and surface temperature is above 7°C and rising or above 10°C	SC6.4.6.17.4)4)
7.	**Shape and Levels**		
	(a) Finished Levels	Must not vary at any point by more than ± 10mm from design levels. Immediately adjacent to kerb and/or gutters, levels must not be below nor more than 10mm above design level	SC6.4.6.17.4(8)
	(b) Finished Shape	Deviation from the bottom of a 3m straight edge must not vary by more than 10mm	SC6.4.6.17.4(8)

SC6.4.6.18 Segmental paving

SC6.4.6.18.1 Introduction

(1) Scope

(a) This sub-section covers the construction of both clay and concrete segmental paving for road pavements, medians, traffic islands, driveways, cycleways, footpaths and other pedestrian areas.

(b) The work covered under this sub-section consists of the supply, placement and compaction of segmental pavers including the provision of a sand or crusher dust bedding course and joint filling sand, over bound or unbound base and/or subbase layer/s.

(c) This sub-section should be read in conjunction with the appropriate specifications for the construction of the base and subbase layers beneath the segmental paving, ie. SC6.4.6.12 Flexible pavements, SC6.4.6.14 Mass concrete subbase.

(d) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note - A reference to drawings is a reference to construction drawings

(2) Choice of paver type, shape, class and laying pattern

(a) The choice of concrete or clay segmental pavers, the paver class (for clay pavers), shape type (for concrete pavers), shape name, colour, thickness and laying pattern ~~shall~~ must be as per decision requirement for each area of application.

(b) Unless otherwise specified, concrete pavers for road pavements ~~shall~~ must be placed in herringbone laying pattern and ~~shall~~ must be in accordance with the requirements for the appropriate road application shown in Table SC6.4.6.18.1.

(c) Unless otherwise specified, clay pavers for road pavements ~~shall~~ must be Class 4, minimum 65 mm nominal thickness, and placed in a herringbone laying pattern.

(d) Paving for cycleways and other pedestrian areas must be carried out in accordance with SC6.4.3.3 Footpath treatment and SC6.4.4.7 Pathways and cycleways.

(e) Paving for road pavements, medians and traffic islands must be carried out in accordance with SC6.4.4.1 Geometric road design and SC6.4.4.2 Pavement design.

(f) Paving for driveways must be carried out in accordance with SC6.4.3.5 Driveways and SC6.4.4.8 Standard drawings.

(3) Terminology

Concrete segmental pavers are units of not more than 0.10 square metres in gross plan area, manufactured from concrete, with plain or dentated sides, with top and bottom faces parallel and with or without chamfered edges. Concrete pavers are identified by shape as being one of the following types:

(a) **Shape Type A** - Dentated chamfered units which key into each other on four sides, are capable of being laid in herringbone bond, and by their plan geometry, when interlocked, resist the spread of joints parallel to both the longitudinal and transverse axes of the units; or

(b) **Shape Type B** - Dentated units which key into each other on two sides, are not (usually) laid in herringbone bond, and by their plan geometry, when keyed together, resist the spread of joints parallel to the longitudinal axes of the units and rely on their dimensional accuracy and accuracy of laying to interlock on the other faces; or

(c) **Shape Type C** - Units which do not key together and which rely on their dimensional accuracy and accuracy of laying to develop interlock.

Clay pavers are manufactured from clay, shale or argillaceous materials which may be mixed with additives. Clay pavers may have square, bevelled (chamfered), rounded or rumbled edges. They are generally rectangular in shape, with the length twice the width, plus 2 mm.

Laying patterns of pavers are identified as being either Herringbone, Basket-weave, or Stretcher as shown in SC6.4.6.18 Attachment A Laying patterns. Each of these may be laid at either 90º or 45º to the line of edge restraints. A variation of Stretcher is the Zig Zag Running Bond, also shown in SC6.4.6.18 Attachment A.

(4) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.6.9 - Open drains kerb and channel
SC6.4.6.10 – Earthworks (construction)
SC6.4.6.12 - Flexible pavements
SC6.4.6.14 - Mass concrete subbase
SC6.4.6.19 - Stabilisation
SC6.4.6.28 - Minor concrete works.

(b) Australian Standards

AS1141.11.1 - *Particle size distribution - Sieving method*
AS/NZS4455 - *Masonry units, pavers, flags and segmental retaining wall units*
AS/NZS4456.0 - *Methods of test - General introduction and list of methods*
AS/NZS4456.3 – *Methods of test - Determining dimensions*
AS/NZS4456.5 – *Methods of test - Determining the breaking load of segmental pavers and flags*
AS/NZS4456.9 – *Methods of test - Determining abrasion resistance*
AS/NZS4586 - *Slip resistance classification of new pedestrian surface materials.*

(c) Concrete Masonry Association of Australia specifications

CMAA MA56-2010 - *Guide to permeable interlocking concrete pavements*
CMAA MA57-2010 - *Concrete segmental and flag pavements - guide to specifying*
CMAA T45-1997 - *Concrete segmental pavements - Design guide for residential access ways and roads*
CMAA T46-1997 - *Concrete segmental pavements - Detailing guide.*

(d) Clay Brick and Paver Institute specification

CBPI Manual 1: 2003 - *Clay Paving Design and Construction.*

SC6.4.6.18.2 Materials

(1) General

(a) The Contractor ~~shall~~ must submit details of all proposed segmental paving materials, including bedding sand or crusher dust and joint filling sand. These details ~~shall~~ must be submitted to the Superintendent for approval supported with test results from a nominated NATA registered laboratory, confirming that the constituents comply with the requirements of this sub-section.

(b) No pavers ~~shall~~ may be delivered until the Superintendent has approved the type and quality of the pavers and noted the source of supply as compliant to the requirements of this sub-section.

(c) All pavers ~~shall~~ must have suitable “slip resistance” for pedestrian traffic and vehicular traffic with a classification “W” according to AS/NZS 4586 for the Wet Pendulum Test. Where specific localities or levels of usage require a higher slip resistance classification, this classification ~~shall~~ must be indicated on the drawings. Such approval ~~shall~~ does not relieve the Contractor of any responsibility for supplying materials that comply with this sub-section.

(2) Concrete segmental pavers

(a) Concrete segmental pavers ~~shall~~ must comply with the requirements of relevant Concrete Masonry Association of Australia Specifications and AS/NZS ~~-~~ 4455 for each area of application.

(b) The material requirements for concrete pavers for each application, derived from CMAA MA57-2010 *Concrete segmental and flag pavements - guide to specifying*, are shown in Table SC6.4.6.18.1.

Table SC6.4.6.18.1 Material requirements for concrete segmental pavers

Pavement application		Minimum characteristic breaking load *kN	Work size minimum thickness mm	Dimensional deviation category (See Table SC6.4.6.18.3)	Maximum abrasion resistance (mean abrasion index) †		
Relevant Australian Standard		AS/NZS 4455.2 AS/NZS 4456.5	AS/NZS 4455.2	AS/NZS 4455.2 AS/NZS 4456.3	AS/NZS 4455.2 AS/NZS 4456.9		
Residential	Pedestrians only (eg paths, patios and outdoor areas)	2	40	DP0	§		
	Pedestrian and light vehicles only (eg driveways, parking spaces and the like)	3	40	DPB1	§		
	Pedestrian and commercial vehicles	5	60	DPB1	§		
					Pedestrian traffic volume		
					Low	Medium	High
Public space	Pedestrian only**	2	40	DPB1	7‡	5.5	3.5
	Pedestrian and light vehicles only	3	50	DPB2	7‡	5.5	3.5
	Pedestrian and commercial vehicles	5	60	DPB2	7‡	5.5	3.5
Trafficked segmental pavers	Minor and residential	6	60	DPB2	NA		
	Local access	6	60	DPB2	NA		
	Collector M	6	76	DPB2	NA		
Industrial	M	10	80	DPB2 or DPB3	7		

(Source: CMAA MA57-2010 *Concrete segmental and flag pavements - guide to specifying* - Table 1: Minimum Requirements for Dimensions, Breaking Load and Abrasion Resistance)

Note—

* At 28 days

† At 90 days

** where cleaning of pavers and flags is undertaken by mechanical means or where prevention of vehicle entry cannot be guaranteed, the minimum recommended pavers and flags are the 'Pedestrian and light vehicles only' for such pavement applications.

§ No abrasion criteria are specified for residential pavers. Abrasion resistance requirements for aesthetic or other purposes ~~shall~~ must be specified to the supplier/manufacturer.

NA Not applicable.

* Shape Type A pavers – dentated pavers that key into each other and by their plan generally interlock and resist relative movement of joints parallel to both the longitudinal and transverse axes of the pavers.
Examples of Type A shapes

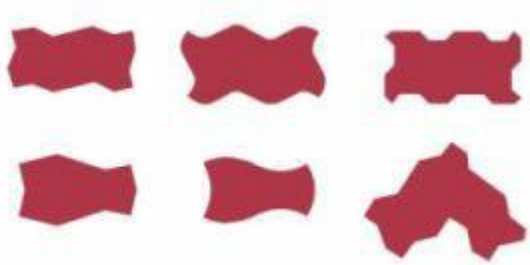


Table SC6.4.6.18.2 Maximum dimensional deviations determined by individual measurement

Category	Work Size dimensions, mm			
	Plan		Height	
	Standard deviation	Mean	Standard deviation	Mean
DP0	No requirement			
DPB1	2.0	± 3.0	3.0	± 2.5
DPB2	2.0	± 2.5	3.0	± 2.0
DPB3	Values declared by the supplier or by agreement between supplier and purchaser			
DPB4	1.5	± 2.0	2.0	± 2.0

Source: CMAA MA57-2010 Concrete segmental and flag pavements - guide to specifying - Table 2: Maximum Dimensional Deviations Determined for Pavers and Flags by Individual Measurement)

Note—all paving units will be categorised in accordance with AS/NZS 4455.3 Method for Determining Dimensions.

(3) Clay segmental pavers
Clay segmental pavers ~~shall~~ must comply with the requirements of CBPI Manual 1:, *Clay paving design and construction* (chapter 3, Specifying clay pavers), and with the requirements of AS/NZS 4455.

(4)
Bedding sand or crusher dust

(a) The bedding material ~~shall~~ must be well-graded, consisting of clean, hard, uncoated grains uniform in quality, generally passing a 4.75 mm sieve. The bedding material ~~shall~~ must be from a single source or blended to achieve, when tested in accordance with AS 1141.11, the following grading:

AS Sieve	**% Passing**
9.52mm	**100**
4.75	**95 - 100**
2.36	**80 - 100**

1.18	**50 - 85**
600µm	**25 - 60**
300	**10 - 30**
150	**5 - 15**
75	**0 - 10**

(b) The material ~~shall~~ must be of uniform moisture content when spread. It ~~shall~~ must be covered when stored on site to protect it from rain penetration.

(c) The bedding material ~~shall~~ must be free of deleterious soluble salts or other contaminants which may cause, or contribute to, efflorescence.

(5) Joint filling sand

(a) The joint filling sand ~~shall~~ must be well graded passing a 2.36 mm sieve, and when tested in accordance with AS 1141.11, having the following grading:

AS Sieve	**% Passing**
2.36mm	**100**
1.18	**90 - 100**
600µm	**60 - 90**
300	**30 - 60**
150	**15 - 30**
75	**5 - 10**

(b) The sand ~~shall~~ must be dry when spread. It ~~shall~~ must be covered when stored on site to protect it from rain penetration.

(c) The sand ~~shall~~ must be free of deleterious soluble salts or other

(d) contaminants. Material used for bedding is not suitable for joint filling.

(6) Concrete for edge restraints

(a) Concrete supplied and placed for the construction of edge strips ~~shall~~ must comply with sub-section SC6.4.6.28 Minor concrete works.

(b) Unless otherwise indicated on the drawings, or where the edge restraint is provided by kerb and/or gutter, the concrete used for edge restraints ~~shall~~ must have a minimum 28 day characteristic compressive strength of 32 MPa for edge restraints to pavers on road pavements and 25 MPa for edge restraints to pavers on footpaths, cycleways, medians and driveways.

SC6.4.6.18.3 Construction

(1) Subgrade preparation

(a) The subgrade ~~shall~~ must be formed to the required depth below finished surface level as shown on the drawings in accordance with SC6.4.6.10 Earthworks (construction).

(b) The finished subgrade foundation for the provision of subbase and/or base ~~shall be~~is subject to the approval of the Superintendent.

(2) Subbase

(a) As shown on the drawings, a subbase or working platform ~~shall~~ must be constructed in accordance with SC6.4.6.14.10 Subgrade Beams.

(b) The subbase ~~shall~~ must be constructed to the specified thickness, compaction and depth below finished surface level and to the design grade and crossfalls of the finished surface.

(c) The finished subbase ~~shall be~~is subject to the approval of the Superintendent.

(3) Base

(a) The base ~~shall~~ must be constructed to the specified thickness and depth below finished surface level, and to the design grade and crossfalls of the finished surface, as shown on the drawings in accordance with sub-section SC6.4.6.12 Flexible pavements.

(b) The base course ~~shall~~ must extend in width to at least the rear face of all new edge restraints.

(c) Notwithstanding the finished level tolerances contained within sub-section SC6.4.6.12 Flexible pavements for base of ±10 mm of design levels, the level on the finished surface of the base course for road pavements to be overlain with segmental paving ~~shall~~ must be trimmed to within + 10 mm or – 0 mm of design levels. The deviation from a 3 m long straight edge placed anywhere and laid in any direction on the top surface of the base course for all segmental paving ~~shall~~ must not exceed 10 mm. Bedding material ~~shall~~ must not be used as a levelling material to compensate for base finishing outside the above tolerances.

(d) The finished surface of the base ~~shall~~ must drain freely without ponding.

(e) The finished base ~~shall be~~is subject to the approval of the Superintendent.

(4) Edge restraints

(a) Edge restraints in the form of kerb and/or gutter or edge strips ~~shall~~ must be constructed along the perimeter of all segmental paving as shown on the drawings. Concrete kerb and/or gutter and edge strips ~~shall~~ must be constructed in accordance with sub-section SC6.4.6.9 Open drains and SC6.4.6.28 Minor concrete works.

(b) Faces of edge restraints abutting pavers ~~shall~~ must be vertical.

(c) Edge restraints ~~shall~~ must be supported on compacted base and/or subbase of the thickness as shown on the drawings. Where not otherwise specified or indicated, the minimum thickness of compacted base beneath the edge restraints ~~shall~~ must be 100 mm adjacent to road pavements and medians, and 50 mm adjacent to footpaths, cycleways and driveways.

(d) Unless otherwise shown on the drawings, contraction joints, 20 mm depth ~~shall~~ must be formed every 5 m of edge restraint length.

(e) After the concrete has hardened and not earlier than 3 days after placing, unless otherwise directed by the Superintendent the spaces at the back of the edge restraint ~~shall~~ must be backfilled with earth, compacted in layers not greater than 150 mm thick, then topsoiled to meet surrounding design levels.

(5) Bedding

(a) The bedding course ~~shall~~ must be spread in a single uniform layer and screeded in a loose condition to the nominated design profile and level. The bedding course ~~shall~~ must be laid such that a uniformly thick nominal 20-25 mm layer is achieved following final compaction of the segmental paving.

(b) Any depressions in the screeding material exceeding 5 mm ~~shall~~ must be loosened, raked and rescreeded before laying pavers.

(c) For the manual placing of paving units, the bedding material ~~shall~~ must be maintained at a uniform loose density. For mechanised laying, the bedding material ~~shall~~ must be uniformly and firmly, but not fully, compacted.

(d) Screeded material left overnight of subject to rain ~~shall~~ must be checked for level and rescreeded where necessary before pavers are placed. The material ~~shall~~ must not be screeded more than 2 m in advance of the laying face at the completion of work on any day.

(6) Laying pavers

(a) Pavers ~~shall~~ must be uniformly placed on the screeded bedding to the nominated laying pattern. Pavers ~~shall~~ must be placed so that they are not in direct contact with each other and ~~shall~~ must have uniform 3 mm nominal joint widths. The pavers ~~shall~~ must be mixed between various pallets to ensure that any colour variation from one pallet of pavers to the next is evenly distributed over the entire paved area.

(b) The first row ~~shall~~ must be located next to an edge restraint or an established straight line, and laid at a suitable angle to achieve the required orientation of pavers in the completed pavement.

(c) In each row, full units ~~shall~~ must be laid first. Edge or closer units ~~shall~~ must be neatly cut using a paver scour, or

mechanical or hydraulic guillotine, and fitted subsequently. Cut pieces of pavers which are smaller in size than one quarter of a full block ~~shall~~ must not be used.

(d) Access chambers, drainage gullies and similar penetrations through the pavement ~~shall~~ must be finished against the paving with a concrete surround or apron designed to suit and fit the laying pattern, otherwise complying with the requirements for edge restraints.

(e) Where pavers are placed over an isolation, contraction or expansion joint in an underlying concrete pavement, a joint ~~is to~~must be provided in the pavers. The joint ~~shall~~ must consist of 10 mm thick preformed jointing material of bituminous fibreboard.

(f) Any foot or barrow traffic ~~shall~~ must use boards overlaying paving to prevent disturbance of units prior to compaction. No other construction traffic ~~shall be~~is allowed on the pavement prior to compaction and provision of joint filling sand.

(g) On completion of subsequent bedding compaction and joint filling operations, all joints ~~shall~~ must have widths within the range 2-4 mm.

(7) Bedding compaction

(a) After laying the pavers the bedding ~~shall~~ must be fully compacted and the surface brought to design levels and surface profiles by not less than two passes of a high frequency low amplitude plate compactor which covers at least 12 units. Compaction ~~shall~~ must continue until all pavers form a smooth surface with adjacent paver edges matching. The level difference between adjoining edges of any two pavers ~~shall~~ must be a maximum of 2 mm, to avoid trip hazards, unless approved otherwise by the Superintendent for rough textured pavers.

(b) Any units which are structurally damaged during bedding compaction ~~shall~~ must be removed and replaced. The pavement ~~shall~~ must then be recompacted for at least 1 m~~etre~~ surrounding each replacement unit.

(c) The paving operations ~~shall~~ must be arranged so that the use of the plate compactor proceeds progressively behind the laying face without undue delay, and such that compaction is completed prior to cessation of construction activity on any day. Compaction ~~shall~~ must not be attempted within 1 m~~etre~~ of the laying face except on completion of the pavement against an edge restraint.

(d) The finished surface level ~~shall~~ must not vary from the design level at any point laid in any direction, by more than 6 mm for all areas with Class 4 segmental pavements and 8 mm for all other areas of segmental paving. Notwithstanding this, the finished surface of the segmental paving, including where the paving abuts an edge restraint other than a drainage inlet, ~~shall~~ must not deviate from the bottom of a 3 m straight edge laid in any direction, except at grade changes, by more than 6mm for road pavements and 8 mm for all other areas of segmental paving.

(e) The channels formed between abutting chamfered units ~~shall~~ must finish with their inverts not less than 5 mm nor more than 10 mm above adjacent drainage inlets.

(f) All compaction ~~shall~~ must be complete and the pavement ~~shall~~ must be brought to design profiles before spreading or placing sand filling in the joints.

(8) Filling joints

(a) As soon as practicable after bedding compaction, and in any case prior to termination of work on any day, dry sand for joint filling ~~shall~~ must be spread over the pavement and the joints filled by brooming.

(b) To ensure complete filling of the joints, both the filling sand and pavers ~~shall~~ must be as dry as practicable when sand is spread and broomed into the joints.

(c) The pavement ~~shall~~ must then receive one or more passes of a plate compactor and the joints then refilled with sand, with the process then repeated sufficiently to ensure that the joints are completely filled.

(9) Protection of work

Other than wheeled trolleys, forklifts and cluster-clamp vehicles, construction and other traffic ~~shall~~ may not use the pavement until bedding compaction and joint filling operations have been completed.

(10) Opening to traffic

(a) As soon as practicable after the filling of joints, construction vehicles may use the pavement, and should be encouraged to traverse the greatest possible area of pavement to assist in the development of “lock-up”.

(b) Excess joint filling sand ~~shall~~ must be removed prior to opening to traffic.

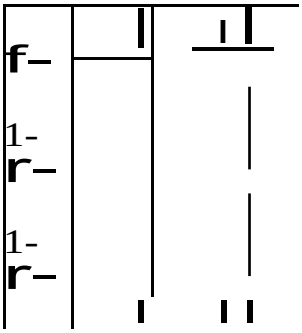
(c) The pavement ~~shall~~ must then be inspected by the Contractor at regular intervals up until the expiration of the defects liability period to ensure that all joints remain completely filled.

SC6.4.6.18.4 Limits and tolerances

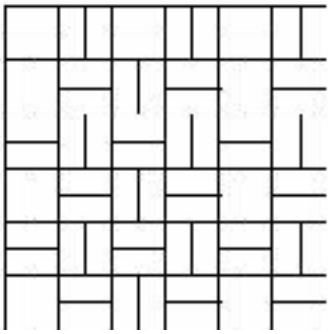
The limits and tolerances applicable to the various clauses in this Specification are summarised in Table SC6.4.6.18.3 below:

Table SC6.4.6.18.3 Summary of limits and tolerances

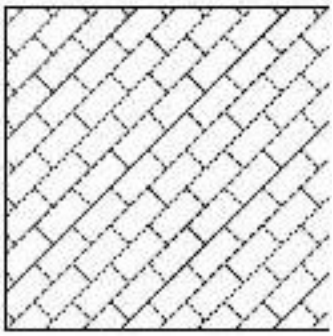
Item	Activity	Limits/Tolerances	Clause
1.	**Base**		
	(a) Surface Level	Finished level of base for road pavements to be within +10mm or -0mm of design levels.	SC6.4.6.18.3(3)
		Finished level of base other than for road pavements, to be within ±10mm of design levels.	SC6.4.6.18.3(3)
		The top surface of the base for all segmental paving ~~shall~~ must not deviate from a 3m straight edge, laid in any direction, by more than 10mm.	SC6.4.6.18.3(3)
2.	**Laying Paving Units**		
	(a) Joint widths	Within the range 2 -4mm.	SC6.4.6.18.3(6)
3.	**Completed Segmental Paving**		
	(a) Surface level	Finished surface level of pavers ~~shall~~ must not vary from design levels by more than ±6mm for road pavements and ±8mm for other than road pavements.	SC6.4.6.18.3(7)
		Finished surface of pavers ~~shall~~ must not deviate from a 3m straight edge, laid in any direction, by more than 6mm for road pavements and 8mm for other than road pavements.	SC6.4.6.18.3(7)
	(b) Level adjacent to drainage inlets	between abutting chamfered units ~~shall~~ must be not less than 5mm and not more than 10mm above the level of adjacent drainage inlets.	SC6.4.6.18.3(7)
	(c) Difference in level of adjacent pavers	≤2mm	SC6.4.6.18.3(7)



Herringbone



Basketweave



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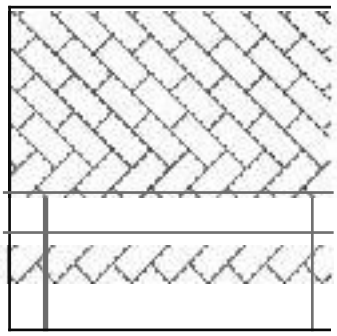


Zig Zag Running Bond

SC6.4.6.19 Stabilisation

SC6.4.6.19.1 Introduction

(1) Scope

This sub-section identifies the materials requirements for stabilised materials provided by stationary plant production as well as materials and process requirements for in-situ stabilisation.

The work to be executed under this sub-section consists of the supply and incorporation of stabilising binders with material in a nominated pavement course or subgrade layer (including materials for the selected material zone, and selected backfill), at specified locations in the work and the spreading, compaction, trimming and curing of such materials.

This sub-section provides the requirements for stabilisation of the types of pavement courses and subgrade zones or layers as shown in Table SC6.4.6.19.1.

Table SC6.4.6.19.1 Types of pavement courses, subgrade zones or layers and stabilising binder

Pavement Course Or Subgrade Zone Or Layer	Stabilising Binder
PAVEMENT COURSE	
Base and Subbase	Cement Blended Stabilising Agent Hydrated Lime (pugmill) Quicklime (in-situ) Foam bitumen (MRTS07C)
SUBGRADE ZONE OR LAYER	
Selected Material Zone	Cement Blended Stabilising Agent Quicklime (in-situ) Hydrated Lime (pugmill)
Other Subgrade Layers	Cement Blended Stabilising Agent Quicklime (in-situ) Hydrated Lime (pugmill)
Selected Backfill Zone	Cement Hydrated Lime (pugmill)

The pavement course or subgrade zone or layer to be stabilised shall be as specified in sub section SC6.4.6.12 Flexible pavements, or as indicated on the drawings.
Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) The Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section one as follows:

SC6.4.6.4 Stormwater drainage
SC6.4.6.10 – Earthworks (construction)
SC6.4.6.12 - Flexible pavements
SC6.4.6.30 - Control of traffic

(b) Australian Standards

AS 1141.11.1	*Particle size distribution – Sieving method*
AS 1289	*Methods of testing soils for engineering purposes*
AS 1289.5.7.1	*Compaction control test – Hilf density ratio and Hilf moisture variation (rapid method)*
AS 1289.5.8.1	*Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge - Direct transmission mode*

AS 1289.4.2.1	*Determination of the sulphate content of a natural soil and the sulphate content of the ground water - Normal method*
AS 1289.6.1.1	*Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen*
AS 2350.4	*Methods of testing portland, blended and masonry cements -Setting time*
AS 2350.9	*Methods of testing portland, blended and masonry cements - Determination of residue on the 45 micrometre sieve*
AS 3582.1	*Fly ash*
AS 3582.2	*Slag - Ground granulated iron blast-furnace*
AS 3583.3	*Determination of loss on ignition*
AS 3583.6	*Determination of relative water requirement and relative strength*
AS 3583.12	*Determination of available alkali*
AS 3583.13	*Determination of chloride ion content*
AS 3583.14	*Determination of insoluble residue content*
AS 3972	*General purpose and blended cements*
AS 4489.6.1	*Test methods for limes and limestones – Lime index - Available lime*
AS 5101.4	*Methods for preparation and testing of stabilized materials – Unconfined compressive strength of compacted materials*

(c) Other publications

Austroads

Guide to pavement technology Part 4D - Stabilised materials, AGPT04D-06.

The Glossary of Austroads Terms, AP-C87-10

NSW Roads and Maritime Services Test Methods

Test method T432: Rate of slaking of quicklime, 2012

SC6.4.6.19.2 Inspection, sampling and testing

(1) Pre-construction compliance

The Contractor shall provide a certificate from a laboratory with appropriate NATA registration stating that the stabilisation mix(es) submitted and the mix constituents comply with the mix nominated in approved stabilisation mix design approved as part of the pavement design and that the stabilised material meets the requirements of sub section SC6.4.6.12 Flexible pavements if incorporated into the works as a pavement layer or alternatively SC6.4.6.10 Earthworks (construction) or SC6.4.6.4 Stormwater drainage.

(2) Construction compliance

Regular inspection, sampling and testing of pavement and subgrade materials shall be undertaken by the Contractor while stabilisation is in progress in accordance with this sub section.

SC6.4.6.19.3 Materials

(1) Unsuitable materials and shape correction

These shall be with unbound gravel of Type 1, Type 2, Type 3 or Type 4 in accordance with SC6.4.6.10 and SC6.4.6.12 New material shall not have a water soluble sulphate content exceeding 1.9 grams of sulphate per litre.

(2) Cement and stablising agent

The type of cement used as the stabilising agent or a constituent in a blended stabilising agent shall comply with AS 3972.

~~Cement shall be from a source approved under the Queensland Government's State Purchasing Policy at time of production.~~

Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any time.

If the Contractor proposes to use cement which has been stored for a period in excess of 3 months from the time of manufacture, the Contractor shall arrange a re-test, to ensure the cement still complies with AS3972, before the cement is used in the work. Test results shall be forwarded to the Superintendent for approval at least 2 days in advance of usage of the material.

The Contractor shall order gravel material with the cement content required to achieve the designed unconfined compressive strength (UCS) of the pavement. It is the Contractor's responsibility to ensure the material being used achieves the required UCS.

(3) Quicklime stabilising agent

Quicklime, consisting essentially of calcium oxide in a highly reactive form, shall have the following properties at the point of spread:

(a) available lime - the content of calcium oxide, determined by AS 4489.6.1, shall not be less than 85% ~~per cent~~. Unless otherwise specified, the spread rate for quick lime shall be 20 kg/m^3; and

(b) slaking rate - the active slaking time shall not be greater than 20 minutes and the temperature rise on slaking, determined from the average of four samples tested in accordance with Test Method T432, shall not be less than 40°C in 6 minutes.

The particle size distribution of the quick lime determined by AS 1141.11 shall comply with the following requirements in Table SC6.4.6.19.2.

Table SC6.4.6.19.2 Particle size distribution of quicklime

AS Sieve	Per Cent Passing
13.2mm	100
9.5mm	96 - 100
4.75mm	70 - 100
2.36mm	0 - 90

~~(4)~~ 1. Hydrated lime stabilising agent

(a) Hydrated lime, consisting essentially of calcium hydroxide, whether used as the sole stabilising agent or blended with other additives, shall have the following properties:

(i) available lime - the content of calcium hydroxide, determined by AS 3583.12, shall not be less than 80% ~~per cent~~;

(ii) form - the material shall be in a dry powder form; and

(iii) residue on sieving - the residue on a 300 micron sieve, determined by (Particle Size) AS 3583.14, shall not exceed ~~2~~ 2% ~~per cent~~.

(b) The properties which characterise the particular hydrated lime to be used in the stabilising agent submitted as part of the mix design are:

(i) percentage of calcium hydroxide;

(ii) fineness percentage by mass passing the 45 micron sieve (AS 2350.9); and

(iii) source.

(5) Ground granulated blast furnace slag stabilising agent

The ground granulated blast furnace slag shall conform to AS3582.2.

The properties which characterise the particular ground blast furnace slag to be used in the stabilising agent submitted as part of the mix design are:

(a) fineness percentage by mass passing the 45 micron sieve (AS 2350.9);

(b) relative strength (28 days) (AS 3583.6); and

(c) source.

(6) Flyash stabilising agent

Flyash shall conform to AS 3582.1.

The properties which characterise the particular flyash to be used in the stabilising agent submitted as part of the mix design are:

(a) fineness - percentage by mass passing the 45 micron sieve (AS 2350.9);

(b) loss on ignition (AS 3583.3); and

(c) source.

(7) Blended stabilising agents

The Contractor may utilise a blended stabilising agent. The Contractor shall obtain mill and batch information which will make the blended stabilising agent traceable to the supplier's test results.

Handling and storage requirements of the Supplier shall be complied with by the Contractor who shall also arrange for sampling of the agent as required by the Superintendent.

The mass of components of the nominated blended stabilising agent shall not vary by more than ± 3% ~~per cent~~ from the blend percentages nominated in the mix design described in approved stabilisation mix design.

When a blended stabilising agent is produced from a combined grinding of components the following properties will characterise the particular stabilising agent blend:

(a) source of each component;

(b) fineness percentage by mass passing the 45 micron sieve (AS 2350.9); and

(c) setting time (AS2350.4).

(8) Water (for curing)

Water shall be free from harmful amounts of materials such as oils, salts, acids, alkalis and vegetable substances. The water shall not contain more than:

(a) 600 parts per million of chloride ion, determined by AS 3583.13;

(b) 400 parts per million of sulphate ion, determined by AS 1289.4.2.1; and

(c) 1% ~~per cent~~ by mass of undissolved solids.

Water accepted as potable and fit for human consumption will not require testing to confirm suitability.

(9)

Foam bitumen

In accordance with MRTS07C.

SC6.4.6.19.4 Stabilisation processes

(1) General

The Contractor shall submit details of the proposed equipment (including the mixing plant) and stabilisation procedures to be used in the work 14 days prior to commencement of the work. This submission, hereafter called the work plan, is to include the following:

(a) the sequence of operations;

(b) widths of stabilisation passes;

(c) provision for traffic if appropriate;

(d) comply with statutory requirements for WHS;

(e) testing methods and frequency;

(f) comply with this specification;

(g) survey control methods; and

(h) curing methods.

Notwithstanding submission to the Superintendent of the Contractor's equipment and stabilisation procedures, the work shall meet all the sub-section requirements, and statutory requirements for work health and safety, and the Contractor shall perform such tests as specified as the work proceeds, to ensure compliance.

Stabilisation of pavement materials shall not proceed during wet weather or if rain is imminent and likely to occur during any stage of the stabilisation process so as to significantly influence the resultant moisture content and uniformity of moisture content in the mix.

(2) Application of stabilising agent

(a) Stationary mixing plant

Application rate of stabilising agent shall be monitored at the pug mill or equivalent plant utilised as approved by the Superintendent.

Application rate measured in kg/t~~ilograms per tonne~~ of product shall be monitored and recorded for every 100 t~~onnes~~ of production.

The achieved accuracy of application rate shall be ±10% ~~per cent~~ of the nominated rate nominated in approved pavement design's stabilisation mix design.

The application rate shall not be allowed to exceed the nominated rate by more than 10% ~~per cent~~.

(b) In-situ

For environmental reasons in urban areas the incorporation of stabilising agent is to be a closed system process where stabilising agent is added and mixed into the pavement within the bowl of the specialist mixing equipment.

Where approved in rural areas spreading shall be carried out using the mechanical spreader nominated in the work plan and subsequently approved by the Superintendent. The approved pavement design's stabilisation mix design nominates the spread rate.

The actual spread rate shall be within ±10% ~~per cent~~ of the nominated rate. The Contractor shall verify this by testing the spread rate for each lot or 500m^2 of pavement treated (whichever is less) in each application of binder. Spread rate testing shall be performed by weighing the contents of a suitable four sided tray placed on the pavement and between the wheels of the closed system stabiliser. The rate of stabilising agent spread shall be calculated by dividing the mass collected (kg) by the area of the tray (m^2).

Where spreading/stabilising vehicles are fitted with load cells, the Contractor shall ascertain the average spreading rate of the stabilising agent by dividing the mass of the stabilising agent spread per run by the area of the run. The Contractor shall record this data for each run and make it available to the Superintendent promptly. Such action will not cancel the Contractor's obligation to undertake prescribed testing of spread rate if required by the Superintendent.

Spreading shall not proceed during windy conditions which may cause loss of stabilising agent or cause nuisance or danger to people or property. Where open spreading is approved.

Traffic or equipment not involved in spreading or mixing of the stabilising agent shall not pass over the spread material until it has been mixed into the layer to be stabilised. Where open spreading is approved.

Any spillage of the stabilising agent on site or at any loading location related to the site shall be removed as soon as possible and within the same work shift of such spillage.

(3) Mixing

(a) Stationary mixing plant

The stationary mixing plant shall be purpose built for the process of mixing road making materials. All equipment shall be maintained and calibrated so as to provide a uniformly mixed product without segregation of the aggregate material.

The plant shall provide for the controlled and metered inclusion of water into the mix.

The stationary mixing equipment shall incorporate a delivery system for mix materials capable of producing a uniform mixture to design requirements. This performance shall be confirmed by monitoring of unconfined compressive strength of production, in accordance with AS 1289.6.1.1, with a pair of test specimens tested for each 100 tonnes of production.

(b) In-situ

Mixing equipment shall be purpose built for the process of in-situ mixing of road making materials. It shall be capable of mixing to the depth specified for the layer to be stabilised and of distributing the stabilising agent uniformly through the full depth and over the whole area of the layer to be stabilised. Where directed a minimum of two passes of the mixing equipment is required. As mixing blades or tynes wear they shall be replaced so as to maintain mixing efficiency consistent with that demonstrated during the trial section. The mixing equipment will be capable of supplying a calibrated amount of water to the mixing bowl in such a manner as to provide a uniformly moist mix to a target moisture content.

The resultant mix shall be uniform over the full depth so that there are no lenses, pockets, lumps or granules of stabilising agent present in the layer or adjacent to it.

The procedure nominated in the Work Plan shall minimise disturbance of the distribution of stabilising agent spread in advance of the mixing process.

The Contractor shall carry out visual inspections during mixing to ensure uniform mixing is being achieved in the layer. Inspection results shall be recorded as cited in SC6.4.5 Construction management.

The Superintendent may require that additional passes by the mixing equipment be carried out to improve the visual uniformity of the mix and/or the moisture content.

(c) Paving equipment
For plant-mixed stabilising pavements, the mixture shall be placed by self-propelled paving machine purpose built for this work and with the capacity to place and spread the mixture in one pass at the required uncompacted thickness, width and shape. Other methods of paving may be considered by council where the use of a self-propelled paving machine is impractical.

(4) Field working period (allowable working time)
The time period from addition of water during the mixing process until the completion of compaction is nominated as the field working period.

The nominated field working period shall be provided in Stabilisation Mix Design for the stabilising agent approved as part of the pavement design. The Nominated field working period shall be based on laboratory tests determining the time from mixing until such time as the calculated Wet Density for standard compaction procedures decreases by more than 2 percentage points. This testing shall be undertaken utilising AS 1289.5.1.1 and samples of the materials representative of those to be utilised in the works. If the field working period is not specified as part of the pavement design, the maximum period between the commencement of mixing and the completion of compaction and trimming shall be 3 hours.

The Contractor will complete the compaction process within the Nominated field working period unless specific approval is provided by the Superintendent to an adjustment for site and seasonal conditions.

(5) Trimming and compaction
After mixing the layer shall be trimmed and compacted in accordance with sub-section SC6.4.6.12 Flexible pavements to produce a tight dense surface parallel with the finished wearing surface so that the levels do not vary from the design levels beyond the tolerance for primary trimming specified in clause SC6.4.6.19.4(7)(a) Levels and surface trim.

Subsequent secondary trimming may be undertaken on one or more occasions in preparation for primer seal and with the objective of meeting shape and level requirements. Secondary trimming shall involve cutting to waste. Work methods that lead to the development of laminations in the pavement will not be allowed and surface slurrying will not be accepted. The Contractor's survey control methods as stated in the work plan will be adequate to ensure that the pavement layer thickness is not reduced during secondary trimming to an extent such that it fails to comply with the requirement for layer thickness in accordance with the tolerance specified in clause SC6.4.6.19.4(7)(b) Layer thickness. When required by the Superintendent survey results shall be provided to confirm that the pavement layer thickness remains within tolerance after secondary trimming.

Measurements with a 3-m straight edge shall be taken at a minimum of ten randomly selected stations so as to represent each 200-m lane length or part thereof. Deviation of the surface from the bottom of a 3-m straight edge placed in any direction will meet the tolerance shown in clause SC6.4.6.19.4(7)(a). This testing will be undertaken immediately prior to sealing or prior to agreed practical completion for any work component.

The stabilised layer shall be compacted over the entire area and depth so that the relative compaction determined by AS 1289.5.1.1 is not less than as detailed in sub-sections SC6.4.6.12 Flexible pavements, SC6.4.6.10 Earthworks (construction) or SC6.4.6.4 Stormwater drainage as appropriate.

To provide true relative compaction assessments the lots shall be sampled and tested within the nominated field working period in accordance with AS-1289.5.1.1.

The maximum wet density (standard compaction) will be determined by sampling immediately after the determination of field density and testing will be undertaken within 2 hours of sampling. A determination of maximum wet density (standard compaction) representing the full layer depth is required for each sampling location when calculation of relative compaction is undertaken.

The field density may be determined by in situ sand replacement testing or by single probe Nuclear Density Meter in direct transmission mode in accordance with AS-1289.5.8.1.

(6) Joints

Joints are defined in this sub-section to comprise interfaces between work episodes that are separated in time by more than the nominal field working period for the nominated stabilisation mix design. A longitudinal joint shall be considered to be a joint generally parallel to the road centreline. A transverse joint occurs when a length of work is terminated and extended at a later time after a period which exceeds the nominated field working period.

All longitudinal and transverse joints shall be formed by cutting back into the previously stabilised and fully compacted sections. A minimum longitudinal overlap of mixing runs shall be 75-mm. Transverse joints shall be overlapped by a minimum of 2-m. The material disturbed during cutting back shall be remixed at full depth and incorporated into the new work. No longitudinal joints shall be allowed within 500-mm of the centreline of a typical wheelpath.

The level and shape of the joints shall be within the limits specified in clause SC6.4.6.19.4(7) Tolerances.

(7) Tolerances

(a) Levels and surface trim

The surface level after primary trimming shall be within a tolerance of +30-mm and +10-mm of the levels shown on the drawings.

The surface level after secondary trimming shall be within a tolerance of +15-mm and -15-mm of the levels shown on the drawings.

The pavement surface after secondary trimming and immediately prior to sealing shall be of a quality such that deviation under a 3-m~~etre~~ straight edge does not exceed 12-mm.

Ensure the final surface level is within ±-15-mm of the design levels in the event only a single trim is carried out.

(b) Layer thickness

The final thickness of the stabilised layer at any point shall be within a tolerance of +20-mm and -10-mm of the nominated layer thickness.

The average thickness of the layer in a lot shall be determined from measurements of six randomly selected locations over any 200-m length of a lot. The average thickness shall not be less than that required to meet the specified final thickness tolerances after trimming.

The layer thickness shall be measured at the edges of the stabilising run ~~before~~ after compaction commences. The layer thickness shall be measured relative to the finished design level.

(c) Width

The width measured at any point of the stabilised layer shall be not less than the specified width as shown in the drawings by more than 50 mm.

The average width of the layer shall be determined from measurements at three sites selected at random by the Superintendent over any 200 m length of a lot and shall be not less than the specified width.

(8) Curing

The Contractor shall submit to the Superintendent details of the proposed method of curing as part of the Work Plan.

The stabilised work shall be protected against rapid drying out by keeping it continuously wet or damp during the period prior to the provision of a subsequent layer or the application of a prime or primer-seal.

Water curing shall consist of frequent light uniform spraying (using fine spray jets) that will not produce significant run off or flooding on sections of the area. Conventional spray bars and high pressure nozzles are not permitted. Slurrying of the surface or leaching of the stabilising agent shall be avoided.

Under this sub-section provision for curing up to the period indicated in the approved Stabilisation Mix Design shall be the responsibility of the Contractor.

(9)

Trial section of stabilised earthworks

Prior to the commencement of works submit a trial section of stabilised earthworks to demonstrate the methods proposed to conform with this sub-section.

This trial section is constructed so that it may be incorporated in the finished work with a length of approximately 50 m.

Construct the trial stabilisation using the materials, equipment and methods for placing and finishing the same as would be used for the entire ~~base~~ stabilisation works. Demonstrate the methods proposed to be used for the construction of joints.

In the event of deficiencies in the stabilisation the trial section may not be approved. The method, equipment, materials and personnel will require to be reviewed and an explanation submitted. A further length of trial stabilisation may be requested. Non-conforming trial sections of stabilised earthworks must be removed to ensure ~~to~~ preventing damage to the remaining stabilised earthworks and underlying materials. Dispose of the removed materials at an approved location.

(10)

Insitu lime stabilisation of subgrade

Lime stabilisation of subgrade material shall be carried out as a two day operation to a minimum depth of 250mm, except for natural subgrades of CBR 0.5% where stabilisation depth shall be a minimum of 300mm. The stabilising agent shall be spread using a purpose built spreader and the stabilising agent and water shall be incorporated into the material using a reclaimer/stabiliser. Alternatively, a reclaimer/stabiliser with a calibrated integrated spreader/applicator may be used to incorporate the stabilising agent and water directly into the material to be stabilised. Where a reclaimer/stabiliser with calibrated integrated spreader/applicator is used, quicklime shall not be used as the stabilising agent.

Day 1: a single lime pass at a rate of up to half the required rate shall be applied. Where quicklime is spread over the subgrade, it shall be slaked in accordance with the requirements in this document. In situations where hydrated lime is used, slaking is not required mixing the stabilising agent into the soil. The hydrated lime or lime slurry formed from the slaking of quicklime shall then be mixed into the material in accordance with the requirements in this document. The depth of mixing shall not exceed 90% of the specified stabilisation thickness. The material shall be lightly rolled to seal the surface prior to the completion of work on that particular day.

Day 2: after the overnight amelioration period, the balance of the required lime shall be spread in accordance with

the requirements in this document. Where quicklime is spread over the subgrade, it shall be slaked in accordance with the requirements in this document. In situations where hydrated lime is used, slaking is not required before mixing the stabilising agent into the soil. The hydrated lime or lime slurry formed from the slaking of quicklime shall then be mixed into the material in accordance with the requirements in this document. Notwithstanding this, a minimum of two mixing passes shall be completed.

Lime shall be spread at a maximum spread rate of 12kg/m^2. The number of passes shall be calculated to comply with this requirement. The stabilising agent shall be uniformly spread over the insitu material at a controlled rate (mass per unit area, kg/m^2). The total rate of spread shall be such that the stabilising agent spread rate for the compacted material is within the specified tolerances. Once the stabilising agent has been spread, no traffic, other than the construction plant employed for the stabilisation work, shall travel over it. After each spreading run at least one mixing run, and trimming and/or compaction as required, shall be completed. Further mixing operations between spreading runs shall comply with requirements in this document.

Quicklime shall be slaked with sufficient water to allow complete hydration such that the material remains friable after slaking and no further exothermic reaction occurs when further water is added to the lime. All through traffic shall be stopped during any slaking operation.

The entire stabilisation process shall not proceed in any of the following situations:

- during rainfall,
- when rainfall appears to be imminent,
- during periods when the wind is strong enough to cause particles of the stabilising agent to become airborne,
- during conditions that may results in the work causing nuisance or danger to people, property, the environment, or livestock,
- when the pavement temperature, measured 50mm below the surface drops below 10°C, and,
- when the air temperature, measured in the shade exceeds 40°C.

SC6.4.6.19.5 Limits and tolerances

The limits and tolerances applicable to the various clauses of this sub-section are summarised in Table SC6.4.6.19.3 Summary of limits and tolerances below.

Table SC6.4.6.19.3 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	Quicklime		
	a) Available Lime	>85% Calcium Oxide content	SC6.4.6.19.3(3) Quicklime
	b) Slaking Rate	Active Slaking time < 20 minutes, and temperature rise on slaking not less than 40ºC in 6 minutes (for an average of four samples).	SC6.4.6.19.3(3) Quicklime

Item	Activity	Limits/Tolerances	Clause
	c) Particle Distribution	Fraction passing AS Sieve: 100% for 13.2mm Sieve 96-100% for 9.5mm Sieve 70-100% for 4.75mm Sieve 0-90% for 2.36mm Sieve	SC6.4.6.19.3(3) Quicklime
2.	Hydrated Lime		
	a) Available Lime	>80% Calcium Hydroxide	SC6.4.6.19.3(4) Hydrated Lime
	b) Particle Size	<2% residue on a 300 micron Sieve	SC6.4.6.19.3(4) Hydrated Lime
3.	Blended Stabilising Agents	Blend percentages shall not vary by more than ±3% from those nominated in SC6.4.6.19 Attachment A (Stabilisation mix design)	SC6.4.6.19.3(7) Blended Stabilising Agents
4.	Water		
	a) Chloride ion content	<600 PPM Chloride ion	SC6.4.6.19.3(8) Water
	b) Sulphate ion content	<400 PPM Sulphate ion	SC6.4.6.19.3(8) Water
	c) Undissolved solids	<1% ~~per cent~~ by mass of undissolved solids	SC6.4.6.19.3(8) Water
5.	Application of Stabilising Agent		
	a) Spread Rate or Incorporation Rate for in-situ plant.	Actual spread rate shall be within ±10% of the nominated rate	SC6.4.6.19.4(2) Application of Stabilising Agent
6.	Trimming and Compaction		
	a) Surface Level	After primary trimming be within +30mm and +10mm of levels shown on drawings After secondary trimming be within ±15mm of levels shown on drawings	SC6.4.6.19.4(7)(a) Tolerances
	b) Layer Thickness	Final thickness of layers shall not vary more than +20mm and -10mm of required thickness	SC6.4.6.19.4(7)(b) Tolerances
	c) Shape	Shall not deviate more than 12mm under a 3m straight edge immediately prior to first sealing	SC6.4.6.19.4(7)(a) Tolerances
7.	Joints		
	a) Longitudinal Overlap	> 75mm overlap of mixing runs	SC6.4.6.19.4(6) Joints
	b) Transverse Overlap	> 2m overlap of transverse joints	SC6.4.6.19.4(6) Joints
	c) Longitudinal Joints	Shall not be allowed within 0.5m of the centreline of a typical wheelpath	SC6.4.6.19.4(6) Joints
8.	Width		
	a) Width of Stabilised Layer	At any point, the width shall be not less than 50mm short of the width shown on the drawings with an average width always greater than that shown on the drawings.	SC6.4.6.19.4(7)(c) Tolerances

Attachments

SC6.4.6.19 Attachment A: Stabilisation mix design

Click here to obtain a copy of the following form.

SC6.4.6.21 Sub-surface drainage

SC6.4.6.21.1 Introduction

(1) Introduction

This is the general specification common and applicable to all types of subsurface drainage and must be read in conjunction with subsurface drainage sub-sections:

(a) SC6.4.6.20 Subsoil, foundations and pavement drains; and

(b) SC6.4.6.8 Drainage mats.

(2) Scope

(a) The work to be executed under this sub-section consists of:

(i) preparation for subsurface drainage construction;

(ii) siting of subsurface drainage facilities;

(iii) the supply of all materials associated with the provision of the subsurface drainage system;

(iv) all activities and quality requirements associated with the supply, placement and compaction of filter material;

(v) the provision of a detailed record of all subsurface drain installations; and

(vi) the marking on the ground of the location of all subsurface drains.

(b) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

(3) Extent of work

Details of the work are to be shown on the approved drawings

(4) Temporary drainage during construction

(a) All drainage works carried out by the Contractor must provide measures of erosion and sedimentation in accordance with the requirements of the accepted project erosion and sediment control plan and/or *Best Practice Erosion and Sediment Control* and make adequate provision for runoff flows at drainage works under construction or at surrounding areas/structure

(b) The Contractor must make adequate provision 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 as a result of the Contractor's activities.

(c) The Contractor's material and equipment must be located clear of watercourses or secured so that they will not cause danger or damage in the event of large runoff flows.

(5) Siting of work

(a) Before commencing construction of any subsurface drainage activity, the Contractor must set out on site the position of the work to the location and levels shown on the drawings, and must present this set-out for inspection by the Superintendent.

(b) The Superintendent may amend the locations or designed levels or the lengths to suit actual site conditions. Should the Superintendent require a change to the conditions of installation an appropriate variation must be ordered.

(c) Should the Contractor propose changes to the location, length, designed levels, conditions of installation or cover to suit the Contractor’s construction procedures, the Contractor must present the proposed set-out in addition to the designed set-out for consideration by the Superintendent. No changes may be made unless the prior written approval of the Superintendent is obtained.

(6) Excavation

(a) In undertaking trench excavation the Contractor must provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

(b) Where public utilities exist in the vicinity of drainage works the Contractor must obtain the approval of the relevant authority/corporation to the method of excavation before commencing excavation.

(c) Excavation by blasting, if permitted, must be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed structure does not exceed 25mm/s. The Contractor must comply with other requirements concerning blasting operations in SC6.4.6.10 Earthworks (construction).

(d) Trenches must be excavated to the line, grade, width and depth shown on the drawings or as directed by the Superintendent. The bottom of the trench must be constructed so that no localised ponding can occur. All loose material must be removed by the Contractor.

(e) Any material at the bottom of the trench or at foundation level which the Superintendent deems to be unsuitable must be removed and disposed in accordance with SC6.4.6.10 Earthworks (construction) by the Contractor and replaced with backfill material in accordance with the requirements of this sub-section. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, must be parallel with the specified level or grade of the pipe.

(f) The excavated material may be used in the construction of embankments backfilling or spoiled in accordance with SC6.4.6.10 Earthworks (construction).

(7) Backfilling

Backfilling must be carried out in accordance with the requirements of the relevant subsurface drainage structures sub-sections.

(8) Outlet structures for subsurface drainage

(a) Subsurface drainage pipes must be connected to discharge into gully pits or to outlet structures as shown on the drawings or as directed by the Superintendent.

(b) Outlets must be spaced at a maximum interval of 150m.

(c) Outlets, including those discharging into gully pits, must be made rodent proof using galvanised wire netting unless otherwise indicated on the approved drawings.

(d) The outlet must be located so that erosion of the adjacent areas does not occur or must be protected by the placement of selected stone or similar treatment together with a marker post to indicate location and assist maintenance.

(e) Outlet pipes from curtain drains must be unslotted. At no point may an outlet pipe be higher than the pipe at the end of the curtain drain.

(f) All concrete used in the construction of outlet structures must conform to the requirements of sub-section SC6.4.6.28 Minor concrete works.

(9) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections

SC6.4.6.10 – Earthworks (construction)
SC6.4.6.28 - Minor concrete works

(b) Australian Standards

AS 1141.11.1	*Particle size distribution - Sieving method*
AS 1141.22	*Wet/dry strength variation*
AS 1289.5.5.1	*Determination of the minimum and maximum dry density of a cohesionless material – Standard method*
AS 1477	*PVC pipes and fittings for pressure applications*
AS 2439.1	*Perforated drainage pipe and associated fittings*
AS 2758.1	*Aggregates and rock for engineering purposes – Part 1: Concrete aggregates*
AS 3705	*Geotextiles - Identification, marking and general data*

AS 3706	*Geotextiles - Methods of test*
AS 3706.9	*Determination of permittivity, permeability and flow rate*
AS 3706.11	*Determination of durability - Resistance to degradation by light, heat and moisture*

(c) Other

Austroads, *Guide to Pavement Technology - Part 4G Geotextiles.*

ASTM International, ASTM-D2434-68 – *Standard test method for permeability of granular soils (Constant Head)*

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

SC6.4.6.21.2 Materials

(1) Corrugated plastic pipe

(a) Corrugated plastic pipe must be Class 1000 complying with AS2439.1 of 65mm or 100mm diameter as indicated on the drawings. All pipes must be slotted except where shown on the approved drawings.

(b) Joints, couplings, elbows, tees and caps must also comply with AS2439.1 and only the manufacturer's recommended fittings may be used.

(c) The Contractor must obtain from the Manufacturer a Test Certificate demonstrating compliance with AS2439.1.

(2) Other types of subsurface drainage

Where a Contractor wishes to use a subsurface drainage pipe other than corrugated plastic pipe, the Contractor must submit full details of the type of pipe, certification from the manufacturer of its suitability and quality and written acceptance by the council for its use in each particular application. Certification of the suitability of any pipe must address the crushing strength, flexural strength, jointing system and slotting details.

(3)

Filter material

(a) General

The types of filter material covered by this sub-section includes:

(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 crushed rock for use in Type A drainage mats; and

(iv) Type D filter material comprising uncrushed river gravel for use in Type A drainage mats.

All filter material must consist of clean, hard, tough, durable particles. A sample of the proposed filter material must be submitted to the Superintendent for approval.

(b) Type A filter material

Type A filter material must be crushed rock complying with the following requirements in Table SC6.4.6.21.1.

Table SC6.4.6.21.1 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
	425µm	0 to 2

(c) Type B Filter Material

Type B filter material must be granular material complying with the following grading requirements in Table SC6.4.6.21.2.

Table SC6.4.6.21.2 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
	425µm	20 to 80
	300µm	0 to 30
	150µm	0 to 2
	75µm	0 to 0.1

In addition to the above grading requirements, Type B filter material must have a coefficient of saturated permeability, when compacted to its maximum dry density as determined by AS1289.5.5.1 and then tested in accordance with Test Method ASTM D2434 68, of at least 8m per day after 3 hours of flow.

Type B filter material must not vary from its original grading as a result of compaction processes by more than the following amounts listed in Table SC6.4.6.21.3.

Table SC6.4.6.21.3 Type B filter material variation

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

(d) Type C Filter Material

Type C filter material must be crushed rock complying with the following requirements in Table SC6.4.6.21.4.

Table SC6.4.6.21.4 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 must 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 must be joined by straight lines and the D90 value must be determined as the theoretical sieve size corresponding to 90% passing.

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

(e) Type D Filter Material

Type D filter material must be uncrushed river gravel complying with the description of rounded aggregate in Table B1, Appendix B of AS2758.1 and the following requirements in Table SC6.4.6.21.5.

Table SC6.4.6.21.5 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%

(4) Geotextile

Prior to placing geotextiles, documentary evidence that the geotextile and installation process conform to the requirements of this sub-section must be produced and submitted to the Superintendent.

(a) General

The geotextile, other than seamless tubular filter fabric, must consist of either a woven or a non-woven type which must be manufactured from synthetic materials other than polyamide. Rolls of geotextile must be marked with product identification and supplied with data sheets and information in accordance with the requirements of AS3705.

The geotextile must 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 AS3706.

The geotextile must be resistant to ultra violet light. No geotextile may be left exposed to sunlight during storage and construction for a period longer than a total of 21 days. If exposure in excess of 21 days does occur, the geotextile must be tested in accordance with AS3706.11 and if its characteristics have deteriorated to or below 90% of the characteristics claimed by the manufacturer or the characteristics determined on unexposed geotextile, whichever is the better, it must be removed and replaced with a geotextile complying with this specification.

The geotextile material type, strength rating “G”, and minimum mass requirements must be as shown on the drawings.

The type, properties, functions, design and construction requirements for a particular application of geotextile installation must be compatible with recommendations provided by the Guide to Pavement Technology – Part 4G, as well as requirements indicated on the drawings.

In addition to the above mentioned requirements, geotextiles for curtain drains must consist of either polyester, polypropylene or polyethylene. The required rates of water flow are shown on Table 4.1 of Guide to Pavement Technology – Part 4G, under 100mm constant head determined using the perpendicular flow test to conform with AS3706.9.

(b) Seamless tubular filter fabric

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

Fitting of the seamless tubular filter fabric must be in accordance with the requirements of SC6.4.6.21 Attachment A. Filter fabric that is excessively stretched, torn or otherwise damaged during fitting of the fabric, storage, transportation or pipe laying will be removed and replaced so as to eliminate any damaged lengths.

SC6.4.6.21.3 Recording of subsurface drainage information

(1) The Contractor must keep a detailed record of all subsurface drainage pipes and the completed subsurface drainage systems must be shown on as constructed plans to be submitted to council upon completion of work.

In addition, the Contractor must prepare a subsurface drainage information sheet or sheets; at the completion of construction of each drain or drainage system and must submit the subsurface drainage sheet or sheets to the Superintendent within 5 working days of the completion of the drain or drainage system.

SC6.4.6.21.4 limits and tolerances

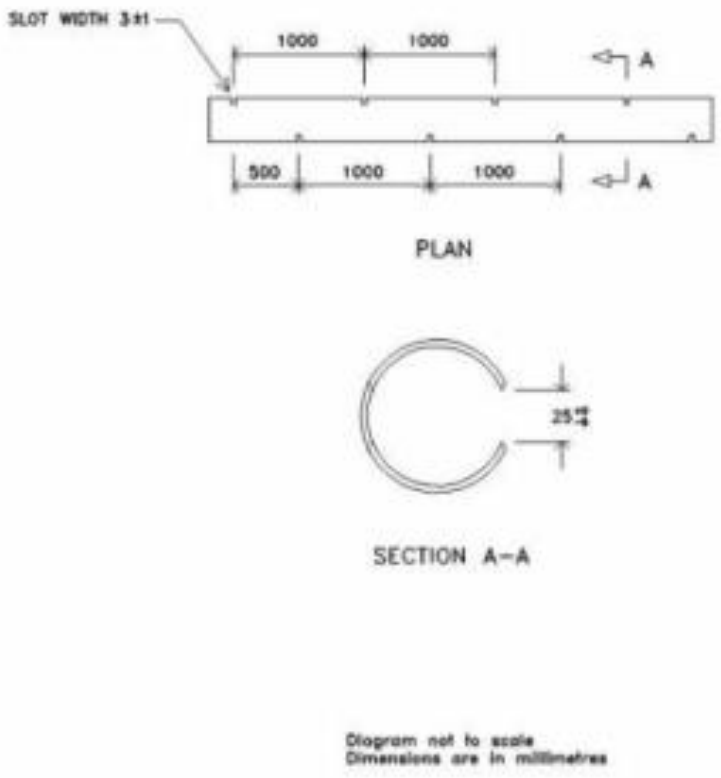
The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.21.6 Summary of limits and tolerances below.

Table SC6.4.6.4.21.6 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Excavation by Blasting** Peak particle velocity	25mm/s	SC6.4.6.21.1(6)
2.	**Outlets** Spacing	Max 150m	SC6.4.6.21.1(8)
3.	**Filter Material** (a) Type A (b) Type B (c) Type C (d) Type D	 Table SC6.4.6.21.1 Tables SC6.4.6.21.2 and SC6.4.6.21.3 Table SC6.4.6.21.4 Table SC6.4.6.21.5	 SC6.4.6.21.2(3) SC6.4.6.21.2(3) SC6.4.6.21.2(3) SC6.4.6.21.2(3)
4.	**Geotextile** (a) Exposure to sunlight	 <21 days If >21 days deterioration not to exceed 10% of claimed characteristics	 SC6.4.6.21.2(4)

Attachment A

Figure SC6.4.6.21.1 Slotting details for thick walled PVC plastic pipe



1. Slotted pipes fitted with seamless tubular filter fabric

(a) Procedure for fitting seamless tubular filter fabric to slotted pipe

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

(ii) The filter fabric must 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 must be referred to as the "mandrel".

(iii) The pipe to be enclosed by the filter fabric must be passed through the mandrel. The filter fabric must 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 must be firmly held to the forward end of the pipe so that it cannot slip back along the pipe.

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

(v) When the end of the pipe emerges from the mandrel, the filter fabric must be clamped to that end of the pipe so that the filter fabric cannot slip down the pipe. The filter fabric must 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 must be cut cleanly leaving enough overhang off the end of the pipe to make a fully covered join with the filter fabric on the adjacent pipe when the pipes are installed in the drain.

(b) Precautions to be taken when using slotted pipe fitted with seamless tubular filter fabric

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

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

(iii) 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 must be restretched to its correct position. If restretching causes any damage to the filter fabric, the damaged filter fabric must be removed from the pipe and replaced with undamaged filter fabric.

SC6.4.6.22 Pavement markings

SC6.4.6.22.1 Introduction

(1) Scope

This sub-section provides standards, advice and guidelines for the removal, setting out, supply and application of pavement marking paint, thermoplastic pavement marking material, pavement marking tape and raised pavement markers. Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-section

SC6.4.6.30 - Control of traffic

(b) Australian Standards

~~AS~~AS1580.205.4 - *Paints and related materials – Methods of test – Application properties – ~~1580.205.4~~ Airless spraying*

~~AS 1906~~AS1906.3 - *Raised pavement markers (retroreflective and non-retroreflective)*

~~AS 2009~~AS2009 - *Glass beads for pavement- marking materials*

~~AS 2700~~AS2700 - *Colour Standards for general purposes*

~~AS 4049~~AS4049.1 *Solvent- borne paint - For use with surface applied glass beads*

~~AS 4049~~AS4049.2~~-~~ - *Thermoplastic pavement marking materials - For use with surface applied glass beads*

~~AS 4049~~AS4049.3~~-~~ - *Waterborne paint - For use with surface applied glass beads*

(c) Queensland Department of Transport and Main Roads Publications

Manual of Uniform Traffic Control Devices (MUTCD)

Guide to pavement markings (GTPM)

Q513 *Wet Film Thickness of Paint (Wheel Gauge), Materials Testing Manual*

MRS45 *Road Surface Delineation*

Traffic and Road Use Management Manual (TRUM):

- TRUM 1.34 - Coloured surface treatments for bicycle lanes, Volume 1: Signing and pavement marking
- TRUM 3.23 - School zones, Volume 3: Road Safety

(d) Other

Australian Paint Approval Scheme – Specification 0041/4 - Roadmarking paint, thermoplastic

Australian Paint Approval Scheme – Specification 0041/5 - Roadmarking paint, water borne

(3) Type of markings

Details of the various types of pavement markings and devices are in accordance with the requirements of the MUTCD, TRUM and GTPM.

Colours

White paint must have a colour equivalent to or whiter than Off White, Colour Y35 in AS2700.

Where yellow is used, the colour shall be equivalent to Y12, Wattle or Y14, Golden Yellow as detailed in ~~AS 2700~~AS2700 or any other colour deemed to lie between these two colours.

Where Green is used as a coloured surfacing on bicycle lanes, guidance on the application of green coloured surface treatments is contained within TRUM 1.34. The colour must be equivalent to Emerald, Colour G13; Traffic Green, Colour G16 or Shamrock, Colour G23 in AS2700. Where only one shade of each colour is specified, Traffic Green, Colour G16 is used.

(4) Types of materials to be applied
The materials shall be applied as follows:

(a) Pavement marking paint
Permanent markings on all wearing surfaces. Temporary markings, other than on the final wearing surfaces. Traffic islands and kerbs where specified;

(b) Thermoplastic pavement marking material
Permanent markings where explicitly indicated on the drawings;

(c) Pavement marking tape
Temporary markings on final wearing surfaces;
Temporary raised pavement markers (TRPMs);
Temporary markers fixed on any surface as a temporary marking.

(d) Reflective glass beads
To be applied to all painted and thermoplastic markings; and

(e) Raised pavement markers
Studs which may be retroreflective (RRPM) or non-retroreflective (NRPM) set into the roadway or attached to the road surface with adhesives, lane dividers, or pavement bars are installed as permanent as shown on the drawings.

(5) Material quality
The Contractor shall submit to the Superintendent NATA Registered Laboratory Test Reports, at least 7 days before work is scheduled to commence, on the quality of the materials, including paint, glass beads, raised pavement markers and thermoplastic material proposed for use.
Only materials conforming to the requirements of the referenced Specifications/Standards shall be used.

(6) Setting out
The Contractor shall set out the work "spotting" to ensure that all markings are placed in accordance with the drawings.
The locations of pavement markings shall not vary by more than ~~20 mm~~20mm from the locations shown on the drawings. Spotting for longitudinal lines is generally at ~~10 metre~~10m intervals with ~~3 metre~~3m intervals on curves of less than ~~50 m~~50m radius.
The contractor must obtain approval from the administrator of the spotting prior to any application of pavement marking.

(7) Surface preparation
Surfaces which are to receive pavement markings shall be cleaned of all dirt, loose material and other contaminants. Pavement surfaces shall be thoroughly dry immediately prior to the application of pavement markings. Pavement marking shall not be carried out during wet weather or, if rain is likely to fall during the process.
In all cases, the reinstatement of longitudinal markings, particularly barrier lines and dividing lines, should occur as soon as possible after the new seal has been laid.
Where raised pavement markers are specified for pavements having a concrete wearing surface, the full area under each raised pavement marker shall be lightly scabbled to remove fine mortar material (laitance).
All painted markings whether installed by machine or hand are retroreflectorised by the application of drop-on glass beads (ballotini).

(8) Provision for traffic and protection of work
In accordance with MUTCD, Part 3 Works on Roads, and SC6.4.6.30 Control of traffic while undertaking the work and shall protect the pavement markings until the material has hardened sufficiently (no pick-up) so that traffic will not cause damage.

(9) Maintenance of pavement markings
The Contractor shall be responsible for the maintenance, and replacement if necessary, of raised pavement markers and all pavement marking during the contract period and the contract defects liability period.

Council requires all linemarking to be refreshed prior to to the end of the Defects Liability Period.

SC6.4.6.22.2 Pavement marking paint

(1) Materials

Paint shall comply with the requirements of ~~AS 4049~~AS4049.1 or ~~AS 4049~~AS4049.3. In this sub-section, the term “paint” shall mean “pavement marking paint”.

Glass beads shall comply with the requirements of ~~AS 2009~~AS2009 for drop-on beads.

(2) Mixing of paint

All paint shall be thoroughly mixed in its original container before use in accordance with the manufacturer’s recommendations to produce a smooth uniform product consistent with the freshly manufactured product.

(3) Application of paint and beads

All longitudinal lines shall be sprayed by an approved self-propelled machine. Line must have uniform thickness and intensity. Two coats of paint and glass beads shall be applied on longitudinal lines to new surfaces. The first coat shall be cured to “no pick up time” prior to the application of the second coat. The two sets of lines forming a one way or two way barrier line pattern shall be sprayed concurrently.

Hand spraying with the use of templates to control the pattern and shape shall be permitted for transverse lines, symbols, legends, arrows and chevrons.

The paint shall be applied uniformly and the wet film thickness shall be neither less than 0.~~35 mm~~35mm nor more than 0.~~40 mm~~4mm.

Glass beads shall be applied by air propulsion to the surface of all longitudinal lines at a net application rate of ~~kilograms per square metre~~ 1.3kg/sqm immediately after application of the paint. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.

Glass beads shall be similarly applied to all other paint markings at a net application rate of 0.~~30 kilograms per square metre~~3kg/sqm immediately after application of the paint by an applied method.

Pavement markings shall be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a neat and smooth marking on the surface of the pavement.

The lengths and widths of longitudinal lines and transverse lines must be within the tolerance specified in MUTCD/~~-~~GTPM and ~~MRST 45~~MRST45.

The dimensions of arrows, chevrons and speed markings must be within the tolerances specified in ~~-~~MUTCD/~~-~~GTPM as appropriate.

Arrows and speed markings shall be placed square with the centreline of the traffic lane.

Glass beads shall be uniformly incorporated in all coats of paint concurrently with the application of the paint.

Longitudinal line marking, when applied, must have a minimum retroreflectivity of ~~350 mcd/~~ 350mcd/lux/m^2

measured
between 10 and 20 days of wear.

(4) Field testing

The thickness of the wet film applied to the road pavement shall be checked by the method described in ~~AS 1580~~AS1580, comb gauge or test Q513 – (07/10).

The application rate of glass beads applied to the surface of the markings shall be checked by the method described in SC6.4.6.22 Attachment A Procedure for measurement of rate of application of spherical glass beads.

(5) Application rates

The minimum application rates for the paint and glass beads shall be as specified in Table SC6.4.22.1.

Table SC6.4.6.22.1 Application rates for paint and glass beads

Work type	Coverage (minimum per coat)	Wet application rate
Longitudinal lines – first coat Type B (drop on beads)	> ~~300 g~~300g/m²	0.~~375 lit~~375l/m² ± 0.25
Longitudinal lines – second coat Type B (drop on beads)	> ~~300 g~~300g/m²	0.~~375 lit~~375l/m² ± 0.25
Longitudinal lines – repaint Type B (drop on beads)	> ~~200 g~~200g/m²	0.~~300 lit~~300l/m² ± 0.20
Longitudinal lines – second coat or repaint applying Type D beads	> ~~400 g~~400g/m²	0.~~500 lit~~500l/m² ± 0.25
Transverse lines – Type B (drop-on beads)	> ~~300 g~~300g/m²	0.~~375 lit~~375l/m² ± 0.25
Transverse lines – Type D beads	> ~~400 g~~400g/m²	0.~~500 lit~~500l/m² ± 0.25

Source: MRTS 45

The combination application rates for anti skid and glass beads shall not exceed the values specified above and in SC6.4.6.22.2(6) unless specified by the manufacturer.

Table SC6.4.6.22.2 Volume of glass beads (ml) required in 10 seconds of operation

Road Speed km/h	Line Widths			
	75mm	100mm	125mm	150mm
8	371	495	619	742
13	603	804	1006	1207
16	742	990	1238	1484

Note—

1. Tolerance of +10% shall be permissible when measuring the above volume.
2. When two or more glass bead dispensers are to be used, each dispenser shall be checked separately to make up the totals shown.
3. Glass beads weigh approximately 1.~~53 grams per millilitre~~53g/ml.

(6) Anti skid

Transverse markings shall incorporate an anti skid treatment with a skid resistance greater than 45 BPN. The application of anti-skid shall comply with the manufacturer's requirements.

SC6.4.6.22.3 Thermoplastic pavement marking material

(1) Primer

A primer, of the type recommended by the manufacturer of the thermoplastic material, shall be applied to the surface immediately in advance of, but concurrent with, the application of thermoplastic material.

The primer shall be applied at the application rate recommended by the manufacturer and shall not be thinned.

(2) Application of thermoplastic material

Thermoplastic material may be applied by screeding, extrusion or profiling or as preformed material.

Thermoplastic material shall be applied to the pavement at a temperature between 180ºC and 200ºC unless a different temperature is recommended by the manufacturer.

The pavement surface to which thermoplastic material is applied shall be completely coated by the material and any voids in the pavement surface shall be filled.

(3) Application rate

Thermoplastic material shall be applied at the minimum thickness specified in Table SC6.4.6.22.3.

Location	Minimum application thickness (mm)
Longitudinal lines	2
Transverse markings	2

Editor's note - the term “thermoplastic material” shall mean “thermoplastic pavement marking material”.

Where specified, glass beads shall be applied immediately to the surface of the molten thermoplastic material at a rate of not less than 0.~~12 kg~~12kg/m2.

(4) Materials

Thermoplastic pavement marking material shall comply with the requirements of ~~AS 4049~~AS4049.2.

Glass beads shall be incorporated in thermoplastic material, in the proportion of 10~~ per cent~~% of the total mass, as part of the aggregate constituent and shall comply with the requirements of ~~AS 2009~~AS2009, Intermix type.

Glass beads for surface application shall comply with the requirements of ~~AS 2009~~AS2009, Drop-on

beads. Tack coat material shall be to the manufacturer's specification.

(5)

Preparation of thermoplastic material on site

Immediately before application, the thermoplastic material shall be uniformly heated in a suitable oil bath kettle to the temperature recommended by the manufacturer. The thermoplastic material shall not be heated above ~~-~~ the temperature recommended by the manufacturer. The thermoplastic material shall not remain molten for more than 6 hours for hydrocarbon resins and 4 hours for wood and gum resins. Should over-heating occur and/or the time ~~expire~~expires for molten materials, then the thermoplastic material shall be discarded.

(6)

Application of thermoplastic material and beads

Where the wearing surface of the pavement is smooth or polished, a tack coat of material may be required by the Superintendent and shall be applied in accordance with the recommendations of the thermoplastic manufacturer. The tack coat shall be applied immediately before the application of the thermoplastic material in accordance with the directions of the manufacturer of the thermoplastic material and the manufacturer of the tack coat material.

All longitudinal lines shall be sprayed by a self~~-~~propelled machine. The two sets of lines forming a one way or two way barrier line shall be sprayed concurrently. The thermoplastic material shall be applied uniformly and the cold film thickness shall be ~~2.0 mm~~2mm with a tolerance of plus or minus 0.~~5 mm~~5mm.

Glass beads shall be applied by air propulsion to the surface of all longitudinal lines at a net application rate of ~~0.30 kilograms per square metre~~ 0.3kg/sqm immediately after application of the thermoplastic material. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.

All transverse lines, symbols, legends and arrows shall be screeded. The screeded thermoplastic material shall be applied using a mobile applicator, and templates to control the pattern.

Preformed thermoplastic sheeting applied in accordance with manufacturer’s specifications is an approved process.

The thermoplastic material for transverse lines, symbols, legends and arrows shall be applied uniformly and the cold film thickness shall be 3.~~5 mm~~5mm with a tolerance of plus or minus 1.~~5 mm~~5mm. The surface finish shall be smooth.

Glass beads for other than longitudinal lines shall be uniformly applied to screeded markings at a net application rate of 0.~~30 kilograms per square metre~~3kg/sqm immediately after application of the thermoplastic material.

Pavement marking ~~shall~~must be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a

neat and smooth marking on the wearing surface of the pavement.

The lengths of longitudinal lines shall not vary by more than 20mm from the lengths shown in MUTCD/-GTPM. The widths of longitudinal lines shall not vary by more than 10mm from the widths shown in MUTCD/-GTPM. The lengths and widths of transverse lines shall not vary by more than 10mm from the lengths and widths shown in MUTCD/ GTPM.

The dimensions of arrows, chevrons and speed markings shall not vary by more than 50mm from the dimensions shown on the drawings or in MUTCD/ GTPM as appropriate. Arrows and speed markings shall be placed square with the centreline of the traffic lane.

(7) Field testing

The thickness of the cold film of thermoplastic material applied to the road pavement shall be checked by measurement, using a micrometer, of the thickness of thermoplastic material applied to a metal test plate. The application rate of glass beads applied to the surface of the markings shall be checked by the method described in SC6.4.6.22 Attachment A Procedure for measurement of rate of application of spherical glass beads.

SC6.4.6.22.4 Pavement marking tape

(1) Materials

Pavement marking tape shall be a strippable type of tape, such as “Staymark Detour Grade”, or equivalent tape approved by the Superintendent. Pavement marking tape must only be used on temporary works.

(2) Application of pavement marking tape

The method of application of pavement marking tape, including surface preparation, shall be in accordance with the manufacturer's recommendations.

(3) Removal of pavement marking tape

When directed by the Superintendent, the Contractor shall remove pavement marking tape in accordance with the manufacturer's recommendations.

(4) Temporary raised pavement markers (TRPMs)

Temporary raised pavement markers must comply with the requirements of ~~AS 1906~~AS1906.

Temporary raised pavement markers may be used to mark the temporary travelled path at short-term work sites, or to indicate the permanent travelled path on new work prior to the application of permanent pavement markings.

The use of temporary raised pavement markers may preclude the need for spotting where existing markings are to be reinstated after a reseal, and for respotting if proposed line markings were set out before the final seal on new works is applied. In these cases, the distance between TRPMs should be the same as would apply for spotting.

Temporary raised pavement markers should not take the place of spotting, as TRPMs may be broken off by traffic before final marking can be carried out. Once the longitudinal lines have been marked, the Temporary raised pavement marker flaps can be removed by cutting them off flush with the pavement surface.

SC6.4.6.22.5 Raised pavement markers

(1) Materials

Raised pavement markers, both reflective and non reflective, shall comply with ~~AS 1906~~AS1906.3 and shall have the dimensions shown on the drawings.

The adhesive used for attaching the raised pavement markers to the wearing surface of the pavement shall be a hot-melt bitumen adhesive or an equivalent product approved.

(2) Installation of raised pavement markers

The use of raised retroreflective pavement markers must be in accordance with the MUTCD, GTPM and TRUM 1.25 Fire Hydrant Indication System.

Raised pavement markers shall be fixed to the wearing surface of the pavement using a hot melt bitumen adhesive or an equivalent product. The adhesive shall be freshly heated to the manufacturer's instructions and thoroughly mixed.

The adhesive shall be spread uniformly over the underside of the raised pavement marker to a depth of approximately 10mm. The raised pavement marker shall be pressed down onto the pavement surface in its correct position and shall be rotated slightly until the adhesive is squeezed out around all edges of the marker. The raised pavement marker shall not be disturbed until the adhesive has set.

On rough surfaces, such as newly laid coarse sprayed bituminous seals, an initial pad of adhesive of diameter ~~20 mm~~20mm larger than the diameter of the base of the raised pavement marker, shall be provided. The adhesive shall be applied to fill the irregularities in the pavement surface to produce a flat, smooth surface flush with the upper stone level. The adhesive pad shall be allowed to set. Additional adhesive shall be applied to the pavement, as described above, and then the raised pavement marker shall be pressed down onto the adhesive pad on the pavement surface to ensure good adhesion.

When installed, raised pavement markers shall conform to the tolerances specified in Table SC6.4.6.22.4.

Table SC6.4.6.22.4 Tolerances - raised pavement markers

	Tolerance (mm)	Distance
Lateral position –	+ 25, - 50	from edge of line
barrier/edge line	± 10	from edge of line
broken line	± 10	from centre of line
flush medians		
Longitudinal position –	± 10	~~1 m~~1m from start of line
broken line	± 100	~~1 m~~1m from start of line
new construction	± 300	~~1 m~~1m from start of line
replacement		

(1) General

The Contractor shall remove pavement markings, no longer required, from the wearing surface of pavements without significant damage to the surface.

Where required, existing pavement markings must be removed by the appropriate method stated in Table SC6.4.6.22.5.

The method of removal shall be submitted to the Superintendent for approval before commencement of the work.

Table SC6.4.6.22.5 Method of removal of existing pavement marking

Method of removal	Duration of result
Black paint	< 1 week
Emulsion and sand	< 2 weeks
Black cold applied resin or plastic	< 6 months
Chip seal	Permanent
Line grinder (asphalt only)	Permanent
Profiler (asphalt only)	Permanent
Abrasive blasting	Permanent

SC6.4.6.22.7 Surface treatments for bicycle lanes and school zone threshold

(1) Coloured surface treatments for bicycle lanes

Refer to the Traffic and Road Use Management Manual - Coloured Surface Treatments For Bicycle Lanes.

(a) The preferred colour is G13 Emerald (AS 2700 S 1996). To accommodate different materials and varying conditions, an approximate colour match to one of the following three ~~AS 2700~~AS2700 S greens is permitted - G13 Emerald, G16 Traffic green or G23 Shamrock. Approximate colour match is determined in accordance with AS/~~NZ1580~~NZS1580.601.1.

(b) A consistent green colour should be provided along a route or within a given locality.

(c) Where green surface colouring is used, it should be continuous through the required area and be bounded by the bicycle lane lines. Pavement markings, such as bicycle symbols and any directional arrows, should be placed over the coloured surface.

(d) A coloured surface treatment needs to do more than just provide a colour contrast. It must be designed to function like any other road surfacing, providing a sound, durable surface layer, which maintains the required texture and skid resistance for its design life.

(e) The design and specification of a coloured surface treatment for bicycle lanes should:

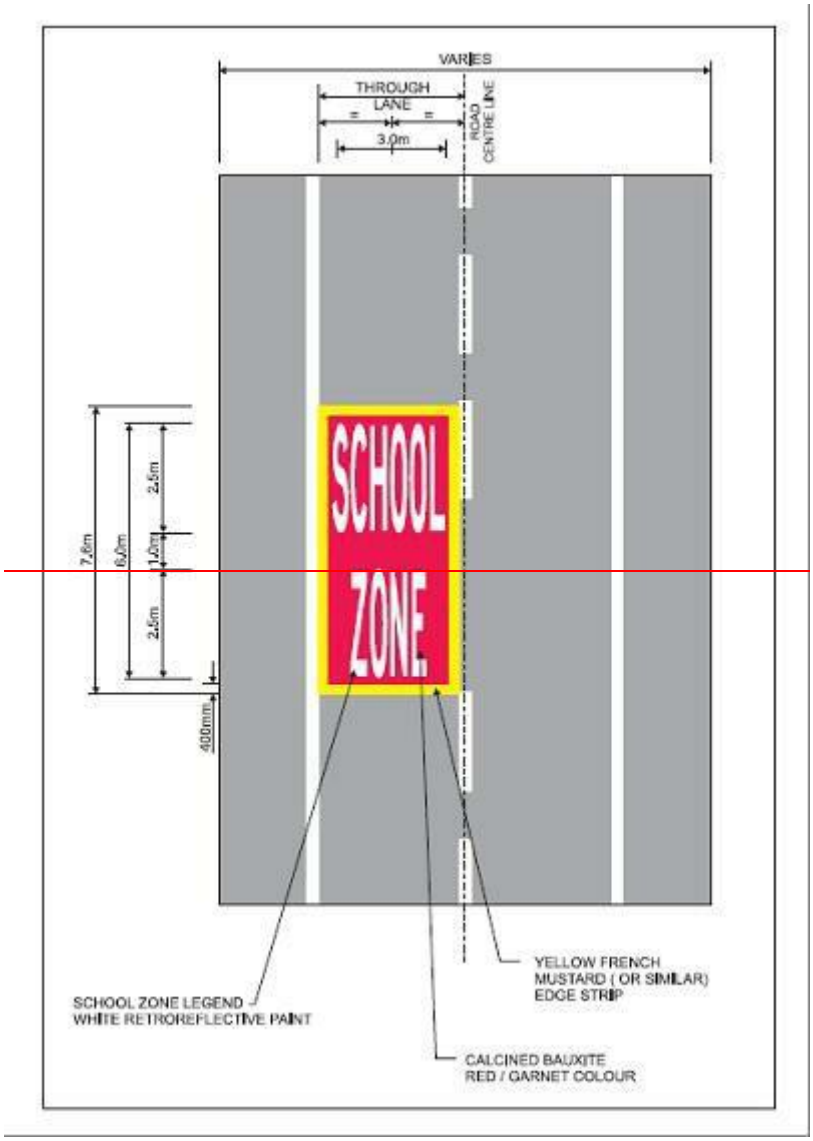
- ensure the suitability of the existing surface to support and bond with the colour treatment;
- provide a surface texture and skid resistance suitable for bicycle use, including in wet conditions; and
- limit differential skid resistance between the bicycle lane and adjacent traffic lanes.

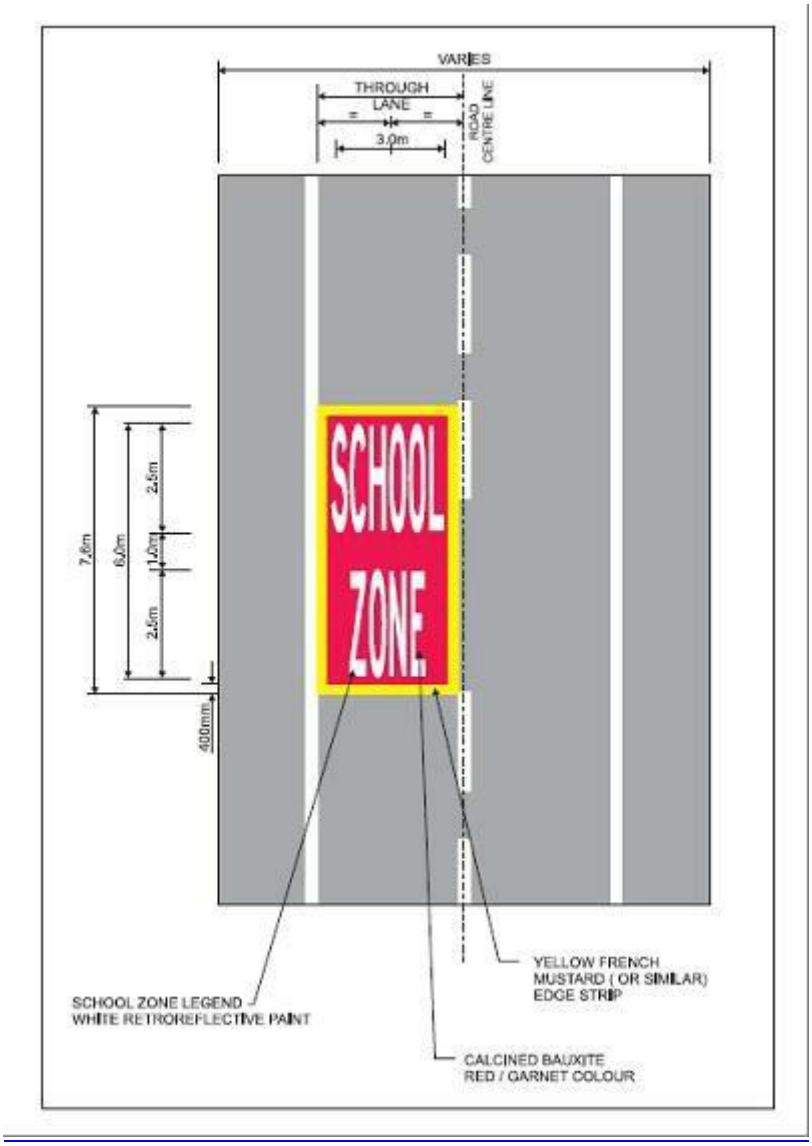
(f) The Department of Transport and Main Roads is considering development of a formal specification for coloured surface treatments for Queensland. Until this is available it is recommended that advice on performance requirements, and the suitability of any product or service being considered for use, be sought from the Superintendent for approval before commencement of the work.

(2) Surface treatments for school zone thresholds

Refer to the Traffic and Road Use Management Manual - 3.23 Traffic and Road Use Management Manual - School Zones.

Threshold treatments may be provided at entrances to school zones to create a change in driver perception of the speed environment. A typical threshold treatment for a school zone is shown in Figure SC6.4.6.22.1.


VARIES
THROUGH LANE
3.0m
ROAD CENTRE LINE
SCHOOL
ZONE
7.8m
6.0m
2.5m
1.0m
2.5m
400mm
SCHOOL ZONE LEGEND
WHITE RETROREFLECTIVE PAINT
YELLOW FRENCH MUSTARD (OR SIMILAR) EDGE STRIP
CALCINED BAUXITE
RED / GARNET COLOUR



Source:TRUM.

Figure SC6.4.6.22.1 Typical threshold treatment for a school zone

Advice on performance requirements, and the suitability of any product or service being considered for use, is to be sought from the Superintendent for approval before commencement of the work.

The pavement marking treatment (set out, type of material, preparation of surface, rate of application, method of application and maintenance) must be submitted to the Superintendent for approval before commencement of the work.

SC6.4.6.22.8 Limits and tolerances

The limits and tolerances applicable to the various clauses of this Specification are summarised in Table SC6.4.6.22.6 – Summary of limits and tolerances below:

Table SC6.4.6.22.6 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Location of Markings**	± 20mm from specified location	SC6.4.6.22.1(6)
2.	**Longitudinal Lines**		
	(a) Length	± 20mm from lengths shown in MUTCD/MRDGPM	SC6.4.6.22.2(3) SC6.4.6.22.3(3)

	(b) Width	± 10mm from widths shown in MUTCD/MRDGPM	SC6.4.6.22.2(3) SC6.4.6.22.3(3)
3.	**Transverse Lines**		
	(a) Length	± 10mm from lengths and widths shown in MUTCD/MRDGPM	SC6.4.6.22.2(3)
	(b) Width		SC6.4.6.22.2(3)
4.	**Arrows, Chevrons, Speed Markings etc.**	± 50mm from the dimensions shown in MUTCD/MRDGPM	SC6.4.6.22.2(3) SC6.4.6.22.3(3)
5.	**Application of Paint**		
	(a) Film Thickness	>0.35mm <0.40mm	SC6.4.6.22.2(3)
6.	**Application of Thermoplastic**		
	(a) Longitudinal Lines Cold Film Thickness	2.0mm ± 0.5mm	SC6.4.6.22.3(3)
	(b) Transverse Lines, Symbols, Arrows etc. Cold Film Thickness	3.5mm ± 1.5mm	SC6.4.6.22.3(3)
7.	**Glass Beads**		
	(a) Volume used in operation	0.~~30 kg/sq m~~3kg/sqm + 10%	SC6.4.6.22.2(3) SC6.4.6.22.3(3)

Attachments

Attachment A

Attachment A: Procedure for measurement of rate of application of spherical glass beads

(1) **Scope**

The following procedure shall be adopted for field measurement of the rate of application of spherical glass beads on to wet paint or thermoplastic surfaces.

(2) **Spherical Glass Beads**

The glass beads shall comply with ~~AS 2009~~AS2009.

(3) **Measurement**

The method of field measurement shall be as follows:

(a) Turn off the paint or thermoplastic supply valves and operate the glass bead dispenser for exactly 10 seconds allowing glass beads to run into a plastic bag or tray.

(b) Pour the glass beads from the bag or tray into a suitable measuring cylinder calibrated in millilitres to measure the volume of glass beads collected. Level but do not compact the glass beads in the cylinder.

(c) Compare the volume of glass beads collected with the correct figure given in Table SC6.4.6.22.1 - Volume of Glass Beads (ml) required in 10 seconds of operation. Table SC6.4.6.22.1 - Volume of Glass Beads (ml) required in 10 seconds of operation shows the correct volumes of glass beads required to give a net application rate on the marked line of approximately 0.~~30 kilograms per square metre~~3kg/sqm for different line widths and road speeds. The glass bead volume figures given in Table SC6.4.6.22.1 - Volume of Glass Beads (ml) required in 10 seconds of operation are calculated for an actual application rate of 0.~~34 kilograms per square metre~~34kg/sqm.

(d) These figures are used for calibrating the machine because there is a loss of beads between the bead dispenser and the marked line and

(e) The volume is measured with beads not compacted.

SC6.4.6.23 Guide posts

SC6.4.6.23.1 Introduction

(1) Scope
This subsection provides ~~standards~~, ~~advice and guidelines~~minimum requirements for the setting out, supply of all materials and erection of guide posts in areas where street lighting is not provided to maintain safety of movement network.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-section
SC6.4.6.30 - Control of traffic

(b) Australian Standards
AS 1906.2 - *Retroreflective devices (non-pavement application)*

(c) AS1580 -Paints and related materials

Queensland Department of Transport and Main Roads specifications
MRS14 *Road Furniture*

SC6.4.6.23.2 Materials

(1) General
Guide posts must be a proprietary metallic or flexible (driveable or non-driveable) post.

The surface of all posts must have a gloss or semi-gloss white finish. The surface shall be smooth and easily cleaned.

Proprietary posts must be minimum 1,500mm in length and must have one face of a minimum 80mm width.

(2) Proprietary posts
Where a proprietary metallic or flexible guide post is proposed, the Contractor must supply details of the proposed guide post including the manufacturer's recommended installation procedure, technical specifications and test certificates.

(3) Delineators
Corner-cubed delineators, conforming to AS 1906.2 must be attached to each post. The delineators must conform to MRS14 *Road Furniture*.

SC6.4.6.23.3 Construction

(1) General
The Contractor must at all times conform to the requirements of sub-section SC6.4.6.30 Control of traffic.

Where the shoulder is in embankment or at natural surface level, the guide posts must be placed near the outer edge of the shoulder and at a uniform distance, minimum 1m, from the pavement edge line. Where the shoulder is located in a cutting, the guide posts must be placed on the road pavement side of the table drain, and minimum 1m from the pavement edge line, in such a manner that it does not impede the flow of water in the drain.

Guide posts must be erected at the locations shown on the Drawings. Underground services laid in proximity to the guide posts must be located prior to erection of posts all care must be taken not to damage such services.

(2) Erection of guide posts
Guide posts must be set vertically in the ground to a depth of approximately 500mm. In order to offset shoulder irregularities this depth must be varied to give uniform display of guide posts to a height of approximately 1m above ground level, with the tops evenly graded. Each guide post must be erected with the widest face at right angles to the centre line of the road.

Allowance must be made in the height of guide posts above the ground for the effects of superelevation and other road geometry in order to keep the guide posts within the range of the beam of vehicle headlights.

Backfilling must be compacted in layers of depth not more than 150mm for the full depth of the guide posts up to ground level. The density of the compacted backfilling must be no less than that of the adjacent undisturbed ground. Guide posts must be firm in the ground to the satisfaction of the Superintendent.

Proprietary guide posts, when installed in the ground in accordance with the recommendations of the manufacturer, must resist overturning, twisting and displacement from wind and impact forces. The Contractor must provide the manufacturer's instructions for anchorage.

If the guide posts are proposed to be installed on concrete pavements, the Contractor must provide the details of fixing the guide posts to the concrete prior installation.

All necessary steps must be taken to prevent people and stock from stepping into the post holes during the erection of the guide posts.

(3) Delineators

"Corner Cubed" delineators, complying with AS 1906.2, must be attached to each guide post using one way, anti-theft screws or rivets etc. In the case of proprietary posts, the delineators must be glued or otherwise fastened to the post in such a manner that they are not dislodged or rendered inactive under vehicular impact. The delineators must be mounted so that the top of the reflector is 100mm below the top of the guide post. The delineators must be so arranged that drivers approaching from either direction will see only red delineators on their left side and white delineators on their right side.

SC6.4.6.26 Landscaping

SC6.4.6.26.1 Introduction

(1) Scope

This sub-section sets out the standards and provides advice and guidelines for the construction of landscape works that will become a council asset.

Landscape works includes but is not limited to, site co-ordination, turfing, gardens, grass seeding, tree plantings, pathways, paved areas, concrete works, stormwater drainage and infrastructure.
This sub-section consists of:

(a) a) the vegetation of cut and fill batters, median areas, pathway verges, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising, sowing of seed and may include surface protection works, hydroseeding, hydromulching and straw mulching; and

(b) b) the supply of plants, planting at locations fertilising, mulching, staking, watering and maintenance of plants.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

All design and documentation, materials supplied and work carried out shall be in accordance with the following standards.

(a) Development manual planning scheme policy sub-sections to ne read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.10 - Earthworks (construction).

(b) Australian Standards

AS 1160	*Bituminous emulsions for the construction and maintenance of pavements*
AS 1289	*Methods of testing soils for engineering purposes – General requirements and list of methods*
AS 1672.1	*Limes and limestones – Limes for building*
AS 2507	*The storage and handling of agricultural and veterinary chemicals*
AS 3000	*Electrical installations (known as the Australian/New Zealand Wiring Rules)*
AS 3700	*Masonry structures*
AS 3798	*Guidelines on earthworks for commercial and residential developments*
AS 3972	*General purpose and blended cements*
AS 4419	*Soils for landscaping and garden use*
AS 4454	*Composts, soil conditioners and mulches*
AS/NZS 4671	*Steel reinforcing materials*
AS 4843	*Synthetic weed blocking fabric*
AS 4970	*Protection of Trees on Development Sites*

(c) Other

Electricity Act 1994

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

(3) Terminology

For the purposes of this document the following definitions apply:

Defects liability period	refer to Section SC6.4.7 Acceptance of completed works.
Gardens, garden beds and garden areas	means a defined area of mulched “garden” containing various shrubs, trees, plants or hedges.

Litter	means bottles, paper, cigarette packets, cigarette butts, drink cans, ice cream sticks, plastic, rubber, glass, milk and fruit juice cartons, paper plates and the like. Litter also includes fallen branches, palm fronds, waste, household rubbish, condoms, sharps/syringes, leaves where leaves are unsightly or cause damage to lawn or garden areas, or other dumped material.
Maintenance period	equivalent to the defects liability period and includes the plant establishment period.
Plant establishment period	coincides with the defects liability period.
Planter box	means a transportable or in situ container designed specifically for containing a garden of trees and /or shrubs.
Sub grade	means the level at the underside of garden or turf top soil or the level at the underside of paving gravel base course.
Superintendent	means the nominated representative for council.

SC6.4.6.26.2 Works management

(1) Qualified personnel

Personnel shall be suitably qualified and competent in all aspects of landscape works and shall be familiar with all relevant Australian Standards. All maintenance work to new and existing trees shall be carried out under the supervision of an Arborist with formal qualifications (Level 5 ~~3~~ Australian Qualification Framework) or at least 5 years recognised experience in Arboriculture.

(2) Design approval

The design of the landscape works will be prepared by a qualified Landscape Architect.

(3) Contractor inspections

Inspections must be certified and documented by a Registered landscape Architect (the supervising landscape architect). All approved works are required to be inspected by Townsville City Council.

(4) Council inspections

(a) Council may inspect the following:

(i) sub grade prior to placing fill;

(ii) sub grade prior to placing garden soil or turf soil;

(iii) sub grade prior to placing the gravel base course;

(iv) sub grade prior to placing paving or concrete works;

(v) installation of gypsum;

(vi) condition of plants after delivery to site and prior to planting, including planting holes prior to planting;

(vii) gardens prior to planting;

(viii) turf areas prior to laying turf;

(ix) areas to be hydro-mulched / seeded prior to treatment;

(x) concrete structures (formwork) prior to placing concrete;

(xi) block work and reinforcing prior to placing core fill concrete; and

(xii) other elements considered necessary by the Superintendent.

(b) Inspection of irrigation works shall be undertaken by the Superintendent and a council Irrigation Officer in association with the Landscape works and is detailed below:

(i) all mainline to be inspected prior to covering;

(ii) drip tube layout prior to covering;

(iii) 240v power conduit from Ergon POS to controller for correct depth prior to covering;

(iv) all envelopers (conduits) work under hard surfaces prior to covering;

(v) all envelopers (conduits) under hard surfaces must be continuous 100 mm PVC CL9, all conduit ends must be sealed with expanding foam prior to covering; and

(vi) water meter assembly installation prior to covering to ensure correct installation of thrust blocks and copper protection.

(5) Inspection results

(a) Work inspected that complies with the sub-section and/or the design plans will be accepted by council.

(b) Any work inspected that does not comply with the sub-section and/or the design plans, will not be accepted by council. Items not acceptable will be noted for rectification.

(c) The contractor is required to rectify these items prior to proceeding to the next construction phase and shall apply for a re-inspection by council on completion of the rectification work.

(6) A minimum of 24 hours notice by is required for notification of an Inspection. Failure by the Contractor to notify council of any inspections required, will result in the works being excavated at the Contractors cost to allow an inspection to be carried out.

(7) Inspection documentation.

Editor's note—this section relates to Inspection Test Plans and is currently under development.

SC6.4.6.26.3 Supply of materials

(1) Materials supply - general

(a) Substitutions

The Contractor shall notify the council immediately if an item is unavailable for inclusion in the works and shall provide alternative supply details if appropriate. Substitutions of any materials or products shall not be made unless approved by the Superintendent in writing.

(b) Material samples

In certain instances, council may request the Contractor to provide samples of materials to be installed or used for work under the development approval.

(c) Materials testing

In certain instances, council may request the Contractor to provide results of materials testing. Where applicable, testing requirements will be set out in the conditions of approval.

(d) Materials warranty

Where requested, the Contractor shall provide to council all relevant warranty details for the materials nominated in any conditions of approval.

(2) Supply of plants

(a) Plant specifications

(i) All plants supplied shall be in a healthy condition free from weeds, pests and diseases. Plants shall be well foliated, showing signs of active growth, true to type and of a form and shape considered typical for the species or variety.

(ii) Leaves shall be of normal size, shape, colour, and texture with no physical or insect damage or disease lesions.

(iii) The plant roots shall be fibrous, well developed and not root bound, with no kinking, knotting, girdling or spiralling and shall be free of any pests or diseases or any other root defects.

(iv) All plants supplied shall be hardened off and in a condition suitable for planting in the Townsville climate.

(v) Trees supplied (unless required to be multi-stemmed) shall have a single leading stem and shall be self-supporting and unstaked.

(vi) Root bound plants, deformed plants and plants showing recent signs of root pruning will not be accepted.

(vii) At time of delivery to the site, each group of plant species shall be clearly and accurately labelled according to botanical nomenclature. Labels shall be water resistant and tied securely to one plant in every 20 for each species.

(viii) Plants which are above the minimum size requirements may be accepted for inclusion within the

works.

(b) Container stock
Plants grown in containers shall have a root system firmly established with no large roots growing out of the container, shall be of such a size that the roots have penetrated to the bottom of the container and occupy 95-100% of the soil volume and/or have sufficient roots to hold the container soil together after removal of the plant from the container.

(c) Ex-ground stock plants

(i) Where plants are growing in ground prior to delivery to the site, the necessary root pruning and/or preparation procedures in accordance with accepted transplanting practice shall be commenced in sufficient time to ensure that, at the time of planting the plant is ready and will meet the specified requirements. Transplanting of ex-ground stock should be conducted under the supervision of a qualified (Level 3 Australian Qualification Framework) horticulturalist or arborist.

(ii) Refer to Table SC6.4.6.26.1 for minimum acceptable root ball sizes for ex-ground stock plants.

Table SC6.4.6.26.1 Acceptable root ball sizes

Small Trees		Large Trees	
Height of Tree (mm)	Root Ball Diameter (mm)	Approximate Tree Trunk Diameter (mm) (300 mm above ground)	Root Ball Diameter (mm)
600 - 900	300	40	500
900 - 1200	350	50	550
1200 - 1500	400	65	600
1500 - 1800	450	75	800
1800 - 2100	550	100	950
2400 - 2700	600	125	1200
2700 - 3000	650	150	1450
3000 - 3600	750	175	1600
3600 - 4200	800		
4200 - 5000	900		

(d) Substitutions
Substitutions of plants shall not be permitted unless approved in writing by council. In the event that a plant is unavailable the Contractor may request to provide a substitution. Substituted plants shall be of the same specified type, quality and size unless otherwise agreed to by council.

(3) Supply of imported soil mix

(a) Imported soil mix shall be organic soil, soil blend or top dressing in accordance with the Australian Standard AS 4419 Soils for landscaping and garden use.

(b) The Contractor shall note the requirements of AS 4419.

(4) Supply of turf

(a) Turf shall be the species nominated on the drawings and shall be supplied by a specialist grower of cultivated turf.

(b) The soil of the turf sod shall be an even thickness of 25 mm minimum.

(c) Turf shall be free from any matter toxic to plant growth and shall be free from roots, weed or weed seeds.

(5) Supply of hydro seeding/mulching
The specific mix/blend of hydro seeding/mulching required shall be nominated on the drawings and supplied by specialist supplier of hydro seeding/mulch.

(6) Supply of mulch materials

(a) All mulch materials supplied shall be in accordance with the current relevant AS 4454 Composts, soil conditioners and mulches.

(b) Organic and inorganic mulch shall be of the type and quality as noted on the drawings.

(c) Organic mulch derived from vegetation cleared on site may only be used where it is free from deleterious materials such as rock, soil and weed material.

(7) Tree stakes and ties

(a) ~~Stakes shall be painted Heritage green,~~ U~~u~~nless otherwise noted on the drawings or approved by council, tree stakes ~~and~~ shall be durable hardwood, straight, free from knots or twists and pointed at one end.

(b) Small plants may only require 1 stake where required.

(c) For trees up to 45 litre ~~stakes shall be~~ 2 stakes – 50 mm x 50 mm x 1800 mm long.

(d) For trees over 45 litre ~~stakes shall be~~ 3 stakes– 50 mm x 50 mm x 2400 mm long.

(e) Ties shall be 50 mm wide furniture grade hessian webbing or similar.

(f) Supply of proprietary items

Timber/concrete garden edging, soil conditioners, root barrier, furniture items, play equipment and other project specific items shall be supplied to the requirements and details noted on design and/or construction drawings.

(8) Supply of gypsum

Gypsum application rates shall be supply in accordance with AS 4454 and as required by soil types specific to the site.

(9) Supply of fertiliser

Fertilisers supplied shall be:

(a) delivered to the site in sealed bags clearly marked to show the manufacturer or vendor, weight, fertiliser type, N:P:K. ratio, recommended uses and application rates; and

(b) applied at the locations and frequencies in accordance with the manufacturers' recommendations.

SC6.4.6.26.4 Earthworks

(1) General

Earthworks relates to gardens, grass areas, pathways and paved areas and includes:

(a) site clearing;

(b) stripping of existing vegetation;

(c) stripping of existing top soil;

(d) excavation to sub grade level;

(e) filling to sub grade level; and

(f) cultivation of the sub grade surface.

(2) Quality management

All materials supplied and work carried out shall be in accordance with the current, relevant Australian Standards:

(a) AS 1289 - Methods of testing soils for engineering purposes; and

(b) AS 3798 - Guidelines on earthworks for commercial and residential developments.

(3) Existing services

Per sub-section SC6.4.6.11 Clearing and grubbing, the Contractor is required to locate all existing and newly installed services prior to commencement of any earthworks. Care shall be taken in areas to be excavated, filled or cultivated not to unearth or damage services. Any damage to services caused by the Contractor shall be reinstated by the Contractor at no cost to council.

(4) Site preparation

(a) Clearing/Demolition

(i) Clearing shall mean the removal of trees, shrubs, scrub and undergrowth and other vegetation above ground level and includes the removal of artificial obstructions such as fences, concrete slabs rubbish, timber, boulders, rubble and other man made products.

(ii) Clearing shall be carried out in accordance with sub-section SC6.4.6.11 Clearing and grubbing.

(b) Grubbing

Grubbing shall mean the removal from below ground level of trees, roots, stumps, rocks and artificial obstructions as defined and specified by sub-section SC6.4.6.11 Clearing and grubbing.

(c) Stripping of existing vegetation

Areas to be excavated or filled shall be stripped of all vegetation to a depth just sufficient to include the root zone (nominal 50 mm). All stripping of vegetation is to be in accordance with sub-section SC6.4.6.11 Clearing and grubbing and must not affect trees/vegetation to be retained, as per clauses SC6.4.5.2.1(18) and (19). ~~Work adjacent to trees and protection of environmentally significant vegetation.~~

The striped material shall be removed from site or may be stockpiled on site for later reuse, if approved by council and in accordance with clause SC6.4.5.2.1(17~~6~~) Stockpiling of materials.

(d) Existing topsoil

Existing topsoil excavated on site may be reused provided that the material conforms to the AS 4419 requirements and is approved for reuse by the Superintendent. The material may be stockpiled on site, in accordance with clauses SC6.4.5.2.1(16) and (17).

(5) Excavation (down to sub grade level)

(a) General

The existing surface of areas to be excavated shall be stripped of all vegetation prior to excavating. Care shall be taken not to unnecessarily expose subsoils through the area of construction by over excavation, to prevent any potential for the development of acid sulphate conditions.

(b) Excavation in gardens

(i) Garden beds shall be excavated down to subgrade level as required to suit the finished surface levels, the depth of garden mix soil and the depth of mulch.

(ii) The subgrade shall be shaped and graded evenly to fall towards subsoil drains (if present) and the topsoil shall be shaped to fall from the centre of the bed outwards in all directions.

(iii) Excavation in gardens shall be in accordance with council's approved standard drawings.

Editor's note— standard drawings for these works are under development.

(c) Excavation in grass areas

(i) Grass areas shall be excavated down to subgrade level as required to suit finished surface levels, the depth of turf top soil and the depth of turf.

(ii) The subgrade shall be shaped and graded evenly to fall towards subsoil drains (if any) and shall be graded evenly to follow the finished surface profile.

(iii) Excavation in grass areas shall be in accordance with council's approved standard drawings.

Editor's note—standard drawings for these works are under development.

(d) Excavation for pathways and paved areas (paving)

(i) Pathways and paved areas shall be excavated down to subgrade level as required to suit finished surface levels, the depth of the gravel base course, bedding sand, pavers or concrete. The subgrade shall be shaped and graded evenly to the falls shown on the drawings and/or to fall to stormwater pits or subsoil drains.

(ii) Excavation for pathways and paved areas shall be in accordance with council's approved standard drawings.

Editor's note—standard drawings for these works are under development.

(e) Excavation near existing trees
Excavation near existing trees shall be undertaken in accordance with clause SC6.4.5.2.1(19~~8~~) Work adjacent to trees and protection of environmentally significant vegetation.

(f) Spoil

(i) Spoil material resulting from excavation shall be reused on site wherever practicable, provided that the material conforms to the specified requirements for its intended use (e.g. filling or top soil) as per AS 4419.

(ii) Spoil material to be reused may be stockpiled on site as per clause SC6.4.5.2.1(17~~6~~) Stockpiling of materials.

(iii) After the excavation process has been completed, the sub grade surface shall be inspected for springs, soft soil areas and other structural weaknesses. Where such weaknesses are encountered the following remedial works may be required:

(A) excavation and replacement of unsuitable material;

(B) surface drainage blankets of sand; and

(C) subsoil drains.

(6) Filling (up to sub grade level)

(a) Existing surface treatment
The existing surface of areas to be filled shall be stripped of all vegetation prior to placing any fill. The existing surface shall then be scarified to a depth of 200 mm. If required, water shall be added to bring the existing surface up to optimum moisture content prior to placing any fill.

(b) Unsuitable existing surface
After the stripping process has been completed, the existing ground surface shall be inspected for springs, soft soil areas and other structural weaknesses in the naturally occurring soil. Where such weaknesses are encountered, the following remedial works may be required:

(i) excavation and replacement of unsuitable material;

(ii) surface drainage blankets of sand; and

(iii) subsoil drains.

(c) Acceptable types of fill material for gardens and grass areas
Fill material to garden and grass areas shall be either:

(i) "general purpose soil" to AS 4419 Clause 4.1; or

(ii) "natural soil" to AS 4419 Clause 4.3; or

(iii) spoil from on site excavations if approved by the Superintendent, with a maximum particle size 25 mm.

(d) Acceptable types of fill material for pathways and paved areas
Fill material to pathways and paved areas shall be:

(i) crusher dust, free from organic matter and lumps of clay; or

(ii) crushed rock gravel uniformly graded, nominal particle size 25 mm; or

(iii) other granular material approved by the Superintendent.

All material used shall have a linear shrinkage - 0 - 8%, Soaked California Bearing Ratio – 15 minimum.

(e) Fill in gardens
Gardens shall be filled up to sub grade level as required to suit the finished surface levels, the depth of garden mix soil and the depth of mulch. The sub grade shall be shaped and graded evenly to fall towards subsoil drains (if any).

(f) Fill in grass areas

Grass areas shall be filled up to sub grade level as required to suit finished surface levels, the depth of turf top soil and the depth of turf. The sub grade shall be shaped and graded evenly to fall towards subsoil drains (if any) or gully pits and to mirror the finished surface profile.

(g) Fill to pathways and paved areas

Path ways and paved areas shall be filled up to subgrade level as required to suit the finished surface levels, the depth of the gravel base course, bedding sand, pavers or concrete. The subgrade shall be shaped and graded evenly to the falls shown on the drawings and/or to fall to stormwater pits.

(h) Fill around existing trees

For information regarding placement of fill and compaction issues r~~R~~efer to AS 4970 Protection of trees on development sites and Clause SC6.4.5.2.1(19~~8~~) Work adjacent to trees and protection of environmentally significant vegetation.

(7) Placing and compacting fill

(a) Fill material shall be placed and compacted in successive horizontal layers to the dimensions, levels, grades, and cross sections as shown on the drawings and so that the surface is always self-draining. Refer to Table SC6.4.6.26.2 for compaction standards. Care shall be taken to ensure that fill to garden areas is not excessively compacted.

(b) Each fill layer shall be scarified, and/or harrowed and processed to a finely divided condition, uniformly watered or aerated as the case may be, to obtain moisture content within the range of 80% - 90% of the optimum moisture content. The loose depth of the material in each layer shall be not more than 150 mm.

(c) Fill shall be placed in layers simultaneously on both sides of structures, culverts and pipe work to avoid differential loading. Fill shall not be placed against concrete or masonry structures, walls and the like until the concrete or masonry work has been in place for a minimum of 14 days.

(d) Existing works and structures shall be protected from damage due to compaction operations. Compaction by mechanical means shall not be carried out within 300 mm of paths, kerbs or structures. Compaction in these locations shall be carried out by hand or the size of compaction equipment shall be limited to ensure no damage is caused. Commence compaction of each fill layer at the structure and proceed away from it.

Table SC6.4.6.26.2 Fill compaction standards

Location	Compaction standard
Gardens and Grassed Areas	85% Relative Dry Density Standard Compaction.
Pathways , Paved Areas and Structures	95% Relative Dry Density Standard Compaction.

(8) Grading

(a) Runoff from impervious surfaces such as roofs, driveways and car parks, and overland flows from turf and garden beds is to be captured and allowed to infiltrate into subsoils by reshaping existing landforms through the use of swales, contour banks, soaks, percolation pits and basins, rain gardens and bioretention filters.

(b) To reduce runoff and erosion and encourage rainwater infiltration into soil, a landscape embankment is not to exceed grades of 1 in 5.

(c) The regrading of land is not to occur within the tree protection zone of existing trees to be retained.

(9) Cultivation

(a) Applies to gardens and grass areas (if directed or if noted on the drawings).

(b) Where shown on the drawings, the sub grade of Gardens and Grass Areas shall be cultivated prior to placing garden mix soil or turf top soil.

(c) The sub grade shall be thoroughly cultivated by ripping parallel to the final contours to loosen the compacted ground and to the depths nominated in Table SC6.4.6.26.3.

Table SC6.4.6.26.3 Cultivation depths

Location	Cultivation depth
Garden Areas	200 mm
Grass Areas	100 mm

(d) In areas of heavy clay natural soil, granulated gypsum shall be spread over the entire area of all gardens at a minimum rate of 2 kg per square metre and shall be thoroughly blended and incorporated into the subgrade during cultivation.

(e) In areas of heavy clay natural soil, granulated gypsum shall be spread over the entire area of all grass areas at a minimum rate of 2 kg per square metre and shall be:

(i) thoroughly blended and incorporated into the subgrade during cultivation if cultivation is to be carried out; or

(ii) spread prior to placing turf soil.

(f) Any soil additives and/or imported materials other than gypsum, that may be required to be applied to the natural soil shall be thoroughly blended with or spread over the subgrade.

(g) Cultivation shall not be carried out when the soil is wet or plastic.

(h) The Contractor shall ensure that no damage occurs to tree roots, underground services, kerbing and the like during the cultivation process. Cultivation by mechanical means shall not be carried out within the drip line of trees to be retained or within 300mm of pathways, paved areas and/or structures. Cultivation in these locations shall be carried out by hand. Refer to Clause SC6.4.5.2.1(19) Work adjacent to trees and protection of environmentally significant vegetation.

(i) After cultivation soil lumps shall have a maximum dimension of 50 mm. Stones exceeding 25 mm, clods of earth exceeding 50 mm, weeds, roots, sticks, rubbish and any other deleterious material brought to the surface during cultivation shall be removed. Any depressions caused by the removal of these materials shall be filled with top soil or on site spoil material approved by the Superintendent.

(j) After cultivation the surface shall be graded smoothly and evenly and trimmed to the required levels allowing for placing the specified depth of imported soil to achieve the finished surface levels as noted on the drawings. Care shall be taken to prevent areas of excessive compaction being caused by construction equipment.

(10) Backfilling trenches

(a) Backfill to trenches up to sub grade level under pathways and paved areas shall be clean sand or crusher dust compacted to 95% relative dry density standard compaction.

(b) Backfill to trenches up to sub grade level in gardens and grass areas shall be imported soil mix or material excavated from the trench or may be other on site material approved by the Superintendent.

(c) Trenches excavated in gardens within the imported garden mix soil shall be backfilled with imported garden mix soil mix as specified.

SC6.4.6.26.5 Vegetation of slopes and drains

(1) Execution and timing of work

(a) The work to be executed under this clause includes the vegetation of cut and fill batters, pathway verges, median areas, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising and either sowing of seed or turfing as shown on the drawings.

(b) Exposed ground shall be vegetated before the area exceeds one hectare or lesser area in compliance with council requirements.

(2) Materials

(a) Topsoil
The Contractor shall use topsoil stockpiled on site under the sub-section SC6.4.6.10 Earthworks (construction). Where imported topsoil is required it shall comply with AS 4419 and shall:

(i) be of a friable, porous nature;

(ii) be free of weeds and weed seeds, bulbs, corms and vegetable propagules;

(iii) contain no refuse or materials toxic to plant growth;

(iv) contain no stumps, roots, clay lumps or stones larger than 50 mm in size;

(v) have an organic content of at least 3 per cent by mass;

(vi) have a pH neither less than 5.5 nor more than 7.5; and

(vii) have a soluble salt content not exceeding 0.06 per cent by mass.

(b) Herbicide

Herbicide used shall be a glyphosate based herbicide listed in SC6.4.6.26 Attachment A.

(c) Seed

(i) All seed used shall be of the species and varieties list in SC6.4.6.26 Attachment A and shall be sown at the application rates specified therein. The Contractor shall submit to the Superintendent the name/s of the proposed seed supplier/s within 2 weeks of the acceptance of the tender.

(ii) The Contractor's attention is drawn to the lead time that may be required to procure some native seed species. The native seed shall be delivered to the site in separate lots for each species and variety, clearly labelled to show species, variety and weight.

(iii) All seed must be accompanied by a "Certificate of Authenticity" which shall be furnished by the Contractor to the Superintendent upon request at any stage of the work. Grass and clover seed shall be pre-packed commercially with an accompanying certificate of germination.

(iv) The Contractor shall not take possession of the seed more than 7 days before sowing is to occur. The seed shall be stored in clean, air tight containers and kept away from direct sunlight. It shall not be exposed to the elements at any stage during storage.

(v) The Contractor shall replace at his own expense any exotic seed batch found not true to type.

(d) Turf

Turf shall consist of 25 mm depth of dense, well rooted, vigorous grass growth with 25 mm depth of topsoil. The type of grass turf to be used shall be selected from SC6.4.6.26 Attachment A and in accordance with the drawings. Unless specified, Kikuyu grass shall not be used. Turf shall be free of weeds, soil pests and diseases. The turf shall be supplied as rolls in long lengths of uniform width, not less than 300 mm, and shall be in sound unbroken condition.

(e) Fertiliser

Fertiliser shall be an organic type listed in SC6.4.6.26 Attachment A with Nitrogen: Phosphorus: Potassium (N:P:K) ratios of 8 : 3.6 : 2.

(f) Vegetable mulch

Vegetable mulch used in hydromulching shall consist of straw, chaff, wood fibre, paper pulp or similar material all finely shredded to a maximum dimension of 10 mm. Meadow hay or weeds shall not be used and paper pulp if used shall not exceed 50 per cent by mass of the total mulch.

(g) Water

Water used shall be potable.

(h) Binder

The binder used in hydromulching and strawmulching shall be Grade ASS, slow setting anionic bitumen emulsion, complying with AS 1160.

(i) Wetting agent

The soil wetting agent added in hydromulching or hydroseeding shall be listed in SC6.4.6.26 Attachment A and applied at the application rate specified therein.

(j) Pesticide

Pesticide used shall be a liquid or powder listed in SC6.4.6.26 Attachment A. The storage and handling of pesticides shall be in accordance with AS 2507.

(3) Vegetation of slopes 3 to 1 or flatter

(a) Preparation of surface

(i) Slopes shall be sprayed with herbicide applied at the rate specified in SC6.4.6.26 Attachment A to kill weed infestation. Sprayed areas shall remain undisturbed for two weeks.

(ii) The surface shall then be tyned to a depth of 200 mm to produce a loose surface and all large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling.

(b) Topsoiling

Topsoil shall be uniformly applied to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location. The topsoiled area shall be cultivated to a depth of 50 mm to provide a roughened surface with soil lumps not exceeding 50 mm dimension.

(c) Mixing of seed

The Contractor shall give the Superintendent 2 days notice before each sowing operation. Seed shall be sown on the day of mixing with pesticide.

(d) Incorporation of pesticide

Immediately before sowing, all grass and native seed shall be treated with pesticide. The pesticide shall be thoroughly mixed as a dry powder with the seed at the rate specified in SC6.4.6.26 Attachment A to the equivalent mass of seed to be spread on 1 hectare of the surface in accordance with SC6.4.6.26 Attachment A.

(e) Sowing

(i) Sowing shall be carried out with an appropriate mechanical seeder. Where practicable, passes shall follow finished surface contours. Seed shall be sown at a depth of 5 mm or shall be raked or harrowed to provide 5 mm cover.

(ii) Seed and fertiliser shall be evenly distributed over the areas to be sown at the rates specified in SC6.4.6.26 Attachment A. Fertiliser shall be applied concurrently with the seeding operation.

(f) Turfing

(i) Turf shall be placed on the prepared topsoiled surface. Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow. Turf seams shall then be topdressed with topsoil.

(ii) Four to six weeks after placement, the turf shall be lightly topdressed with topsoil to correct any undulations or unevenness in the established turf.

(g) Watering

The Contractor shall water areas to be sown to a moist condition and shall rewater areas to a moist condition without surface runoff on a daily basis for a minimum of 15 days after sowing, or as otherwise directed by the Superintendent, to promote and maintain growth.

(4) Vegetation of slopes steeper than 3 to 1

(a) General

Where required or directed by the Superintendent, slopes shall be vegetated by one of the following methods:

(i) topsoiling and hydromulching;

(ii) topsoiling, hydroseeding and straw mulching; or

(iii) hydroseeding.

(b) Preparation of surface

(i) Weeds shall be killed by spraying with herbicides as specified in SC6.4.6.26 Attachment A.

(ii) No more than 7 days before seeding all loose material shall be removed from fill batters and cut batters, which are not stepped, by dragging a heavy steel chain of minimum weight of 30 kilograms per metre of length or by other methods approved by the Superintendent.

(c) Topsoiling

Where batters have been stepped, the steps shall be loosely filled with topsoil. Elsewhere, topsoil shall be uniformly applied to provide an average thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.

(d) Hydromulching or hydroseeding

(i) The hydromulch or hydroseed shall comprise the materials shown in Table SC6.4.6.26.4. The

materials shall be applied at the application rates shown in Table SC6.4.6.26.4.

(ii) Dry surfaces shall be watered by a fine spray before the application of the hydromulch.

(iii) During preparation of the hydromulch or hydroseed slurry, liquid form pesticide shall be added to the storage tank, to facilitate surface application, at a rate of 5 litres of pesticide to the equivalent volume of hydromulch or hydroseed slurry to be spread on 1 hectare of surface in accordance with Table SC6.4.6.26.4.

(iv) Storage tanks, containers and equipment to be used in hydromulching or hydroseeding of slopes shall be clean and free of contamination from previous operations.

(v) A slurry mixture shall be produced by addition of the specified materials in the tank and agitated to maintain a uniform consistency during application. It shall be applied uniformly over the whole surface.

(vi) Hydromulch or hydroseed shall not be applied under the following weather conditions at the site:

(A) when temperature is higher than 35 ºC;

(B) when winds exceed 15 km/hr;

(C) where, in the opinion of the Superintendent, the surface is too wet; or

(D) during rain periods or when rain appears imminent.

(vii) Application rates shall be in accordance with Table SC6.4.6.26.4.

Table SC6.4.6.26.4 Materials and application rates

Application Rate per Hectare		
Material	**Hydromulching**	**Hydroseeding**
i) Vegetable Mulch (kg)	2,500	Nil
ii) Water (L)	35,000	20,000
iii) Binder (L)	700	Nil
iv) Fertiliser	See SC6.4.6.26 Attachment A	
v) Seed	See SC6.4.6.26 Attachment A	
vi) Wetting Agent (L)	35	20
vii) Pesticide (L)	5	5

(e) Straw mulching

The mulch to be applied after hydroseeding shall comprise a matrix of straw and an anionic slow setting bitumen emulsion binder. Meadow hay shall not be used. The straw mulch shall be uniformly applied by a suitable blower unit at a rate of 250 bales (each of 20 kilograms) of straw per hectare of surface. The bitumen emulsion shall be incorporated as a spray into the air stream of the mulch blower at a rate of not less than 2,500 litres of bitumen emulsion per hectare of surface. The finished straw mat shall have a minimum thickness of 20 mm at any location.

(5) Vegetation of open drains

(a) Preparation of surface

The Contractor shall so execute the work that the excavation of open drains to the specified profiles is followed within 7 days by the vegetation of the surface as specified in this clause. Topsoil shall be spread to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.

(b) Sowing

Before sowing, the surface shall be watered. Seed and fertiliser shall then be applied uniformly at the rates specified in SC6.4.6.26 Attachment A by one of the following procedures as directed by the Superintendent:

(i) mechanical sowing;

(ii) hydromulching or hydroseeding; and

(iii) by hand.

(c) Surface protection - general

Where shown on the drawings or directed by the Superintendent, one of the following protective treatments shall be applied immediately to all or part of the sown surface.

(d) Surface protection - spraying with bitumen emulsion
An anionic slow setting bitumen emulsion, conforming with Grade ASS of AS 1160, shall be sprayed over the surface at a rate of 1 litre of bitumen emulsion per square metre of surface.

(e) Surface protection - lining with organic fibre mat

(i) The channel surface shall be lined with an organic fibre mat listed in SC6.4.6.26 Attachment A. The runs of matting shall be laid along the direction of water flow. The matting shall be laid loosely on the soil surface and not stretched.

(ii) The upstream end of the matting shall be slotted into a trench 150 mm wide by 150 mm deep and pinned to the base of the trench at 200 mm centres. The trench shall be backfilled with soil and compacted by foot.

(iii) The pins shall be `U' shaped, 4 mm gauge wire, 50 mm wide and 150 mm long legs.

(iv) Adjacent runs of matting shall be overlapped 100 mm with the higher run lapped over the lower run. The matting shall be pinned along the sides of each run at 500 mm centres and along the middle of each run at 1 m centres. End overlaps shall be 150 mm wide with the higher run end lapped over the start of the lower run and pinned at 200 mm centres.

(f) Turfing

(i) Turf shall be as specified under clause SC6.4.6.26.5(2)(d).

(ii) Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow in the drain, and pinned into position at 500 mm centres.

(iii) Seams of turf shall be topdressed with topsoil.

(g) Watering
The Contractor shall water treated areas in order to promote and maintain growth as specified under clause SC6.4.6.26.5(3)(g).

SC6.4.6.26.6 Garden construction

(1) Scope
The following work activities relate to the construction of garden beds, garden areas and mass planting areas:

(a) earthworks (excavation, filling and cultivation);

(b) supply and application of soil improvement additives;

(c) supply and placing garden mix soil;

(d) supply and placing mulch;

(e) supply and planting of trees, shrubs, ground cover plants and the like including stakes and other plant supports;

(f) supply and application of fertiliser;

(g) supply and installation of garden edging; and

(h) supply and installation of subsoil drains.

~~Refer to the standard drawings for typical garden details.~~

~~**Editor's note—**standard drawings for these works are under development.~~

All garden construction shall be in accordance with the current relevant Australian Standards:

- AS 4419 - *Soils for landscaping and garden use*; and
- AS 4454 - *Composts, soil conditioners and mulches*.

~~**Editor's note—**standard drawings for these works are under development.~~

(2) Co-ordination
The sequence for placing garden mix soil, installing irrigation, placing mulch and planting will vary according to the type of plants and irrigation system. The Contractor is required to liaise with other Contractors and the Superintendent to ensure the best possible method of construction is undertaken.

(3) Earthworks

Gardens may require Excavation or Filling to achieve the finished surface levels nominated on the drawings. After excavation or filling, all gardens may require cultivation.

(4) Garden bed dimensions

Planting bed dimensions are in accordance with the following:

(a) garden beds have an average minimum width of 1.2 m, provided that the bed is no less than 0.5 m wide; and

(b) root zone depths for plants are at least that of the root ball of the plant at planting.

(5) Soil condition

(a) Priority is to be given to using existing site soil as imported soil is a limited resource.

(b) Existing topsoil is conserved by either not disturbing the soil during construction or by stockpiling it prior to construction commencing, in accordance with SC6.4.5.2 Stockpiling of materials.

(c) Subsoil is to be cultivated to a minimum depth of 200 mm for garden beds and 100 mm for turfed areas unless this will adversely affect the roots of established trees.

(d) The minimum top soil depth is:

(i) 100 mm for non-irrigated turf areas;.

(ii) 200 mm for irrigated turf areas; and

(iii) 300 mm for garden beds;

(e) If additional soil is required to meet these minimum depths, soil is to meet AS4419 Soils for landscaping and garden use.

(f) The soil quality is sufficient to allow plants to grow effectively. Soil amelioration measures to improve the infiltration of existing soils, the soil's macropore and micropore balance and ensure a stable soil ecosystem, include the following:

(i) scarification of crusted topsoil layers;

(ii) aeration of topsoil layers;

(iii) deep ripping of subsoil layers;

(iv) using hand tools only within the tree protection zone of a tree identified for retention;

(v) the application of gypsum to sodic clay topsoils and subsoils;

(vi) installing a 50 mm layer of lucerne hay between the topsoil and mulch layer;

(vii) adding worms to the topsoil;

(viii) applying soil rhizobia in solution to the topsoil;

(ix) inoculating plants with Mycorrhizal fungi; and

(x) incorporating soil wetters, crystals and wettable foams.

(6) Soil improvement additives

Any soil additives to be applied shall be as required/recommended by soil test results.

(7) Placing imported soil in gardens

(a) Garden mix soil shall be an imported "Organic Soil".

(b) Garden mix soil shall be a minimum depth of 300 mm after consolidation.

(c) Garden mix soil shall be placed, spread and graded evenly in maximum 150 mm thick layers to finish at a level which allows the surface of the mulching material after consolidation to be flush with adjacent finished levels. Care shall be taken to prevent areas of excessive compaction being caused by construction equipment.

(d) Garden mix soil shall be graded evenly to form a gentle crowned appearance at the centre of the garden

bed and/or shall conform to the finished levels detailed on the drawings.

(e) The surface of the garden mix soil shall be smooth and free from stones or lumps of soil prior to planting.

(8) Mulch material
Refer to clause SC6.4.6.26.3 Supply of materials.

(9) Placing mulch

(a) Mulch shall be placed as soon as practicable after planting and shall be placed progressively as planting proceeds along the length of the garden or planting area.

(b) Mulch shall be spread smoothly and evenly over the entire garden so that after initial consolidation the finished level of the mulch is flush with adjacent finished levels.

(c) Mulch shall be shaped around plants to slope into the plant and shall be kept a minimum of 50 mm clear of plant stems to avoid collar rot.

(d) Organic mulch
Organic mulch shall be placed to a depth not greater than 100 mm and as a minimum shall be maintained to a depth of 75 mm after consolidation.

(e) Inorganic mulch
Not less than 14 days prior to the placing of inorganic mulch, herbicide shall be applied to the entire area to be mulched and prior to placing the mulch.

(f) Inorganic mulch shall be placed to a minimum depth of 100 mm unless noted otherwise on the drawings for the type of mulch specified.

SC6.4.6.26.7 Planting

(1) General

(a) Planting shall be carried out in accordance with the best horticultural practices.

(b) Plants shall be installed at the spacings and locations detailed on the drawings to avoid existing services or to cover an area uniformly.

(c) In feature planting areas at least 25% of tree plantings are to be provided as larger advanced stock, with a minimum 25 litre pot size.

(d) The Contractor is required to locate all existing services prior to planting.

(e) Planting shall not be carried out if the soil is very wet or water logged or during periods of extreme weather conditions such as extreme heat, cold wind or rain.

(f) Plant supplies are to be healthy, attractive, and a general high standard of stock in order to ensure long-term viability of the specimen. The stock will be free from disease, pests and weeds and structural defects, as per clause SC6.4.6.26.3 Supply of materials.

(2) Planting procedure – container stock

(a) A planting hole with vertical sides shall be excavated to a width of twice the diameter of the root ball of the plant and to a minimum depth of 100 mm deeper than the height of the plant container.

(b) The depth of the planting hole shall allow for the clearance specified and shall be in relation to the finished surface level where applicable.

(c) The sub grade material at the bottom of the planting hole shall be loosened to a depth of at least 50% of the root ball depth and the compacted sides of the planting hole shall be loosened to prevent confinement of root growth to the hole. Additional excavation of the base of the planting hole may be required to ensure that the plant has sufficient sub grade drainage.

(d) Plants shall be thoroughly watered in the pot prior to planting so that when removed from the pot the root ball is moist. Plants shall be removed from their pots without damage to the root system. Plants shall not be removed from pots until the planting hole is complete and ready for planting.

(e) The plant shall be placed in the centre of the hole with the stem vertical and shall be set at a height such that the top of the potting material is level with the surrounding soil. Plants placed on a slope shall be set

in the centre of the hole with the top of the potting material level with the lowest side of the planting hole and the plant stem vertical.

(f) Fertiliser tablets or granules shall be placed in the planting hole at the time of planting in accordance with the manufacturers recommended rates of application. The fertiliser shall be placed around the plant at half the depth of the planting hole and shall be covered with backfill soil to ensure no direct contact with the plant roots.

(g) Plants other than container stock trees placed in gardens shall be backfilled with garden mix soil as specified for the entire planting hole. The garden mix soil shall be lightly tamped around the plant and thoroughly watered to eliminate air pockets.

(h) During planting care shall be taken to ensure that soil is not mixed with the mulch. Mulch that is contaminated with soil shall be replaced.

(i) Container stock trees shall be backfilled in 150 mm layers up to within 200 mm of the top of the planting hole. The backfill soil shall be tamped around the tree and thoroughly watered to eliminate air pockets. Backfill the top 200 mm with garden mix soil.

(j) In areas other than heavily planted borders, shrubs or tuft plants, each individual plant shall have a watering basin for the extent of the planting hole formed with garden mix soil around the base of the plant.

(k) Individual container stock trees located in irrigated grassed areas shall have a 150 mm high watering basin for the extent of the planting hole formed with garden mix soil around the base of the tree.

(l) Plants placed on a slope shall have a small horizontal terrace formed for the extent of the planting hole.

(m) Immediately after planting, the plants shall be watered to thoroughly water the root ball and the backfill. Watering shall be carried out progressively as planting proceeds to ensure that plants do not dry out and as a minimum, plants shall be watered within a maximum of 1 hour from planting.

(n) All identification labels, nursery ties and the like shall be removed from the plants immediately after planting

(3) Planting procedure - ex ground stock plants

Editor's note—content under development.

(4) Transplanting trees

(a) Trees to be transplanted will be noted on the construction drawings prior to the commencement of construction.

(b) Preparation of the tree prior to transplanting shall be carried out in accordance with accepted transplanting practice and any requirements provided by council to suit the particular species and project.

(c) Preparation of the tree for transplanting shall be commenced in sufficient time to ensure that at the time of planting the tree is adequately prepared and will meet the specified requirements.

(d) All transplanting work shall be carried out under the direction of a suitably qualified horticulturist or arborist.

(e) Planting of the transplanted tree shall be generally in accordance with the details shown on the drawings.

(f) The resulting excavation after the tree has been removed shall be backfilled with compacted fill material suitable for the location.

(5) Root barrier

(a) Locations and type of root barrier shall be noted on the drawings or shall be as directed by the Superintendent.

(b) Root barrier shall be installed as per the manufacturers' recommendations and with particular attention to the location of any underground services and service pits.

(c) Root barrier must be installed in all situations where it is likely that tree roots may interfere or adversely

affect infrastructure - such as driveways, kerbs, pathways and other street furniture and buildings, e.g. where species such as Ficus are to be planted in reasonable proximity to pathways.

SC6.4.6.26.8 Staking, ties and guying

(1) Every container stock tree shall be staked and tied unless otherwise approved by the Superintendent. Tree stakes

(a) Stakes shall be:

(i) a minimum of 2 stakes per tree;

(ii) placed outside of the tree root ball;

(iii) driven into the ground a minimum one third of their length;

(iv) for smaller trees (trees up to 45 litre), at least 1.0 metre apart; and

(v) for columnar trees, spaced to avoid excessive root ball damage.

(b) Care shall be taken to avoid damage to the tree root system and any services when installing stakes.

(c) All stakes shall remain in place for the entire “maintenance period” unless otherwise instructed by the Superintendent.

(2) Ties

Ties shall be fixed securely with staples to the stakes in a figure eight pattern around the tree stem. As a minimum one tie at half the height of the main stem shall be provided with additional ties as necessary to stabilise the tree.

(3) Guying

(a) Trees requiring the installation of guying shall be noted on the construction drawings or shall be as directed by the Superintendent.

(b) Guying consists of a minimum of three heavy duty stakes of either steel or timber driven into solid ground, with heavy duty galvanised wire ties firmly fasten to the stakes and looped around the tree trunk with suitable wrapping to protect the trunk.

(c) Underground guying where required to be used, shall be positioned for stability purposes, placement of the guy wires shall away from the tree trunk to avoid girdling issues as the tree matures. Such tree quying practices shall be removed prior to Off Maintenance inspection and acceptance by council.

Editor’s note—underground guying is accepted where suitable for the tree in question. ~~Specifications are to be developed in future.~~

SC6.4.6.26.9 Sub soil drains construction

(1) Sub soil drains in gardens may be required in areas of heavy clay soils and in roadway medians, roundabouts and the like. Sub soil drains shall be installed at the locations and to the details shown on the drawings.

(2) Pipes and fittings shall be perforated plastic Type 1 Class 200 to AS2439: Part 1. Sub soil drain filter fabrics shall be approved geo fabric material in accordance with the relevant Australian Standards.

(3) Pipe surround shall be a coarse washed river sand complying with the grading requirements given in Table SC6.4.6.26.5 and shall completely surround the perforated pipe.

(4) The subsoil drain pipe shall be laid to grade continuously to the outlets nominated on the drawings at a minimum grade of 1:100.

(5) Sub soil drains may be inspected by the Superintendent prior to placing any garden mix soil or backfill.

Table SC6.4.6.26.5 Recommended grading for sub-soil drain sand

A.S. SIEVE	% PASSING
9.5 mm	100
4.75 mm	98-100
2.36 mm	70-100
1.18 mm	30-78
600 µm	2-15
300 µm	0-4
150 µm	0-1

SC6.4.6.26.10 Garden edging

(1) Supply and installation of timber, concrete or recycled plastic proprietary garden edging shall be in accordance with the details on the drawings and the manufacturer's recommendations where applicable. Timber or recycled plastic garden edging must have a minimum thickness of 30 mm.

(2) Supply and installation of concrete kerbing shall be as specified in clause SC6.4.6.26.15.

SC6.4.6.26.11 Planter boxes

(1) Planter boxes shall be constructed at the locations and to the details shown on the construction drawings.

(2) Planter box soil shall be an imported soil mix (Potting Mix). Refer to project specific specifications where applicable.

(3) Planter boxes must have appropriate drainage (see clause SC6.4.6.26.9 Sub soil drains construction) provided that it is connected to a lawful discharge point. The drainage discharge is not permitted to cause nuisance, such as staining or sediments, to adjacent areas.

SC6.4.6.26.12 Grass area construction

(1) General

The following work activities relate to grass areas construction:

(a) earthworks (excavation, filling and cultivation);

(b) supply and application of soil improvement additives;

(c) supply and placing turf soil;

(d) supply and lay grass turf;

(e) supply and lay grass seeding;

(f) supply and installation of hydro-seeding/mulching; and

(g) supply and application of fertiliser.

All grass area construction shall be in accordance with the current relevant Australian Standards:

- AS 4419 Soils for landscaping and garden use; and
- AS 4454 Composts, soil conditioners and mulches.

(2) Co-ordination

The sequence for placing turf soil, installing irrigation and placing turf will vary according to the type of plants and irrigation system.

(3) Earthworks

Grass areas may require excavation or filling to achieve the finished surface levels detailed on the construction drawings. Refer to clause SC6.4.6.26.4 Earthworks.

(4) Placing turf soil

(a) Turf soil shall be an imported soil mix Type 2 “Soil Blend”.

(b) Turf soil shall be a minimum depth of 100 mm after light compaction.

(c) Turf areas shall be graded to fall evenly between the finished surface levels detailed on the drawings and/or shall be graded to drain freely to stormwater inlets without causing ponding. As a minimum turf areas shall be graded to fall at 1:100.

(d) Turf soil shall be spread evenly and shall be lightly compacted to finish at a level which allows for the finished turf surface to be flush with adjacent surfaces such as paved areas, pathways mowing strips and the like. Care shall be taken to prevent areas of excessive compaction being caused by construction equipment.

(e) The surface of the turf soil shall be smooth and free from stones or lumps of soil prior to laying the turf.

(5) Turf material

(a) Turf shall be the species nominated on the drawings and shall be supplied by a specialist grower of cultivated turf approved by the Superintendent.

(b) Where turf areas are provided within centre medians, round-abouts and other identified areas of road reserve where edging/mowing may require traffic control, all turf is to be Empire Zoysia or approved similar turf and of a minimum width of 1.6 m to allow for clear mowing access.

(6) Laying turf

(a) Prior to laying turf, fertiliser shall be thoroughly mixed into the turf soil. Refer to Table SC6.4.6.26.5 for application rates.

(b) Areas to be turfed shall be divided into sections that can be prepared and completed (including adequate watering) in the same day.

(c) Turf shall be laid in straight lines in a stretcher bond pattern across the fall of the slope or parallel with the long side of level areas. Cross joints shall be staggered with a maximum gap of 5 mm between adjacent sections of turf.

(d) Immediately after laying the turf shall be rolled with a roller weighing not more than 90 kg/m of width.

(e) As soon as practicable after rolling turf shall be watered thoroughly with a fine spray to a depth of 150 mm. Watering shall continue as necessary to maintain moisture to this depth and to maintain the turf in a healthy condition.

(f) Where levels have deviated from the design levels after placing and watering the turf shall be lifted and the section regraded with turf soil to achieve design levels prior to replacing the turf.

(g) Turf shall be protected from pedestrian traffic until established and shall be protected from vehicle traffic at all times.

SC6.4.6.26.13 Hyrdo seeding/mulching

(1) General

(a) Excavation, filling, cultivation and placing imported soil mix for hydro seeding/mulching areas shall be as specified for turf areas.

(b) Details for hydro seeding/mulching supply and sowing shall be as noted on the drawings and/or as specified under separate cover.

(c) Organic mulches are to be applied to landscaped garden beds and trees which:

(i) meet AS 4454 Composts, soil conditioners and mulches;

(ii) are applied to a depth of 75 – 100 mm;

(iii) are of a coarse texture to allow water penetration to prevent nitrogen drawdown of the soil;

(iv) are aged prior to application;

(v) do not use plastic sheeting, typically used for weed suppression as it prevents rainwater from infiltrating soils and inhibits gaseous exchange between the soil and air; and

(vi) use a biodegradable mulch mat on any waterway embankment.

(d) Inorganic mulches, such as recycled concrete or brick cobbles, are limited to feature or themed landscapes, or in windy areas where organic mulches may be blown away.

(2) Supply of mulch materials

(a) Mulch materials supplied shall be free of deleterious and extraneous matter such as soil, weeds, seeds, rubbish, vermin, insects, pests, fungus, sticks, disease, declared plants or noxious weeds and shall be free of any matter toxic to plant growth or germination.

(b) All mulch materials supplied shall be in accordance with AS 4454 Composts, soil conditioners and mulches.

(c) Organic mulch
Organic mulch may be either:

(i) tea tree mulch from an approved supplier; or

(ii) wood chip produced by the chipping of native and other approved vegetation removed during the clearing and grubbing process on site (max 50 mm size); or

(iii) wood chip obtained from a council stockpile as directed by the Superintendent or his delegated site supervisor; or

(iv) other material as noted on the drawings.

(d) Inorganic mulch
Inorganic mulch shall be of the type and quality and noted on the construction drawings.

(3) Surface preparation

(a) Level sites
Prior to hydro seeding/mulching the area to be treated shall be graded to fall evenly between the finished surface levels detailed on the drawings and/or shall be graded to drain freely to stormwater inlets without causing ponding.

(b) Embankments and slopes (1 on 5 maximum slope)
Prior to hydro seeding/mulching the area shall be lightly cultivated across the slope to minimise surface run-off and erosion. After cultivation, soil crumb size shall not exceed 20 mm.

(c) The surface of the area to be treated shall be free from weeds, stones, roots, sticks or other deleterious material and have a general moisture content of around 10% just prior to applying the hydroseed/mulch.

(4) Irrigation
An approved temporary above ground irrigation system shall be installed to ensure establishment of the hydro seeding/mulching is achieved within the timer frame specified. Refer to SC6.4.6.27 Irrigation.

SC6.4.6.26.14 Paving construction
Refer to sub-section SC6.4.6.18 Segmental paving.

All areas of road reserve fronting a subject site must be assessed against, and treated in accordance with SC6.4.3.3 Footpath treatment policy where specified.

SC6.4.6.26.15 Concrete kerbs
This section contains specific details for construction of concrete kerb in landscape and open space situations. Concrete kerb is most commonly used for garden edge or as a restraint for softfall areas in playgrounds.

All concrete garden edge kerb or similar structure shall have minimum rectangular profile dimensions of 150 mm wide x 200 mm deep with edges rounded to a radius of 20 mm (minimum) and constructed in accordance with clause SC6.4.6.28.2(2) Kerb and channel. Where the concrete garden edge kerb abuts grass areas, the surface of the kerb must finish level with the surface level of the grass area.

SC6.4.6.26.16 Concrete works

For all concrete works associated with Landscaping activities refer to sub-section 6.4.6.28 Minor concrete works.

SC6.4.6.26.17 Masonry work

This section covers the supply of all materials, placing and finishing of all masonry blockwork including concrete core-filling and clay brickwork. Masonry Work includes walls, retaining walls, free standing piers, structures and the like. All masonry work shall conform to the requirements of AS 3700.

(1) Materials

(a) Blocks - Hollow load bearing masonry blocks shall conform to the requirements of AS 3700 - Section 2, and shall have a characteristic unconfined compressive strength of 15 MPa unless nominated otherwise agreed.

(b) Masonry blocks shall be sound, dry, clean and crack free and shall have been cured for not less than 14 days before delivery. The correct type of block shall be used to make provision for all lintels, pilasters, bond beams, openings, etc.

(c) Clean out blocks shall be used in the first course of all reinforced cores and/or where cores are to be concrete filled.

(d) Cement - for mortar shall be Portland Cement Type A and shall conform in all respects with the requirements of AS 3972.

(e) Sand - for mortar shall be clean, sharp and free from organic impurities and excess fines and efflorescing salts.

(f) Water - used in mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.

(g) Hydrated lime shall conform to the requirements of AS 1672.1.

(h) Admixtures - no air-entraining additives or other admixtures shall be incorporated in the mortar unless specifically approved by the Superintendent.

(i) Reinforcement - shall comply with AS/NZS 4671 as applicable.

(j) Clay bricks - and brickwork shall conform to AS 3700. Clay brick shall have a characteristic unconfined compressive strength of 40 MPa unless otherwise agreed.

(2) Mortar for blockwork

(a) All mortar for blockwork shall consist of a homogeneous mixture of the ingredients and shall be classified as M4 in AS 3700. The following proportions by volume shall be used unless the minimum compressive strength of mortar at 28 days has been nominated on the drawings. Cement 1: Lime 0 to 0.25: Sand 3.

(b) The mortar components shall be properly volume batched using calibrated volume boxes. Batching by shovel will not be permitted.

(c) Mortar shall be mixed in an approved mixing machine for not less than 3 minutes. Handmixing shall not be permitted unless specifically approved by the Superintendent. The dry ingredients shall be thoroughly mixed prior to the addition of water, which shall then be worked thoroughly through the mixture.

(d) Mortar shall be transported in a covered container such that excessive evaporation will be prevented. Retempering of mortar shall not be permitted.

(3) Core-fill concrete

(a) Core-fill concrete shall comply with the relevant requirements of AS 3600 Concrete Structures. Ready mixed concrete from an approved supplier shall be used. As a minimum and unless shown otherwise on the drawings, core-fill concrete supplied shall have the following properties in Table SC6.4.6.26.6.

Property	Design Value
Characteristic strenght F'c at 28 days	N 20
Norminal maximum size of aggregate	10 mm
Slump	230 mm +/-30 mm

(b) Testing of core-fill concrete supplied shall be carried out by the Concrete Supplier as part of the suppliers Quality Assurance System. The Contractor is required to provide the Superintendent with copies of the suppliers Test Certificates relating to the particular batch of core-fill concrete supplied.

Core-fill concrete supplied that does not meet the requirements of this specification shall be liable to rejection by the Superintendent. If directed by the Superintendent the Contractor will rectify any masonry wall which has been filled with rejected core-fill concrete.

(4) Laying blocks

(a) All work shall be carried out by experienced tradesmen to the general requirements of AS 3700 - Section 8. Blockwork shall be laid in lifts or not more than 2400 mm in height.

(b) All blocks shall be laid dry and wetting of the blocks shall not be permitted under any circumstances.

(c) Cutting of blocks shall be reduced to an absolute minimum by setting out to avoid irregular or broken bond.

(d) Blocks shall be stacked on planks or other supports free from contact with the ground and shall be covered at all times to ensure that the blocks remain dry.

(e) Blocks shall be laid in straight uniform courses of running bond unless noted otherwise on the drawings. Intersecting walls shall be bonded as shown on the drawings.

(f) The surface of the concrete footing, floor slab, beam, etc. on which the base course is to be laid shall be thoroughly cleaned prior to laying the base course to ensure all laitance is removed.

(g) The base course shall incorporate clean out blocks at every reinforced core, with the clean out opening on the inside face of the wall.

(h) Reinforcement starter bars shall be checked for alignment prior to laying the base course. Starter bars shall be vertical. Bending starter bars to allow the laying of the base course is not acceptable. Any starter bars out of position shall be rectified by the Contractor as directed by the Superintendent.

(i) For unreinforced and reinforced masonry walls, horizontal joints shall have full mortar coverage on the face shells and on the webs.

(j) For unreinforced masonry walls all vertical joints shall have full mortar coverage. For reinforced masonry walls all vertical joints shall be buttered only for the thickness of the face shells.

(k) All horizontal and vertical joints shall be 10 mm in width with a maximum mortar intrusion into the cores of 6 mm. Mortar droppings into cavities or cores shall be avoided.

(l) Tooling of the joints shall be done when the mortar is partially set but still sufficiently plastic to bond. All tooling shall be done with a V-shaped or round bar in a manner that will compact the mortar rather than drag it out. Raked joints shall not be permitted to encroach more than 5 mm in depth.

(m) If it is necessary to move a block after it has been set in place with mortar, then the block shall be removed from the wall, the mortar removed and the block shall be reset in fresh mortar.

(n) Capping blocks shall be fixed with a suitable flexible external grade adhesive as detailed on the drawings. Laying capping blocks in mortar only is not acceptable.

(o) Where new blockwork is to be laid on top of an existing masonry block wall, the existing core concrete shall be cleaned to expose all aggregate and treated using an adhesion enhancer such as bondcrete or approved equivalent before block laying is commenced.

(p) Extreme care shall be exercised to prevent mortar adhering to the face of blockwork. Acid shall not be used to clean down masonry walls.

(5) Reinforcement

(a) Steel reinforcement shall be supplied and bent in accordance with AS 3700. Rebending of reinforcement

with or without heating is not permitted unless approved by the Superintendent.

(b) Steel reinforcement shall be free from rust, oil, varnish, mud or any other coatings, cracks, scale blister and other defects and shall comply in all respects with AS/NZS 4671.

(c) All horizontal reinforcement shall be laid into the wall as the block laying progresses. Galvanised wire loops shall be cast into the horizontal joints prior to placing the reinforcement to ensure correct positioning of the reinforcement.

(d) Vertical reinforcement shall be placed after the wall has been laid and shall be placed in the core with the correct cover to the face of the blocks as detailed on the drawings. Unless noted otherwise on the drawings vertical reinforcement shall be placed in the centre of the core.

(e) Splice lengths for both horizontal and vertical reinforcement shall not be less than 45 bar diameters for plain round bars or 30 diameters for deformed bars or 450 mm, whichever is the greater.

(f) All reinforced block walls shall have vertical reinforcement in the core at the ends, corners, sides of openings, adjacent to control joints, at unbonded intersections and at the maximum centres between these points.

(6) Cast in elements

(a) The Contractor shall co-ordinate with all other trades as necessary to ensure that all conduits, fitments, penetrations and the like are incorporated in the masonry as detailed on the drawings and as specified.

(b) All bolts, anchors and other steel fittings shall be accurately set into the walls as the work progresses and positioned such that they shall be thoroughly embedded in mortar or core-filling concrete as required.

(c) Where items to be cast into the blockwork are found to be out of position and cannot be satisfactorily corrected, then the section of blockwork shall be completely demolished, and then reconstructed to allow correct positioning.

(7) Joints in blockwork

(a) Joints in blockwork shall be the type and at the locations detailed on the drawings. Joints with steel dowels shall have the dowels securely supported to ensure that the dowel remains in the correct position during the placing of core-fill concrete.

(b) Construction joints shall be located as detailed on the drawings or shall be located where agreed with the Superintendent to suit specific site requirements.

(c) Joint filling compounds shall be as detailed on the drawings and shall be installed in accordance with the manufacturers recommendations, with particular attention to the preparation of the blockwork surface to suit the application of the joint filling compound.

(8) Placing core-fill concrete

(a) Masonry walls shall cure for at least 3 days before core-fill concrete is placed.

(b) The cores to receive core-fill concrete shall be cleaned of all mortar protrusions by rodding from the top of the wall. All mortar droppings and foreign matter shall then be removed via the clean out openings at the base of the wall, the vertical reinforcement positioned and formwork fixed in place to seal the clean out block opening.

(c) Core filling shall not proceed until the reinforcement and cores have been inspected by the Superintendent. Clean out openings shall not be sealed until the inspection has been carried out.

(d) Core-fill concrete shall be thoroughly compacted into place as it is poured with the aid of small immersion vibrators or rodding. Block cores shall be topped up after settlement occurs.

(e) Core-fill concrete shall be placed for the full height of the blockwork in lifts of not more than 2400 mm in height. A minimum delay period of 1 hour and a maximum delay period of 3 hours shall be observed between lifts.

(f) Proprietary core plates shall be used to confine the core-fill concrete to the reinforced cores.

(g) Placing of core-fill concrete in bond beams shall be done in one continuous operation for the full length of the bond beam. Construction joints in bond beams other than control joints, are not acceptable.

(h) Extreme care shall be exercised to prevent slurry adhering to the face of blockwork. Acid shall not be used to clean down masonry walls

(9) Mortar for clay bricks

(a) All mortar for clay bricks shall consist of a homogeneous mixture of the ingredients and shall be classified as M3. Refer to AS 3700.

(b) The following proportions by volume shall be used unless the minimum compressive strength of mortar at 28 days has been nominated on the drawings. Cement: 1, Lime: 1, Sand: 6.

(c) Mortar for clay bricks shall be generally in accordance with clause SC6.4.6.26.17(2) Mortar for block work.

(10) Laying clay bricks

(a) Clay bricks shall be fully bedded and fully faced. Bed joints shall be 10 mm nominal height.

(b) Clay brick masonry walls shall be laid with galvanised brick ties at 600 mm maximum centres each way and at 300 mm centres adjacent to openings in accordance with manufacturer's specifications.

(c) Laying of clay bricks shall be generally in accordance with clause SC6.4.6.26.17(4) Laying blocks.

(11) Protection of walls

(a) During construction and after the wall is laid and prior to placing core-fill concrete; under no circumstances shall masonry blocks be wetted or allowed to become wet.

(b) At the completion of a day's work and during wet weather the top and sides of all walls shall be covered to prevent rain penetrating the cores and wetting the blocks.

(c) During the construction of masonry walls and prior to the core-fill concrete having gained its full strength, the Contractor shall protect the wall by suitable means such as bracing to ensure that the wall is not damaged and to ensure the safety of workers on the site.

(12) Tolerances

(a) All masonry shall be built true and plumb such that the maximum "out-of-plumb" in a 3 m height does not exceed 10 mm.

(b) The bed joint at any level shall be within ± 3 mm.

(13) Surface finishes to masonry

(a) Surface finishes, such as painting, rendering or textured finishes shall be as detailed on the drawings or as nominated in the Finishes Schedule.

(b) Prior to applying any surface finish the substrate shall be free from dirt, dust, oil, grease, mould, fungi, efflorescence, release agents, bond breakers, scaling and laitance or any other contaminants or foreign material that may affect adhesion. Remove all traces of loosely adhering material by scraping, grinding, wire brushing or air blowing as necessary.

(c) Preparation of the surfaces to be treated, application of the surface finish and curing after application if required, shall be carried out in strict accordance with the manufacturer's recommendations. Particular attention shall be made to application during suitable weather conditions.

(d) Gap fill and/or sealant material used for joints or cracks in walls shall be checked for compatibility with the proposed surface finish.

(e) Anti-vandal coatings shall be used in circumstances where walls are exposed (i.e. not screened by soft landscaping) and prone to graffiti.

(f) Dissimilar materials adjacent to surfaces to be treated shall be masked to avoid contact, (e.g. capping and flashings).

(g) The Contractor shall provide the Superintendent with all warranty details of the surface finishes.

SC6.4.6.26.18 Stormwater drainage

All stormwater drainage shall be constructed in accordance with the relevant stormwater drainage guidelines contained in SC6.4.6.4 Stormwater drainage.

SC6.4.6.26.19 Infrastructure items

Supply and installation of infrastructure items such as timber decking, timber and steel fencing, seats, picnic sets, barbeques, play equipment and signage shall be as detailed on the drawings and constructed in strict accordance with the manufacturers' specifications. The Contractor shall provide the Superintendent with all warranty details. Concrete for footings, plinths and the like for infrastructure items shall be in accordance with clause SC6.4.6.26.16 Concrete works.

SC6.4.6.26.20 Electrical

The installation of electrical components shall comply with the requirements of AS 3000. Where required under the *Electricity Act 1994*, electrical installations shall be installed by a registered Electrical Contractor as defined by that Act. Refer to the electrical engineer's drawings and specifications for all requirements.

SC6.4.6.26.21 Summary of limited and tolerance

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.26.7 below.

Item	Activity	Limits/Tolerances	Clause
1.	**Topsoil**	>3% by mass	SC6.4.6.26.5(2)(a).
	a) Organic Content		
	b) pH	>5.5 <7.5	SC6.4.6.26.5(2)(a)
	c) Soluble Salt	<0.06% by mass	SC6.4.6.26.5(2)(a)
2.	**Turf**	Widths >300mm.	SC6.4.6.26.5(2)(d)
3.	**Vegetable mulch**	maximum size <10mm	SC6.4.6.26.5(2)(f)
	a) Material	<50% by mass of total mulch	SC6.4.6.26.5(2)(f)
	b) Paper Pulp		
4.	**Topsoiling**	Minimum compacted thickness	SC6.4.6.26.5(3)(b)
		at any location of 30mm	SC6.4.6.26.5(4)(c)
			SC6.4.6.26.5(5)(a)
5.	**Straw mulching**	Finished thickness >20mm.	SC6.4.6.26.5(4)(e)
	a) Straw Mat		
6.	**Mulch**	Shall not exceed 5% by volume.	SC6.4.6.26.3(6)
	a) Fines		
	b) Woodchip	Maximum size <50mm.	SC6.4.6.26.3(6)
7.	**Plant material**	Contain >20% <25% by volume	SC6.4.6.26.3(2)
	a) Container Soil Mix	of clay.	

Attachments

SC6.4.6.26 Attachment A: Landscaping materials

MATERIAL *(sample only - to be completed by compiler)*	**TYPE**	**MINIMUM APPLICATION RATE**
1. HERBICIDE *	"Roundup"	As per manufacturers recommendations
2. SEED		
a) Grass	Rye Corn (April-August) or	60 kg/ha
Japanese Millet (September-March		60 kg/ha
Hulled Couch		5 kg/ha
Red Clover (Inoculated)		5 kg/ha
White Clover (Inoculated)		5 kg/ha
"Elka" Perennial Rye		5 kg/ha
(b) Native	Acacia dealbata	4 kg/ha
Acacia buxifolia		1 kg/ha
Acacia decurrens		1 kg/ha
Acacia pravissima		1 kg/ha
Leptospermum lanigerum		1 kg/ha
Hardenbergia violacea		500 g/ha
Kennedia prostrata		500 g/ha
Acacia implexa		200 g/ha
Banksia marginata		200 g/ha
Bursaria spinosa		200 g/ha
Callistemon pallidus		200 g/ha
Dodonaea viscoca		200 g/ha
3. TURF GRASS (a) Medians (b) Verges/Footpaths (c) Other Areas	Couch Buffalo Couch	Refer to drawings " "
4. FERTILISER * (a) Vegetation of Slopes/Drains (b) Landscape Planting	Dynamic Lifter "Nitro" "Kokei" pellets	1000 kg/ha
5. WETTING AGENT *	"Aquasoil"	1 litre/1000 litres of mix water
6. PESTICIDE * (a) Liquid (b) Powder	"Lorsban 500 EC" "Lorsban 250 W"	5 litres 10 kg
7. ORGANIC FIBRE MAT *	"Sta-firma" (light grade)	-
8. MULCH	Composted/Pasteurized	100mm thick
* Material shall be as listed or equivalent as approved by council.		

SC6.4.6.28 Minor concrete works

SC6.4.6.28.1 Introduction

(1) Scope

(a) This sub-section provide details for the supply and placement of concrete, including sprayed concrete, and ancillary requirements including excavation, preparation of foundations, forming up, placement of reinforcement and backfilling for work shown on the drawings but not having individual policy sub-sections. These works include kerb and channel, New Jersey type barriers, drainage pits and other supplementary structures, headwalls, box culverts, box culvert base slabs, driveways, footpaths, median toppings, retaining walls, footings, paving edge strips and works of a similar nature.

(b) The work also includes supply and placement of miscellaneous minor concrete work for water and sewerage construction such as valve chambers, thrust and anchor blocks, bulkheads, pumping stations, bedding, encasement and cast-in-situ access chambers.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:

SC6.4.6.6 - Pipe drainage

SC6.4.6.10 - Earthworks (construction)

SC6.4.6.12 - Flexible pavements

SC6.4.5 Construction management.

(b) Australian Standards

~~AS 1012~~AS1012.1 *Sampling of fresh concrete*

~~AS 1012~~AS1012.3.1 *Determination of properties related to the consistency of concrete - Slump test.*

~~AS 1012~~AS1012.8.1 *Method of making and curing concrete - Compression and indirect tensile test specimens*

~~AS 1012~~AS1012.8.2 *Method of making and curing concrete - Flexure test specimens*

~~AS 1012~~AS1012.9 *Determination of the compressive strength of concrete specimens*

~~AS 1012~~AS1012.14 *Method for securing and testing cores from hardened concrete for compressive strength*

~~AS 1141~~AS1141.14 *Particle shape, by proportional caliper*

~~AS 1141~~AS1141.21 *Aggregate crushing value*

~~AS 1141~~AS1141.23 *Los Angeles value*

~~AS 1141~~AS1141.24 *Aggregate soundness – Evaluation by exposure to sodium sulphate solution*

~~AS 1289~~AS1289.3.3.1 *Calculation of the plasticity index of a soil*

~~AS 1289~~AS1289.5.1.1 *Determination of the dry density/moisture content relation of a soil using standard compactive effort*

~~AS 1289~~AS1289.5.2.1 *Determination of the dry density/moisture content relation of a soil using modified compactive effort*

~~AS 1289~~AS1289.5.4.1 *Compaction control test - Dry density ratio, moisture variation and moisture ratio*

~~AS 1379~~AS1379 *Specification and supply of concrete*

~~AS 1478~~AS1478.1 *Chemical admixtures for concrete, mortar and grout – Part 1: Admixtures for concrete*

AS/~~NZS 1554~~NZS1554.3 *Welding of reinforcing steel*

AS/~~NZS 1859~~NZS1859 *Reconstituted wood-based panels*

~~AS 2082~~AS2082 *Visually stress-graded hardwood for structural purposes*

AS/~~NZS 2271~~NZS2271 *Plywood and blockboard for exterior use*

~~AS 2758~~AS2758.1 *Concrete aggregates*

~~AS 3600~~AS3600 *Concrete structures*

~~AS 3610~~AS3610	*Formwork for concrete*
~~AS 3799~~AS3799	*Liquid membrane-forming curing compounds for concrete*

~~AS 3972~~AS3972 *General Purpose and blended cements*
AS/~~NZS 4671~~NZS4671 *Steel reinforcing materials*
AS/~~NZS 4680~~NZS4680 *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

(c) Other
NSW RTA, *Shotcrete design guidelines*

SC6.4.6.28.2 Excavation and foundations

(1) General
The foundation where specified, shall be formed at the required depth below the finished surface levels shown on the drawings. Rock foundations shall be neatly excavated to form a bed for the concrete, and shall be thoroughly scraped and cleaned. Soil foundation shall, as far as possible, be excavated neatly from the solid material to coincide with the under-surface of the concrete. Compaction requirements must meet the appropriate compliance standards as specified in sub-section SC6.4.6.10 Earthworks (construction).

All soft, yielding or other unsuitable material shall be replaced with sound material approved by the Superintendent, and the subgrade shall be compacted to provide a minimum relative compaction as specified in SC6.4.6.10 Earthworks (construction). If the subgrade is dry it shall be sprinkled with as much water as it will readily absorb, before the concrete is placed.

Preparation of the foundation is required in accordance with foundation type, as follows:

(a) concrete working base - remove projections above the plane surface, and loose material; and

(b) graded prepared subgrade - blind with sufficient sand to create a smooth surface free from hard projections. Wet the sand just before laying the underlay.

Editor's note—Provision of a vapour barrier for external slabs on ground prevents water loss to the subgrade and has the potential to reduce slab curling at edges and corners.

~~AS 2870~~AS2870 Section 5.5 provides additional requirements and detailing of damp proof membranes for concrete slabs and footings exposed to either saline or acid sulphate soils. ~~AS 2870~~AS2870 Section C5.5 and CCAA T56 provide information on concrete exposed to saline soils.

Polymeric Film Underlay must be installed over the prepared foundation. Lap joints at least ~~200 mm~~200mm and seal the laps and penetrations with waterproof adhesive tape. Face the laps away from the direction of concrete pour. Take the underlay up vertical faces past the damp proof course where applicable, and tape fix at the top. Patch or seal punctures or tears before pouring concrete. Cut back as required after concrete has gained strength and forms have been removed.

The Contractor shall supply all necessary sheeting and bracing to safely support the excavation in accordance with statutory requirements. The excavation shall be kept free of water.

Prior to the construction of footings for cast-in-situ concrete walls on earth foundations, cover the latter with a mass concrete blinding slab. Unless otherwise specified, place precast concrete wall sections on a fresh mass concrete bedding layer while it is still in a plastic state. Ensure the following is adhered to:

(a) for earth foundation, place concrete not less than ~~50 mm~~50mm thick; and

(b) for rock foundation, place the concrete at least ~~50 mm~~50mm above the highest points of rock.

Place neither forms nor other materials on the bedding layer within 48 hours of the concrete being placed.

(2) Kerb and channel
Kerb and channel may be constructed in fixed forms, by extrusion or by slip forming, in accordance with ~~AS 2876~~AS2876.

The foundation, concrete quality, curing and testing details shall be in accordance with ~~AS 2876~~AS2876 except where placed on pavement courses, where the requirements of the respective pavement course must prevail.
Kerb and

channel will be constructed to the profile nominated on the drawings.

The top and face of the finished kerb and channel shall be true to line and the top surface shall be of uniform width, free from humps, sags or other irregularities. Kerb and channel shall have a steel float finish.

The level at any point on the surface of the kerb invert shall be within ±~~6 mm~~6mm of the design level. When a straight edge ~~3 m~~3m long is laid on top of or along the face or invert of the kerb, the surface shall not vary more than ~~5 mm~~5mm from the edge of the straight edge, except at kerb laybacks, grade changes or curves or at gully pits requiring gutter depression. The drainage invert shall be free draining and shall not pond water.

Unless shown otherwise on the drawings, contraction joints, shall be formed every ~~5 m~~5m of kerb invert length for a minimum of 50~~ per cent~~% of cross sectional area. The joint shall be tooled ~~20 mm~~20mm in depth to form a neat groove of ~~5 mm~~5mm minimum width.

Unless shown otherwise on the drawings, expansion joints, ~~15 mm~~15mm in width for the full depth of the kerb and channel, shall be constructed where the kerb invert abuts against kerb gully pits, both sides of kerb laybacks/ramps for vehicular or pedestrian access, retaining walls and overbridges. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

Where kerb and channel is cast adjacent with a concrete pavement the same type of contraction, construction and expansion joints specified in the concrete base shall be continued across the kerb and channel.

All house stormwater outlets shall be provided and/or extended, to match the existing type and size of pipe, through the kerb as shown on the drawings providing correctly graded drainage outlet into channel. Pipework shall be in accordance with the requirements for UPVC pipes in sub-section SC6.4.6.6 Pipe drainage, or as directed by the Superintendent for other types of pipe.

At all driveway crossings, where shown on the drawings or where directed by the Superintendent, barrier kerb shall be discontinued to provide for vehicular or pedestrian access. At such locations, kerb laybacks/ramps ~~shall~~must be constructed in accordance with the drawings and Standards. Footpath crossovers shall be constructed to meet the laybacks as shown on the drawings, or reinstated to match existing materials where not otherwise shown.

After the new kerb and channel has been constructed and not earlier than 3 days after placing, the spaces on both sides of the kerb and/or gutters shall be backfilled and reinstated in accordance with the drawings, or as instructed by the Superintendent.

Backfill material behind the kerb shall consist of granular material, free of organic material, clay and rock in excess of ~~50 mm~~50mm diameter, or material as approved by the Superintendent.

Backfill material behind the kerb shall be compacted in layers not greater than ~~150 mm~~150mm thick, to a relative compaction of 95~~ per cent~~% when tested in accordance with ~~AS 1289~~AS1289.5.4.1, for standard compactive effort. The whole of the work shall be finished in a neat and workmanlike manner, free draining and free from surface undulations and trip hazards.

Pavement material adjacent to new gutter shall be backfilled in accordance with the drawings or as directed by the Superintendent.

Where specified in drawings, kerb only work shall be pinned as detailed in Standard drawings.

(3) New jersey type barriers, driveways and footpaths

For New Jersey type barriers, driveways and footpaths a subbase of approved quality and of minimum ~~150 mm~~150mm compacted thickness, unless otherwise shown on the drawings, shall be placed over the subgrade. The surface shall then be checked for uniformity, line and level, and all irregularities shall be made good.

The subbase material shall be compacted to provide a minimum relative compaction as determined by ~~AS~~ AS1289.5.4.1 of 100~~ per cent~~% for standard compactive effort as specified in SC6.4.6.10 Earthworks (construction).

The finished subbase shall not deviate more than ~~15 mm~~15mm under a straight edge ~~3 m~~3m long, subject to any necessary allowance on vertical curves.

(4) Drainage pits and other supplementary structures

Where the excavation is in sound rock, and the Superintendent so directs, part of the concrete lining of gully pits and other structures may be omitted, provided that a neatly formed pit of the required dimensions is constructed, and provided that the wall of the pit adjacent to and parallel with the road is constructed of formed concrete in all cases.

(5) Retaining walls, headwalls and wingwalls

In the case of rock foundations for retaining walls, headwalls and wingwalls, the excavation shall be carried into the rock for a minimum depth of ~~150 mm~~150mm. Where cut-off walls are to be provided, the depth of cut-off in rock foundations may be reduced to ~~100 mm~~100mm.

Prior to the construction of cast-in-situ concrete walls on earth foundations, the latter shall be covered by a mass concrete bedding layer at least ~~50 mm~~50mm thick and finished to a uniform surface. No forms or other materials shall be placed upon the bedding layer within a period of 48 hours after the concrete has been placed.

Unless otherwise specified, precast concrete wall sections shall be placed on a fresh mass concrete bedding layer while it is still in plastic state. In the case of soil foundations, the concrete shall be not less than ~~50 mm~~50mm thick, and where the foundation is in rock, the concrete shall be of such thickness as is required to provide a uniform surface at least ~~50 mm~~50mm above the highest points of rock.

SC6.4.6.28.3 Formwork

(1) General

Formwork shall be provided in accordance with ~~AS 3610~~AS3610 to produce hardened concrete to the lines, levels and shapes shown on the drawings or specified elsewhere. It shall have adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workers and equipment, without loss of shape. Forms shall be mortar tight and designed to allow removal without risk of damage to the completed structure. Joints in the formwork shall be perpendicular to the main axis of the shape of the concrete.

Where concrete is placed in earth excavations, side forms shall be provided to prevent contact between concrete and the insitu earth.

Design of formwork for high sections shall be such that it shall not be necessary to drop concrete freely from a greater height than 1.~~2 m~~2m or to move concrete along the formwork after deposition.

Formwork material used shall be sound and suitable for the purpose intended and surface finish specified.

Provision shall be made for the accurate location and firm support of fittings, bolts, anchorages and formers of holes as shown on the drawings. Temporary fittings used for the support of the formwork shall be arranged to permit removal without damage to the concrete. The use of wires and or bolts extending to the surface of the concrete shall not be permitted except where shown on the drawings.

Forms for edges of concrete shall be filleted and for re~~-~~entrant angles chamfered as shown on the drawings.

Temporary openings shall be provided where necessary for cleaning out of formwork and inspection before concreting.

(2)

Approval of formwork design

For box culverts and reinforced concrete retaining walls, detailed drawings, design calculations, description and/or samples of materials proposed for use shall be submitted for the Superintendent's concurrence before manufacture of the formwork is commenced.

(3) Provision for drainage

Where shown on the drawings, or where directed by the Superintendent, weepholes of ~~50 mm~~50mm diameter shall be provided in retaining walls and wingwalls.

(4) Construction

The type and quality of material selected for formwork and the workmanship used in construction shall be such that the surface finish specified shall be obtained. Construction shall be such that the erection tolerances shall be obtainable.

Timber for formwork shall be well seasoned, free from defects and, where in contact with fresh concrete, free from loose knots.

Timber forms for exposed surfaces shall be constructed from plywood or particle board with hardwood or approved softwood studs and wales. The plywood used for forms shall comply with ~~AS 2271~~AS2271, the hardwood shall comply with ~~AS 2082~~AS2082 and the particle board with AS/~~NZS 1859~~NZS1859.

Formwork for exposed surfaces shall be made from panels having uniform widths of not less than ~~1 m~~1m and uniform lengths of not less than ~~2 m~~2m, except where the dimensions of the member formed are less than the specified panel dimensions. Plywood panels shall be placed with the grain of the outer plies perpendicular to the studding or joists. Where form panels are attached directly to the studding or joists the panel shall be not less than ~~15 mm~~15mm thick. Form panels less than ~~15 mm~~15mm thick, otherwise conforming to these requirements may be used with a continuous backing of dressed material of ~~20 mm~~20mm minimum thickness. All form panels shall be placed in a neat, symmetrical pattern.

Forms for all surfaces which will be completely enclosed or permanently hidden below the ground may be constructed from dressed or undressed timber, steel, plywood or particle board.

Mild steel form surfaces in contact with concrete shall have all bolt and rivet heads counter-sunk and all welds ground back to even and smooth surfaces.

(5) Erection

(a) General

(i) Dimensions and position of forms shall be carefully checked after the forms are erected. Forms shall be aligned accurately and the location of all fittings, hold formers, etc. checked prior to placing concrete. Departure of the forms from the surfaces shown on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work. For tolerances in plan position and levels, refer to clauses SC6.4.6.28.5(7) Finishing of unformed surfaces and SC6.4.6.28.5(10) Treatment of formed surfaces.

(ii) Joints as erected shall be mortar tight.

(iii) The interior surface of the forms shall be treated to ensure non-adhesion of the mortar. Commercial quality form oil or grease will be acceptable, but the oil or grease used on forms against surfaces to be exposed shall not stain or discolour the concrete surface. The coating shall be uniformly spread in a thin film and any surplus shall be removed prior to placing concrete. In the case of unlined timber forms, the timber shall be thoroughly wetted before oiling. Forms shall be treated before placing reinforcement to ensure that the form release agent will not contaminate the surface of the reinforcing steel or construction joints.

(iv) Formwork hardware shall be treated with a form release agent and so arranged that it may be removed from the concrete without excessive jarring or hammering.

(b) Approval by the Superintendent

(i) The formwork shall be inspected by the Superintendent, and the placing of reinforcement in the spaces formed, where specified, shall not commence until the formwork is approved by the Superintendent.

(ii) Placing of concrete shall not commence until the reinforcement, where specified, has been

accepted by the Superintendent, and all dirt, chips, hardened concrete, mortar and all foreign matter removed from the forms.

(iii) When an inspection is requested by the Contractor, a notice of not less than 24 hours, excluding Saturdays, Sundays and public holidays, shall be given to the Superintendent.

SC6.4.6.28.4 Materials for concrete

(1) Cement

Cement shall be Type GP Portland Cement complying with ~~AS 3972~~AS3972.

When submitting details of the nominated mix in accordance with clause SC6.4.6.28.4(6) Testing of materials, the Contractor shall nominate the brand and source of the cement. On approval of the nominated mix by the Superintendent, the Contractor shall only use the nominated cement for the work.

Documentary or other acceptable evidence of the quality of the cement shall be furnished by the Contractor if required by the Superintendent.

If the Contractor proposes to use cement which has been stored for a period in excess of 3 months from the date of testing, a re-test shall be required at the Contractor's expense before the cement is used.

All cement shall be transported in watertight containers, and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

(2) Water

Water shall be free from injurious amounts of materials harmful to concrete and to its reinforcement and neither salty nor brackish.

Water which is not potable for human beings shall not be used in reinforced concrete.

(3) Fine aggregate

Fine aggregates shall consist of clean, hard, tough, durable uncoated grains, uniform in quality, and shall conform to the requirements of ~~AS 2758~~AS2758.1 in respect of bulk density, water absorption (maximum 5~~ per cent)~~%) material finer than 2 micrometres, impurities and reactive materials.

Fine aggregates shall be evenly graded within the absolute limits shown in Table SC6.4.6.28.1 Fine aggregate grading, and shall not deviate from the proposed grading by more than the amounts in Table SC6.4.6.28.1.

Table SC6.4.6.28.1 Fine aggregate grading

Australian Standard Sieve	Proportion Passing (% of Mass)	Deviation from Proposed Grading (% of Mass of Sample)
9.50mm	100	
4.75mm	90 - 100	±5
1.18mm	40 - 85	±10
300µm	8 - 30	±10
150µm	2 - 10	±5
75µm	0 - 4	±3

(4) Coarse aggregate

Coarse aggregate shall consist of clean, hard, durable, crushed stone, crushed river gravel, screened river gravel or metallurgical furnace slag and shall conform to the requirements of ~~AS 2758~~AS2758.1 in respect of particle density, bulk density, water absorption (maximum 2.5~~ per cent),~~%), material finer than 75 micrometres, weak particles, light particles, impurities and reactive materials, iron unsoundness and falling or dusting unsoundness. In all other respects, the coarse aggregate shall comply with this sub-section. If required, coarse aggregate shall be washed to satisfy these requirements.

The percentage of wear shall be determined by ~~AS 1141~~AS1141.23, and the loss of weight shall not exceed 30~~ per cent.~~%.

When required by the Superintendent, coarse aggregate shall be tested for conformance for any or all of the properties set out below:

(a) crushing value - ~~AS 1141~~AS1141.21
The aggregate crushing value shall not exceed 25~~ per cent;~~%;

(b) soundness - ~~AS 1141~~AS1141.24
The loss of mass when tested with sodium sulphate shall not exceed 12~~ per cent;~~%; and

(c) particle shape - ~~AS 1141~~AS1141.14
The proportion of misshapen particles (2:1 ratio) shall not exceed 35~~ per cent.~~%.

Coarse aggregate shall be evenly graded within the absolute limits shown in Table SC6.4.6.28.2 Course aggregate grading and shall not deviate from the grading of the samples submitted under clause SC6.4.6.28.4(6) Testing of materials by more than shown.

Table SC6.4.6.28.2 Coarse aggregate grading

Australian Standard Sieve (mm)	Proportion Passing (% of Mass)			Deviation Proposed Grading (% of Mass of Sample)
	40mm Nominal	20mm Nominal	Extrusion Concrete	
	For Walls exceeding 150mm thickness	For all other structures		
53.0	100			±10
37.5	95 - 100			±10
26.5		100		±5
19.0	30 - 70	95 - 100		±5
13.2			100	
9.50	10 - 35	25 - 35		
4.75	0 - 10	0 - 10		
2.36	0 - 2	0 - 2		

(5) Admixtures
Chemical admixtures and their use shall comply with ~~AS 1478~~AS1478.1. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below, shall not be used.

During the warm season, (October to March inclusive), a set retarding admixture approved by the Superintendent shall be used to control slump within the limits stated in clause SC6.4.6.28.5(4) Consistency. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with ~~AS 1478~~AS1478.1 shall be submitted to the Superintendent, together with the proposed “dosage chart” in accordance with SC6.4.6.28.4(6) Testing of materials. If the Contractor proposes to vary the admixture between the warm and cool seasons such variation shall require approval by the Superintendent by providing the necessary certificate of compliance.

(6) Testing of materials
The Contractor shall submit to the Superintendent a copy of a NATA Certified Laboratory Test Report on the quality and gradings of the aggregates proposed to be used in the work.

The materials shall only be used after receipt of the Superintendent's notification of acceptance, and then only as long as the materials accord with the Specification.

SC6.4.6.28.5 Handling and treatment of concrete

(1) Measuring

All materials shall be measured by weight, except that:

(a) water may be measured by volume with an approved adjustable water-measuring and discharging device;

(b) cement may be measured by bags as packed by the manufacturer in which case batches shall be proportioned on the basis of one or more unbroken bags of cement, and for this purpose one bag of cement shall be assumed to weigh ~~40 kg~~40kg. Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the components of the batch are discharged from the batching hopper; and

(c) measurement by volume for smaller works may be undertaken with the prior approval of the Superintendent.

(2) Measuring by weight, on-site mixing

Where concrete is to be mixed on site, and where mix control is likely to be less efficient than at a central batching plant, the weights of cement, fine and coarse aggregate shown in Table SC6.4.6.28.3 Materials in batch containing 1 bag (~~40 kg~~40kg) cement may be used as a guide to produce the classes of concrete specified. Small changes in the proportions of fine and coarse aggregate may be required to improve density or workability of the concrete. The use of proportions shown in Table SC6.4.6.28.3 shall not relieve the Contractor of his obligation to provide concrete of the specified compressive strength.

Table SC6.4.6.28.3 Materials in batch containing 1 bag (~~40 kg~~40kg) cement

MPa	Cement kg	Fine Aggregates kg	Coarse Aggregates kg	Total Aggregates kg
10	40	130	250	380
15	40	100	190	290
20	40	88	126	214

The proportions set out in Table SC6.4.6.28.3 make allowance for moisture contents of aggregates of 6~~ per cent~~% for fine aggregates and 1~~ per cent~~% for coarse aggregates. Where the moisture content of aggregates exceeds 8~~ per cent~~% or 3~~ per cent~~% respectively, the proportions of the mix shall be changed to compensate for the excess water in the aggregate.

(3) Measuring by volume, on-site mixing

Where measurement by volume is approved, the proportions of the materials shall be such as are required to produce a mix free of voids and having the specified strength at 28 days.

The nominal proportions given in Table SC6.4.6.28.4 Volume batching may be used as a guide for volume batching.

Table SC6.4.6.28.4 Volume batching

MPa	Parts by Volume		
	Cement	Fine Aggregate	Coarse Aggregate
10	1	3	6
15	1	2.25	4.5
20	1	2	3

The volumes of fine and coarse aggregates for each batch shall be measured in boxes or bins. The aggregates shall be measured loose (i.e. without compaction) in the boxes and shall be struck off level. Measurements by shovels or like methods will not be permitted. Batch proportions shall be so arranged that each batch contains 1 bag of cement. One ~~40 kg~~40kg bag of cement shall be assumed to have a volume of 27.5 litres.

(4) Consistency

A sufficient quantity of water shall be added to the mix so that the consistency of the concrete is such that it can be placed in the forms, compacted and worked into all corners without permitting the ingredients to

segregate, or excess free water to collect on the surface. If required by the Superintendent, the Contractor shall determine the consistence of the concrete in accordance with ~~AS 1012~~AS1012.3.1. Except for extruded concrete, the nominated slump shall not exceed ~~80 mm~~80mm, plus the field tolerance of ±~~15 mm~~15mm.

In the case of concrete placed by an extrusion machine, the water in the mix shall be only sufficient to produce a slump of ~~10 mm~~10mm to ~~15 mm~~15mm.

(5) Mixing and delivery

(a) General

(i) Concrete may be mixed either at the site or at a central mixing plant. All concrete shall be mixed with mechanically operated mixers. In an emergency, hand mixing may be permitted. Submit proposal for concrete mixing other than pre mixed concrete for approval by superintendent.

(ii) Any concrete which exhibits signs of segregation shall not be used.

(b) Machine mixing at site

(i) The mixing of concrete shall be done in a batch mixer which will ensure a uniform distribution of the materials throughout the batch.

(ii) The mixer shall be of such capacity that one or more whole bags of cement may be used per batch of concrete. The volume of the mixed material shall not exceed the manufacturer's rated capacity of the mixer.

(iii) The mixing time for each batch shall not be less than 1.5 minutes after all ingredients are assembled in the mixer, and prior to any portion of the batch being removed.

(iv) The entire contents of a batch shall be discharged from the mixer before any materials are placed therein for the succeeding batch.

(c) Mixing in an emergency

(i) In the case of breakdown of the mechanical mixing equipment, hand mixing in small quantities so as to complete a section of the work or reach a suitable construction joint is permitted.

(ii) Hand mixing shall be done on a water-tight platform of sufficient size to allow the mixing of at least two batches simultaneously. The amount of cement used shall be 10 ~~per cent~~% more than the amount specified for machine mixed concrete.

(iii) The fine aggregate and cement shall first be mixed until a uniform colour is obtained, and then spread on the mixing platform in a thin layer. The coarse aggregate, which shall have been previously drenched with water, shall then be spread over the fine aggregate and cement in a uniform layer, and the whole mass turned over as further water is added with a rose sprinkler. After the water is added, the mass shall be turned at least three times, not including shovelling into barrows or forms, until the mixture is uniform in colour and appearance. Hand-mixed batches shall not exceed 0.~~25 cubic metres~~25m^3 each.

(d) Ready-mixed concrete

(i) The concrete shall be mixed and delivered in accordance with the requirements of ~~AS 1379~~AS1379 relating to:

(A) mixing and delivery; and

(B) use of non-agitating equipment,

(ii) The water used for flushing the chutes and for cleaning shall be discharged in an area acceptable to the Superintendent. The chutes shall be long enough to permit delivery to the whole of the area enclosed by the forms.

(6) Placing and compacting concrete

No concrete shall be mixed or placed, without the approval of the Superintendent, while the air temperature is, or is likely to be within 24 hours, below 5 ~~-~~°C or while the shade temperature exceeds 38 ~~-~~°C. All concrete shall

be placed in the dry. Prior to placing concrete the area shall be clean and moist but free from any ponding of water.

The concrete shall be mixed in the quantities required for immediate use and shall be placed in position as rapidly as possible. Any concrete which has developed initial set, or which does not reach the forms within 30 minutes after the water has been added (except when transported in agitator trucks) shall not be used.

The concrete shall be deposited in the forms, without separation of the aggregates. Concrete shall not be dropped freely from a height greater than 1.~~2 m~~2m, or be deposited in large quantities at any point and moved or worked along the forms. Conveying equipment, including open troughs and chutes, where used, shall be made of metal, or have metal linings. Where used on steep slopes, troughs and chutes shall be equipped with baffles, or be placed in short lengths in such a way that the direction of flow of the concrete is changed. The concrete shall be placed in horizontal layers in one continuous operation between the ends of the work and/or construction joints. Care shall be taken to fill every part of the forms and to work the coarser aggregate back from the face. The freshly placed concrete shall be compacted by continuous spading, slicing or by vibrator units. Vibrators shall not be left in one position for more than 30 seconds, and shall not be permitted to rest on reinforcement.

Exposed surfaces of the concrete shall be struck off and finished with a wooden float. Where shown on the drawings corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted.

Concrete shall not be moved after it has been in the forms for more than 10 minutes.

In the case of concrete placed by an extrusion machine, small quantities of cement-sand slurry, comprised of two parts of plasterer's sand and one part of cement (by volume), together with sufficient water to bring it to a semi-fluid condition, shall be placed in the special receptacle in the machine, if the machine is so equipped and shall be fed onto the surface of the concrete at a rate sufficient to produce a smooth and uniform finish.

(7) Finishing of unformed surfaces

(a) Surfaces other than wearing surfaces

Unformed surfaces shall be compacted and tamped so as to flush mortar to the surface, screeded off and finally dressed with a wooden float to an even surface. Care shall be taken to drain or otherwise remove promptly any water which comes to the surface. A capping of mortar will not be permitted.

All future contact surfaces shall be left rough, with the coarse aggregate at the surface firmly embedded but not forced below the surface.

(b) Wearing surfaces

Where a concrete wearing surface is shown on the drawings the concrete shall be thoroughly compacted and the surface screeded off by a vibrating screed, or hand screeded where the distance between forms perpendicular to the direction of screed is no greater than ~~2 m~~2m. Immediately following compaction and screeding the concrete shall be tested for high or low spots and any necessary corrections made. The surface shall be finished true and uniform and free from any glazed or trowelled finish and shall be finally dressed with a wooden template or float, or by the use of belting in an approved manner. The departure from grade shall not exceed ~~5 mm~~5mm in any ~~3 m~~3m length.

Where an asphaltic concrete wearing surface is specified, the surface of the concrete, after being compacted, screeded and corrected, shall be dressed with a wooden float and finally broomed to produce a rough surface.

(c) Finished levels and location

The unformed surface of concrete structures not adjacent to road pavements shall not vary more than ~~25 mm~~25mm in plan position and not more than ~~25 mm~~25mm from the specified levels. In the case of barriers, drainage pits, culvert slabs and other structures adjacent to road pavements, the finished concrete shall not vary more than ~~10 mm~~10mm from the specified levels and alignment. Barriers, footpaths and similar shall not deviate from level or alignment by more than ~~5 mm~~5mm from a straight-edge ~~3 m~~3m long, subject to any necessary allowances on vertical and horizontal curves.

(8) Curing and protection

All exposed surfaces of the freshly placed concrete shall be kept moist either by the use of plastic sheeting, damp sand or commercial curing compounds, in accordance with ~~AS 3799~~AS3799, for a minimum period of 3 days. During this time the work must be adequately protected from the effects of excessive surface evaporation, rain, running water, vandalism and other causes likely to damage the concrete. All costs involved in making good or replacing any work that has been damaged due to the above mentioned factors shall be borne by the Contractor.

Curing for concrete shall generally be in accordance with the appropriate surface exposure classification in ~~AS 3600~~AS3600.

If it is proposed to use a liquid membrane-forming curing compound submit the following information:

(a) certified test results for water retention to ~~AS 3799~~AS3799 Appendix B;

Editor's note—It is likely that polyvinyl alcohol (PVA-based) products will not comply with water retention requirements.

(b) evidence of compatibility with concrete, and with applied finishes including toppings and render, if any, including methods of obtaining the required adhesion.

For visually important surfaces, evidence that an acceptable final surface colour will be obtained.

(9) Removal of forms

All forms shall remain in place, after placement of concrete, for minimum periods specified hereinafter. These periods may be extended by the Superintendent if the air shade temperature falls below 10 °C during the periods specified.

Mass retaining walls, headwalls, wingwalls, gully pits, sumps, and similar drainage structures	48 hours
Footpaths, driveways and similar	17 hours
Sides of reinforced concrete walls when height of each day pour is:	
• under 0.~~6 metres~~6m	1 day
• 0.~~6 m~~6m to ~~3 m~~3m	2 days
• ~~3 m~~3m to ~~6 m~~6m	3 days
• ~~6 m~~6m to ~~9 m~~9m	5 days
Supporting forms under deck slabs of culverts	10 days

To permit the satisfactory finishing of barriers, forms shall be removed in not less than 12 hours nor more than 48 hours after placing concrete, depending upon weather conditions.

Care shall be taken in removing forms so that the concrete will not be cracked, chipped or otherwise damaged. The use of crowbars or other levering devices exerting pressure on the fresh concrete to loosen the forms will not be permitted.

No superimposed load shall be allowed on any part of a structure until the concrete has reached at least 70~~ per cent~~% of the design strength.

Hole formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

(10) Treatment of formed surfaces

All concrete surfaces shall be true and even, free from stone pockets, depressions or projections beyond the surface. All arrises shall be sharp and true, and mouldings shall be evenly mitred or rounded. Care shall be exercised in removing forms to ensure this result. Formed concrete surfaces shall be presented for inspection by the Superintendent within 1 day of stripping of formwork and finishes in accordance with the classes of surface finish in ~~AS 3610~~AS3610 as follows:

Non-visible surfaces - Class 4

Visible surfaces - Class 2

As soon as the forms are removed from mass or reinforced concrete work, all rough places, holes and porous spots shall be repaired by removing defective work and filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete, and shall be brought to an even surface with a wooden float.

Any tie wires or other fitments extending to outside surfaces, shall be cut back after removal of forms, to a depth of at least ~~40 mm~~40mm with sharp chisels or cutters. All cavities caused by removal of fitments or tie wires shall be wetted and carefully packed with cement mortar, as above.

The surfaces of bolt cavities, tie wire holes, and all defects in concrete shall be coated prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water. The method of application of such agent and the conditions in which it is to be used shall generally be as laid down by the manufacturer.

The formed surfaces of concrete structures not adjacent to road pavements shall not vary more than ~~25 mm~~25mm in plan position and not more than ~~25 mm~~25mm from the specified levels. In the case of drainage pits and other structures adjacent to road pavements, the finished concrete shall not vary more than ~~10 mm~~10mm from the specified levels and alignment.

(11) Joints

Submit proposed methods, timing and sequence of sawing joints for approval by superintendent a minimum of 7 days prior to works commencing.

Where horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures the joints may be made at the base of walls and at other locations in the walls where approved by the Superintendent. In order to provide for bond between the new concrete and the concrete which has already set, the surface on which the new concrete is to be placed shall be thoroughly cleaned of loose material, foreign matter and laitance. The surface shall be roughened or keyed and saturated with water. After any excess water has been removed, the surface shall be thinly coated with a neat cement grout.

Retaining walls shall be provided with vertical expansion joints as shown on the drawings. The expansion joints shall consist of jointing material of approved quality, and of thickness shown on the drawings, and a depth sufficient to fill the joint. The jointing material shall be neatly cut to fit the surface of the concrete.

Where barriers are extruded or cast in place, narrow transverse vertical grooves, ~~20 mm~~20mm deep, shall be formed neatly in the surface of the freshly placed concrete to produce contraction joints for the control of cracking. The contraction joints~~, shall~~ must be at intervals of ~~3 m~~3m.

In barriers, unless shown otherwise on the drawings, expansion joints, ~~15 mm~~15mm in width for the full depth of the barrier, shall be constructed at intervals not exceeding ~~15 m~~15m and where the barrier abuts against gully pits. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

In footpaths, median toppings and driveways, unless otherwise shown on the drawings, expansion joints, ~~15 mm~~15mm in width for the full depth of paving, shall be constructed at intervals not exceeding ~~15 m~~15m and where the pavement abuts against gutters, pits and structures. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

All unreinforced paving shall be provided with narrow vertical grooves, ~~20 mm~~20mm deep to induce contraction joints for the control of cracking. The joints shall be formed in the freshly placed concrete in a neat regular pattern to form “slabs” no bigger than ~~2 m²~~2m². The ratio of the longest side to the shortest side shall not exceed 1.6.

(12)

Strength of concrete

When tested in accordance with ~~AS 1012~~AS1012.9, the concrete shall have a characteristic compressive strength not less than that shown on the drawings or if not shown shall have a compressive strength not less than that

specified in Table SC6.4.6.28.5 Concrete strength requirements for the particular class of work. The cement content restrictions shown in Table SC6.4.6.28.5 refer to Portland cement. Where General Purpose Blended cements are utilised the acceptable minima are indicated in brackets.

The characteristic strength shall be determined from the average of not less than two specimens, moulded from each class of concrete being used in the work, and selected to represent the whole of the concrete placed at the time of moulding.

In general, two pairs of test specimens shall be moulded for each ~~15 cubic metres~~15m^3 of concrete, or part thereof, one pair being intended for the 7 day test if required and the other pair for a 28 day test.

Table SC6.4.6.28.5 Concrete strength requirements

Use	Charac-teristic Strength MPa	Minimum Portland Cement per ~~cu~~ m^3 (Minimum GB Blended Cement)	Coarse Aggregate Nominal Size	Characteristic Cylinder Strength Required	
				7 days	28 days
		kg	mm	MPa	MPa
Foundations, mass retaining walls	20	270 (330)	40	15	20
Mass concrete footings, pitching, linings etc.	20	270 (330)	20	15	20
Miscellaneous minor concrete work	20	270 (330)	20	15	20
Reinforced concrete culverts, drainage structures, driveways footpaths, headwalls, base slabs, sign structures. Large footings, retaining walls	32 50	320 (380) 350 (455)	20 20	24 36	32 50
Extruded concrete Safety Barriers	25 40	270 (330) 330 (380)	14 20	15 24	20 40

Note—the total cement and Portland cement quantities indicated as minima are aimed at providing suitably durable concrete for exterior public works under normal circumstances.

The strengths specified at 28 days shall be increased by multiplying by factors as shown in Table SC6.4.6.28.6 Concrete age conversion factors for tests at ages in excess of 28 days.

Table SC6.4.6.28.6 Concrete age conversion factors

*Age of test specimen in days of date of testing	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 and greater	1.25
*For intermediate ages the factor shall be determined on a pro-rata basis	

If the test specimens fail to achieve the specified characteristic strength, the Contractor may, with the approval of the Superintendent, arrange for cores to be taken from the work. If the average strength of such cores complies with the specified requirements nominated in Table SC6.4.6.28.5 Concrete strength requirements, the concrete will be accepted.

If cores taken fail to satisfy the strength requirements, the concrete shall be removed.

(13) Sampling concrete

Equipment and facilities shall be provided by the Contractor for the taking and storage of samples of any materials or concrete being used, or intended to be used in the work.

Concrete test specimens shall be cylinders ~~300 mm~~300mm long and ~~150 mm~~150mm diameter, moulded concurrently in the presence of the Superintendent or Superintendent's representative, in accordance with ~~AS 1012~~AS1012.8, from samples taken in accordance with ~~AS 1012~~AS1012.1.

SC6.4.6.28.6 Reinforcement for concrete

(1) Fibre reinforced concrete

Footpath/Bikeways/Driveways.

The concrete shall be reinforced with a mixed dose of High Performance Polymer and Discreet Graded Fibrillated filament fibres. These fibres shall be provided as a coarse filament in an engineered contoured sinusoidal profile of not less than 600 denier and discreet graded fibrillated filament fibres of not greater than 6 denier. These fibres are to be manufactured from virgin polypropylene and added to the concrete by the concrete company, at the rate of 4.~~6 kg per cubic metre.~~6kg/m^3. The 4.~~6 kg~~6kg consists of 3.~~8 kgs of~~8kg HPP and 0.~~8 kgs of~~8kg discrete Graded Fibrillated filament fibres.

Two bags of "Novomesh" HPP as supplied by Tapex Concrete Fibres Qld or approved equivalent added per ~~cubic metre~~m^3, will be deemed suitable for council's use. Where footpaths/bikeways are not subject to wheel loads one bag of fibres per ~~cubic metre~~m^3 will suffice.

Any alternate product must have prior written approval obtained from council.

(2) Steel reinforcement

Steel reinforcement shall comply with AS/~~NZS 4671~~NZS4671 *Steel reinforcing materials*. The type and size of bars shall be as shown on the drawings.

If changes are proposed to reinforcement shown on the drawings, submit details to superintendent for approval 2 days prior to commencing works.

Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but shall not be brought to a smooth polished condition.

Damaged galvanising must be repaired in accordance with AS/~~NZS 4680~~NZS4680 Section 8 and notification of repairs made to the superintendent for approval.

The Contractor shall supply evidence satisfactory to the Superintendent that steel reinforcement complies with AS/~~NZS 4671~~NZS4671. Test certificates shall show the results of mechanical tests and chemical analysis.

Where the material cannot be identified with a test certificate, samples shall be taken and testing arranged by the Contractor. The samples shall be selected randomly and consist of three specimens each at least 1.~~2 m~~2m in length. The cost of all samples and tests shall be borne by the Contractor.

Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding a load of ~~200 kg~~200kg mass on the chair for one hour at 23 ± 5~~-~~°C without malfunction. The Contractor shall demonstrate that the proposed chairs conform with these requirements.

(3) Bending

Reinforcement shall be formed to the dimensions and shapes shown on the drawings. It shall not be bent or straightened in a manner that will injure the material, and bars with kinks or bends not shown on the drawings will not be accepted. Heating of reinforcement for purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450~~-~~°C and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching.

(4) Splicing

(a) General

All reinforcement shall be furnished in the lengths indicated on the drawings. If splicing is required, it shall be in accordance with the provisions of AS/~~NZS 4671~~NZS4671.

The cost of any test ordered in connection with splices not shown on the drawing shall be borne by the Contractor.

(b) Lapped splices

Laps in reinforcing bars, wire or fabric shall be as shown on the drawings. Laps not shown on the drawings shall be as follows for unhooked bars:

Plain bars, Grade 250 40 bar diameters
Deformed bars, Grade 400 ~~–~~35 bar diameters
Hard-drawn wire 50 bar diameters

Splices in reinforcing fabric shall be so made that the overlap, measured between outermost transverse wires of each sheet of fabric is not less than the spacing of those wires plus ~~25 mm~~25mm.

(5) Marking

Bars of identical shape shall be made up in bundles of three and securely tied together by soft iron wire. Each bundle shall have a stout metal label of not less than ~~40 mm~~40mm diameter attached to it. Each metal label shall be punched with the appropriate marking in accordance with the steel list shown on the drawings. If called for on the drawings the marking shall incorporate a prefix, and bars with different prefixes shall be stored separately.

(6)

Storage

Reinforcement shall be stored above the surface of the ground and shall be protected from damage and from deterioration by exposure.

(7)

Delivery and receipt of reinforcement

Unless the Contractor elects to have the reinforcement inspected at the site, no reinforcement shall be delivered to the site until all tests and inspections have been satisfactorily completed and permission to deliver has been granted by the Superintendent.

The Contractor shall give 10 working ~~days~~days' notice to the Superintendent for carrying out inspection and testing. The Superintendent will carry out the inspection and testing with reasonable expediency, but the Contractor shall not be entitled to an extra as a result of any delays in this connection.

(8)

Placing

Reinforcement shall be accurately placed as shown on the drawings and shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs, or metal hangers, and by wiring together at all intersections or at 0.~~5 m~~5m centres, whichever is the greater distance, using annealed iron wire of diameter not less than 1.~~25 mm~~25mm. Steel shall not be supported on metal supports which extend to the surface of concrete, on wooden supports, or on pieces of coarse aggregate. Reinforcement shall have the minimum cover shown on the drawings or otherwise approved by the Superintendent.

The Superintendent may approve the use of tack welding instead of wire ties on reinforcing wire. All welding of reinforcing steel shall be in accordance with ~~AS 1554~~AS1554.3. Tack welding of cold-worked and hard grade bars shall not be permitted.

The reinforcement in each section of the work shall be approved by the Superintendent before any concrete is deposited in the section and adequate time shall be allowed for inspections and any corrective work which may be required. Notice for inspection shall not be less than four normal working hours.

Splices shall be staggered where practicable and when not shown on the drawings they shall be arranged as directed by the Superintendent.

Bars forming a lapped splice shall be securely wired together in at least two places, unless welded.

The clear cover of any bar, including stirrups, to the nearest concrete surface shall be as shown on the drawings. Where not so indicated it shall be as stated below:

(a) concrete normally in contact only with air:

(i) slabs: ~~40 mm~~40mm;

(ii) other than slabs: ~~45 mm~~45mm; and

(b) concrete in contact with earth or fresh water:

(i) slabs of box culverts: ~~50 mm~~50mm; and

(ii) other than culverts: ~~50 mm~~50mm.

(9) Cores, fixings and embedded items general

Cores, fixings and embedded items identified on shop drawings showing the proposed locations, clearances and cover, and indicating proposed repositioning of reinforcement must be presented for inspection by the superintendent.

If cutting or coring of hardened concrete is proposed, provide details to the superintendent for approval.

For adjoining elements to be fixed to or supported on the concrete, provide for the required fixings. If required, provide for temporary support of adjoining elements during construction of the concrete.

If in external or exposed locations, galvanize anchor bolts and embedded fixings, or propose alternative materials such as stainless steel.

Fix cores and embedded items to prevent movement during concrete placing. In locating cores, fixings and embedded items, reposition but do not cut reinforcement, and maintain cover to reinforcement.

Isolate embedded items so that water cannot track to concrete providing minimum cover to reinforcement.

SC6.4.6.28.7 Backfilling

(1) General

Backfilling at barriers, paving, etc., and minor concrete works shall not commence until after the concrete has hardened and not earlier than three days after placing.

No superimposed load on any part of what will become a load bearing structure within 21 days after placing concrete shall occur unless the structure is effectively and independently supported to the satisfaction of the Superintendent (approval must be sought at a minimum of 3 working days prior to loading upon evidence of early strength) or until the Contractor can demonstrate that 85% of the design strength of the concrete has been achieved.

Selected backfill shall be placed against retaining walls and cast-in-place box culverts for a horizontal distance equal to one-third of the height of the wall. It shall consist of granular material, free from clay and stone larger than ~~50 mm~~50mm gauge. The Plasticity Index of this selected backfill material shall not be less than 2 or more than 12 when tested in accordance with ~~AS 1289~~AS1289.3.3.1. The material shall be placed in layers not exceeding 150~~ ~~mm and ~~shall~~must be compacted to provide a relative compaction as specified in sub-section SC6.4.6.10 - Earthworks (construction).

(2) Treatment at weepholes

Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from ~~50 mm~~50mm to ~~10 mm~~10mm such that:

(a) the maximum particle dimension shall not exceed ~~50 mm~~50mm; and

(b) no more than 5~~ ~~per cent~~% by mass shall pass the 9.~~5 mm~~5mm A.S. sieve.

The broken stone or river gravel, enclosed in a filter fabric suitable for drainage without scour, shall be continuous in the line of the weepholes, extend at least ~~300 mm~~300mm horizontally into the fill and extend at least ~~450 mm~~450mm vertically above the level of the weepholes.

Alternatively the Contractor may provide a synthetic membrane of equivalent drainage characteristics at no extra cost to the Principal. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane shall be subject to the Superintendent's approval.

SC6.4.6.28.8 Sprayed concrete

(1) References

NSW RTA – *Shotcrete Design Guidelines*.

(2) General

Sprayed concrete is concrete pneumatically applied at high velocity on to a surface. Application may be either a wet or dry process. A sound homogeneous product shall be provided with surface finish reasonably uniform in texture and free from blemishes.

The minimum depth of sprayed concrete to be applied shall be ~~75 mm~~75mm.

Sprayed concrete lining in open drains shall be coloured to match the adjoining rock colour.

Sprayed concrete shall have a minimum cement content of ~~380 kg~~380kg/m^3 as discharged from the nozzle and shall have a minimum compressive strength of ~~25 MPa~~25MPa at 28 days when tested by means of ~~75 mm~~75mm diameter cores taken from in-place sprayed concrete.

Cores shall be secured, accepted, cured, capped and tested in accordance with ~~AS 1012~~AS1012.14. Equipment and facilities shall be provided by the Contractor for the taking of cores from the work. The Contractor shall arrange for a laboratory with appropriate NATA registration for the curing and testing of the cores. Copies of test results shall be forwarded to the Superintendent.

The cost of all work and material required in the taking, handling, delivery and testing of cores shall be borne by the Contractor.

At least 14 days prior to applying any sprayed concrete the Contractor shall submit to the Superintendent details of his proposed procedure, plant, materials and mix proportions. Materials shall comply with ~~AS 3600~~AS3600.

(3) Test panels

Not less than 7 days before applying concrete, the Contractor shall prepare at least three test panels for each mix proposed, in conditions similar to those in the works and in the presence of the Superintendent. The test panels shall be made by applying a ~~75 mm~~75mm thickness of sprayed concrete to a hardboard panel approximately ~~750 mm square~~750mm^2. The sprayed concrete shall be applied to the panels in the same manner, using materials including steel reinforcing fabric, equipment, pressures and curing that will be used in the Works. The panels shall be submitted to the Superintendent for examination.

The Contractor shall cut four ~~75 mm~~75mm diameter cores from one test panel for each proposed mix approximately 48 hours after the panel has been sprayed. The cores shall be tested as for cores from in-place sprayed concrete. One core shall be compression tested at 3 days, one core at 7 days and the remaining two cores at 28 days.

Should any of the cores reveal defects such as lack of compaction, dry patches, voids or sand pockets or should the test panel exhibit an unacceptable surface finish, the Contractor shall modify the mix design and/or method of placement and prepare fresh test panels for testing and inspection.

Sprayed concrete shall not be applied to the Works until the Contractor produces test panels for the approval of the council.

(4) Surface preparation

Earth surfaces shall be graded, trimmed and compacted and shall be dampened prior to applying the sprayed concrete. The Contractor shall take any precautions necessary to prevent erosion when the sprayed concrete is applied.

Rock surfaces shall be cleaned of loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface. The rock surface shall be dampened prior to applying the sprayed concrete.

Corrugated steel pipes shall be cleaned of loose material, mud and any other foreign matter.

The Contractor shall remove free water and prevent the flow of water which could adversely affect the quality of

the sprayed concrete.

(5) Application of sprayed concrete

Application shall begin at the bottom of the area being sprayed and shall be built up making several passes of the nozzle over the working area. The nozzle shall be held so that the stream of material shall impinge as nearly as possible perpendicular to the surface being coated. The velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix shall be regulated so as to produce a dense coating with minimum rebound of the material and no sagging. Rebound material shall be removed after the initial set by air jet or other suitable means from the surface as work proceeds and disposed of.

Spraying shall be discontinued if wind causes separation of the nozzle stream.

Concrete shall not be sprayed in air temperatures less than 5 °C.

Construction joints shall be kept to a minimum. A joint shall be formed by placing or trimming the sprayed concrete to an angle between 30° and 45° to the sprayed concrete surface. The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying.

When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement.

Adjoining surfaces not requiring sprayed concrete shall be protected from splash and spray rebound. Splash or rebound material on these adjoining surfaces shall be removed by air-water jet or other suitable means as work proceeds.

(6) Curing

Curing shall commence within one hour of the application of sprayed concrete and may be by water or by colourless wax emulsion curing compound complying with ~~AS 3799~~AS3799 and applied in accordance with manufacturer's specifications.

In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least 7 days.

SC6.4.6.28.9 Summary of limits and tolerances

The limits and tolerances applicable to the various clauses in this Specification are summarised in Table SC6.4.6.28.7 – Summary of limits and tolerances below:

Item	Activity	Limits/Tolerances	Clause
1.	**Foundation**		
	(a) Relative Compaction	³95% RDD(standard compactive effort) within 0.~~3 m~~3m below subgrade	SC.6.4.6.28.2(1)
	Barriers, Footpaths etc.		
	(a) Finished Subbase	To be trimmed and compacted so that the levels do not vary more than ~~15 mm~~15mm under a straight-edge ~~3 metres~~3m long.	SC6.4.6.28.2(2)
	(b) Relative Compaction of Subbase	³100% (standard compactive effort)	SC6.4.6.28.2(2)
3.	**Formwork**		
	(a) Position of Forms	Forms shall be aligned accurately so that departure of the forms from the surfaces specified on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work.	SC6.4.6.28.3(5)
4.	**Fine Aggregate**		

Item	Activity	Limits/Tolerances	Clause
	(a) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table SC6.4.6.28.1.	SC6.4.6.28.4(3)
5.	**Coarse Aggregate**		
	(a) Percentage of wear	Loss of weight shall not exceed 30%	SC6.4.6.28.4(4)
	(b) Crushing Value	Crushing value shall not exceed 25%	SC6.4.6.28.4(4)
	(c) Soundness	The loss of mass when tested with sodium sulphate shall not exceed 12%	SC6.4.6.28.4(4)
	(d) Particle Shape	The proportion of misshapen particles (2:1 ratio) shall not exceed 35%	SC6.4.6.28.4(4)
	(e) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table SC6.4.6.28.2.	SC6.4.6.28.4(4)
6.	**Aggregate Moisture Content**	Where moisture content of fine aggregate exceeds 8%, or moisture content of coarse aggregate exceeds 3%, the proportion of mix shall be changed.	SC6.4.6.28.5(2)
7.	**Consistency** Method 1 the	In accordance with ~~AS 1012~~AS1012.3, slump shall not exceed the nominated slump ±~~15 mm~~15mm.	SC6.4.6.28.5(4) SC6.4.6.28.5(4)
		In the case of concrete placed by extrusion machine, the slump will be between ~~10 mm~~10mm and ~~15 mm~~15mm.	
8.	**Ready-Mixed Concrete**		
	(a) Mixing & Delivery	The time taken from the introduction of water until the concrete is completely discharged shall be not more than 1.5 hours. Where non-agitating equipment is used the concrete shall be completely discharged not more than 30 minutes after the addition of water.	SC6.4.6.28.5(5)
9.	**Placing & Compacting of Concrete**	Concrete shall not be placed without the approval of the Superintendent if the air temperature within 24 hours is likely to be below 5~~-~~°C or the shade temperature is likely to exceed 38~~-~~°C.	SC6.4.6.28.5(6)
10.	**Finishing of Unformed/Formed Concrete Surfaces**		
	~~(a)~~ Wearing Surface	t~~T~~o be finished true and uniform so that (a) departure from designed grade shall not exceed ~~5 mm~~5mm in any ~~3 metre~~3m length.	SC6.4.6.28.5(7)(b)
	(b) Finished Surfaces		
	(i) Not Adjacent to Roads	≤~~25 mm~~25mm Plan position	SC6.4.6.28.5(7)(c) SC6.4.6.28.5(10
		≤~~25 mm~~25mm Level	
	(ii) Adjacent to Roads Alignment	≤~~10 mm~~10mm	SC6.4.6.28.5(7)(c) SC6.4.6.28.5(10)
		≤~~10 mm~~10mm Level	SC6.4.6.28.5(7)(c)
	(iii) Culvert Inverts Alignment	≤~~25 mm~~25mm	SC6.4.6.28.5(10)
		≤~~10 mm~~10mm Level	

SC6.4.7 Acceptance of completed works

SC6.4.7.1 Release of the plan of survey

SC6.4.7.1.1 Introduction

The Release of the plan of survey sub-section details the requirements that must be met prior to the release of the Plan of Survey.

(1) Principles

Prior to the release of the Plan of Survey the developer must:

(a) comply with all conditions of the development permit; and

(b) ensure that all required fees, bonds, contributions, infrastructure charges and outstanding rates are paid.

Works will not be accepted on maintenance until the formal Plan of Survey has been released.
Where exceptional circumstances exist and an early release of the Plan of Survey is agreed to by the Director Planning and Development, the developer is required to bond any outstanding work.

(2) Terminology

Terms in this policy have the same definition as in the *Sustainable Planning Act 2009*, unless otherwise defined.

DEHP	*Department of Environmental and Heritage Protection*
Plan of Survey	Includes all surveys undertaken by a cadastral surveyor as defined by the *Surveyors Act* 2003 and for the purpose of: • subdividing one or more lots; or • dedicating land to public use; or • redefining a lot by resurvey; or • amalgamating two or more lots to create a smaller number of lots; or • defining an area for an easement, lease, profit a prendre or covenant; or • any other purpose that the Registrar may require the registered proprietor to undertake.
On maintenance date	The date the works have been inspected and are complete, relevant conditions of the Development Permit have been satisfied, council has accepted maintenance responsibility for agreed public infrastructure and the developer commences the defects liability period.
Off maintenance date	The date the works are fully accepted by council following an inspection by council, which considers that all works are satisfactory, and the defects liability period concludes.
Maintenance period	The period of time between when council accepts the works on-maintenance until council accepts the works off-maintenance. This includes any establishment periods and the defect liability period, the period of time during which the developer is required to repair defects that occur. A defect is an imperfection, fault of deficiency in the works and does not include general wear and tear of items or damage due to misuse.

SC6.4.7.1.2 Release of plan of survey requirements

The following must be received or completed prior to the release of the Plan of Survey.

(1) Certification

(a) The developer must submit one print of each drawing, excluding council Standard Drawings:

(i) as originally approved by council;

(ii) including amendments incorporated in the construction of the development; and

(iii) overprinted with a certificate from a Licensed Surveyor or Registered Professional Engineer of Queensland (RPEQ) as detailed below.

(b) An RPEQ and/or a Registered Landscape Architect must certify that the completed works comply with the development approval, the specific outcomes of the applicable regulations and good engineering practice.

The RPEQ and/or Registered Landscape Architect must also certify the 'as constructed drawings by including the following statement on each drawing:

"I/We (Name) of (Firm) hereby certify that the works as shown on the 'as constructed' drawings reflect any changes that were made during the course of construction (signed with RPEQ No and dated)".

(c) A Registered Surveyor must certify that the locations, surface and invert levels of all works and infrastructure presented on the as constructed drawings and digital submissions have been surveyed and are true and accurate representations of the works by including the following statement on each as constructed drawing:

"I/We (Name) of (Firm) herby certify that this drawing accurately describes and records the nature and the location of the works depicted hereon as they have been constructed for the purposes of the development (signed and dated)".

(2) As constructed drawings

One signed hard copy and digital copies of the as constructed drawings (AutoCAD DWG and a copy converted to PDF A1 format correctly scaled to A3 size) must be submitted and approved by council. As constructed information must be provided for all completed works, and must include the following information.

(a) Lot

(i) The lot layout as approved and as shown on the Plan of Survey.

(ii) Approved street names.

(b) Earthworks

(i) As constructed contours or where allotments are under 2000m^2 spot levels will be adequate to verify a minimum as constructed surface gradient of 1 in 250.

(ii) Denote location, extent and depth of fill.

(iii) The maximum depth of fill on each lot must be indicated.

(iv) Flood lines as adopted by council.

(v) Street names as approved by council and noted on the Plan of Survey.

(c) Infrastructure

(i) Pavement and kerb and channel information (e.g. edge of pavement and kerb and channel alignment and depths of pavement, kerb type, road surface type and depth, road pavement details, type and depth, road cross sections).

(ii) Stormwater drainage information, including:

(A) pipe alignments denoting sizes and invert levels at each end;

(B) manhole location; and

(C) inlet pit types to be denoted.

(iii) Major overflow paths and trunk drainage channels located and clearly shown.

(iv) Invert levels and offsets of the junction points and manhole connections where roof water drainage systems have been used.

(v) Sewerage 'as constructed plans', including all required details, lodged and approved.

(vi) (a) Location of maintenance structure (MH, MC, JU and end of PCS or house drain connection point)

(vii) (b) Material type and sizes

Details of all water mains, fittings of consequence and markers, including relevant dimensions, included on as constructed plans, which are to be lodged and approved.

Location and dimensioning of subsoil cleanout points.

(viii) BOS data to detail location of house drain connection point – building envelop upgraded.

Editor's note: -

a) The accuracy of as constructed plans locating house connections is essential.

b) Council's Inspector, while on site, may take measurements that will permit some cross checking of as constructed plans. Should these checks indicate discrepancies, then reopening of the work will be required for checking measurement of the work.

(3) Ongoing operational requirements

Where requested, applicants are required to identify the ongoing operational requirements in a relevant Maintenance Plan, as detailed in Section SC6.4.2 Development application guidelines.

(4) The on maintenance inspection

The on maintenance inspection must be satisfactorily completed prior to the release of the Plan of Survey. The Consulting Engineer must undertake and report on the following prior to requesting the on maintenance inspection.

(a) Lodgement

(i) Demonstrated full compliance with all conditions of relevant Development Approvals.

(ii) Building approval for all buildings/structures, where required by the *Building Code of Australia* (BCA).

(iii) Plan of Survey submitted in accordance with approved proposal plan and any approved amendments, or where the Plans of Survey differ from the approved proposal plan, details of any changes must be provided with the application.

(iv) A Supervision Certificate from the Consulting Engineer and request to have the works accepted on maintenance.

(v) Infrastructure Agreements, if required, must be in place for the provision of and/or connection to trunk infrastructure.

(vi) Approval by other authorities, e.g. evidence of NBN Agreement, Certificate of Acceptance or Letter of Supply from Ergon.

(b) Sewer

Sewerage works

(i) Pressure test all sewers and manholes to ensure the requirements of the specification are met.

(ii) Check by internal examination (closed circuit television) that all sewers are straight, clean and to grade.

(iii) Check that all manholes are sound, smooth and clean and benched as per the required standard.

(iv) Check that house connection jump up construction complies with council's standards.

(v) Performance testing of pumping equipment. This testing will require the connection of the electricity supply and water to the pump station.

(vi) Obtain licences for overflows to the sewerage system from DEHP.

All sewerage works including pump stations, rising mains, trunk mains and the proposed sewers must have been inspected and certified by the supervising engineer as being 100 per cent complete and in full working order. Sewer systems must be installed, tested and operational. (Bonding of pump stations may be accepted; refer to SC6.4.7.3 Sewer pump-out agreements.

(c) Water

(i) Water reticulation

(A) Pressure test and supervise the swabbing (if necessary) and sterilisation of the water mains.

(B) Check location of hydrants and valves to ensure they are in their correct location.

(C) Check that all valves and hydrants are working satisfactorily (include lid arrangement as per SD-350.

(D) When water mains have been constructed, mains must be commissioned in accordance with council requirements.

(ii) All works associated with water supply on site must be 100 per cent complete, and all water mains must be tested and live. Reservoirs and associated pump stations must be commissioned prior to the lodgement of survey plans unless otherwise approved by council.

(d) Earthworks

(i) All allotment preparation work and earthworks on allotments must be 100 per cent complete in accordance with the requirements of SC6.4.6.10 Earthwork construction, with finished surface levels, the degree of compaction achieved and geotechnical assessments required on any of the allotments submitted and approved by council. All works within allotments must be fully completed and no further disturbance required on the allotments. Appropriate erosion and sediment control measures must also be in place for all disturbed areas.

(ii) Where specific revegetation works have been bonded for future completion, the earthworks and top soiling must be complete prior to the release of the Plan of Survey.

(iii) All survey pegs placed.

(e) Roads

(i) Roads must be completed and fully sealed.

(ii) Pavement line markings completed at major intersections.

(iii) All traffic control devices, including traffic islands to be completed.

(iv) All traffic signage to be in place and completed compliant with Manual of Uniform traffic control devices (MUTCD) requirements.

(v) Traffic signals, if present, to be installed, completed and fully functional, compliant with the relevant requirements and legislation.

(vi) Retaining walls within road reserve to be completed and maintenance requirements documented.

(vii) Fences and noise abatement/screening walls to be completed and maintenance requirements documented.

(f) Stormwater

(i) Stormwater drainage works must be installed with all erosion controls in place and able to function without detriment to the system. Allotments must be provided with the nominated flood immunity. All stormwater systems must be constructed, including kerb and channel. Downstream drainage easements must have been executed in favour of council, necessary drainage and other easement documentation must have been submitted, and required reserves for drainage, parkland, etc. must have been provided.

(ii) This excludes large water sensitive urban design (WSUD) measures such as bio-retention basins and wetlands, where the acceptance of the asset and ongoing maintenance requirements is to be in accordance with SC6.4.3.9 Water sensitive urban design guidelines.

(iii) Performance testing of pumping equipment must be passed satisfactorily. This testing will require the connection of the electricity supply and water to the pump station.

(g) Services

Evidence must be provided of street lighting, telecommunications and electrical supply works commitments. Satisfactory evidence must be provided to council of a negotiated agreement with service providers for telecommunications and NBN Co infrastructure, reticulation of electricity and the provision of street lighting, and gas service providers for provision of gas (if gas is provided).

(h) Payments and Bonds

(i) The full payment of fees and bonds, including the maintenance bond and any bonds for incomplete works. The maintenance bond will be a minimum 5 per cent of the value of the works as certified by the RPEQ and accepted by council, and must be lodged with council until the development is accepted as off maintenance.

(ii) All outstanding rates paid.

(iii) All infrastructure charges required by the conditions of the development permit must be paid.

(iv) Accompanied by the prescribed form and fee of an amount in accordance with council's fees and charges current at the time of payment.

(i) Land

The developer must covenant that all transfers of land and interests in land to council are free of encumbrances and registered in the Title's Office at the same time as the Plan of Survey is registered at no cost to council.

SC6.4.7.1.3 Bonds

To enable early release of the Plan of Survey it will be necessary to bond all outstanding works and requirements. Security bonds for incomplete works will be subject to a minimum value of $15,000.

(1) Standard bond conditions

(a) Estimates

(i) To verify the maintenance bond estimates, council must be supplied with a schedule of the works together with the appropriate estimated rates and amounts for all the items.

(ii) To verify the incomplete works bond estimates, council must be supplied with a schedule of the incomplete works together with the appropriate estimated rates and amounts for the incomplete works.

(iii) Such estimated prices must be fair and reasonable.

(b) Conditions

(i) The amount of the security for incomplete works must be for an amount of not less than one hundred and fifty per cent (150 per cent) of the certified cost of the works remaining to be completed as at the date of the release of the subject Plan of Survey.

(ii) Incomplete works must be itemised, valued and certified by an RPEQ.

(iii) All bonds submitted must be clearly identified as to the particulars of the site and the purpose of the bond.

(iv) Insurance and indemnity certificates must be current and valid to cover the period outstanding works are being completed.

(c) Acceptable security

(i) Cash bonds

(ii) Unconditional bank guarantees.

(A) A bank guarantee must include:

- a binding contractual relationship between council and the guaranteeing bank;
- specific requirements for renunciation of the guarantee; and
- a requirement of adequate notice of renunciation.

(B) Bank guarantees must not have expiration dates.

(2) Incomplete works bond

(a) Incomplete works condition

In addition to the standard bond conditions:

(i) Where council consents to the early release of a Plan of Survey in line with the minimum requirements listed in Section 3, the developer will be required to lodge a security (bond) and an undertaking to complete the works within an agreed timeframe. These works must be completed to the satisfaction of council and the security submitted in a format as detailed in this sub-section. Security bonds for incomplete works will be subject to a minimum value of $15,000.

(ii) Outstanding works must be itemised, valued and certified by an RPEQ.

(iii) Potential purchasers of lots must be advised of the arrangements.

(b) Required information

The RPEQ must provide the following information:

(i) certification of the value of incomplete works;

(ii) detailed schedule of the scope and cost of the incomplete works for auditing purposes;

(iii) certification that all external and internal works can be completed and accepted on maintenance

within the timeframes detailed elsewhere in this Policy sub-section;

(iv) certification that the contract has been let for the construction of the remaining internal and external works and the name of the Contractor;

(v) proposed finish dates for remaining internal and external works; and

(vi) security lodgement form completed clearly indicating that the purpose of the bond is for incomplete works.

(3) Revegetation bonds

Revegetation bonds may be required where conditioned by a development permit. At the time of on maintenance council may accept the drains and earth batters within a subdivision whereby the vegetation is not in accord with the objectives of this and other SC6.4 Development manual planning scheme policy sub-sections, subject to the following requirements.

(a) Revegetation performance bond

(i) A bond for the incomplete revegetation must be included as a performance bond for incomplete works along with all other bonds for incomplete works upon that subdivision.

(ii) The bond for the revegetation works must be 150 per cent of the approved estimated cost of the revegetation works to allow for the typical seasonal weather encountered in the region, due to the risk of erosion and scouring in areas of exposed earth.

(iii) The revegetation performance bond will be considered for acceptance on and off maintenance separate to the general subdivision works.

(b) Revegetation maintenance bond

(i) The revegetation performance bond will be reduced to a revegetation maintenance bond upon achievement of a minimum scour protection, which is deemed as 40 per cent vegetal coverage, which includes 15 per cent of the total area having the specified species. The revegetation maintenance bond must be equal to the approved estimate of the value of the works required to achieve the specified grass coverage by the off maintenance date.

(ii) The acceptance of revegetation on maintenance will correspond with the reduction of the performance bond for revegetation works. The acceptance of the revegetation works off maintenance and release of the revegetation maintenance bond will require the specified grass coverage to be completed but will not occur prior to the remainder of the development being accepted off maintenance.

(4) Sewer pump station bonds

(a) Where a sewage pump station is a pump station identified by council in the Priority Infrastructure Plan (PIP) and that sewage pump station is identified as minor trunk infrastructure, then consideration will be given to the release of the Plan of Survey prior to the completion of the works associated with that pump station.

(b) The pump station must be located upon land that is or will be under the control of the council upon the registration of the subject Plan of Survey.

(c) The working drawings and specifications must have been completed and approved by council for construction.

(d) The Consultant Engineer acknowledges that with respect to the nominated works that they are working for council and not the developer, and that the specifications nominate council as the Principal of the Contract.

(e) The tenderers must have been reported to council and council must have approved the successful tenderer.

(f) The Contract must have been let, and a submitted works program must indicate that the trunk infrastructure is programmed to be completed prior to when the commencement of dwelling construction is envisaged, including provision for a normal wet season.

(g) The developer must enter into a Deed of Agreement with council, as detailed in SC6.4.7.3 Sewer pump-out agreements that includes provision for a pump-out service and a security for this pump-out. The

template in Attachment A of SC6.4.7.3 Sewer pump out agreements may be used for the Agreement.

SC6.4.7.1.4 Early release of the plan of survey

(1) Justification for early release

Council may elect to release plans of survey prior to satisfaction of the development permit on the basis that critical works are provided and security is afforded for the outstanding works. This process requires the developer to request the early signing in writing at the time of lodging a survey plan and payment of a fee, demonstrating how conditions of the development approval are satisfied or secured.

Early approval and dating of the Plan of Survey does not discharge the developer from obligations to satisfy the conditions of development approval, and the development may be subject to enforcement action for non-compliance with the development permit(s) and/or the undertaking given to complete the outstanding works.

The aim of this clause is to enable the developer to have the Plan of Survey released from the council as early as possible while at the same time ensuring that the allotments being constructed will be fully serviced at the time that the Plan of Survey is registered and subsequent sales of the allotment takes place.

(2) Early release of survey fees

A fee for the early release of the Plan of Survey in accordance with council's schedule of fee's and charges at the time of payment will also be required as payment separate to the incomplete works bond.

(3) Minimum requirements

Council will not sign any Plans of Survey where the relevant works or matters are incomplete, unless the following are completed:

(a) Early Plan of survey on maintenance inspection

An on maintenance inspection must be satisfactorily completed in accordance with SC6.4.7.1.2(4) and as detailed below, however some minor defects may be outstanding, with minor defects defined as those not impacting on public safety and/or the ability of council to operate and maintain the infrastructure.

(b) Earthworks

All allotment preparation work and earthworks on allotments to be 100 per cent complete in accordance with the requirements of SC6.4.6.10 Earthworks (construction), with finished surface levels, the degree of compaction achieved and geotechnical assessments required on any of the allotments submitted and approved by council. All works within allotments must be fully completed and no further disturbance required on the allotments. Appropriate erosion and sediment control measures must also be in place for all disturbed areas.

(c) Sewerage

All sewerage works including pump stations, rising mains, trunk mains and the proposed sewers have been inspected and certified by the supervising engineer as being 100 per cent complete and in full working order. Sewer systems must be installed, tested and operational. (Bonding of pump stations may be accepted; refer to SC6.4.7.1.3(4)). Conduit inspection must be undertaken in accordance with SC6.4.2.2.6 Conduit assessment.

(d) Water

All works associated with water supply on site are 100 per cent complete, and all reticulation has been pressure tested, sterilised, completed and connected to an existing supply. All water pumping stations must be certified by an RPEQ as being 100 per cent complete and in full working order.

(e) Roads

Roads must be completed to the point where the pre-seal inspection has been carried out by council's inspectors and the pavements are approved for application of bitumen or asphalt.

(f) Stormwater

(i) Stormwater drainage works must be installed with all erosion controls in place and able to function without detriment to the system. Allotments must be provided with the nominated flood immunity. All stormwater systems must be constructed, including kerb and channel. Downstream drainage easements must have been executed in favour of council, necessary drainage, other easement

documentation must have been submitted, and required reserves for drainage, parkland, etc. must have been provided.

(ii) This excludes large WSUD measures such as bio-retention basins and wetlands, where the acceptance of the asset and ongoing maintenance requirements is to be in accordance with SC6.4.3.9 Water sensitive urban design guidelines.

(g) Services

Evidence must be provided of street lighting, telecommunications and electrical supply works commitments. Satisfactory evidence must be provided to council of a negotiated agreement with service providers for telecommunications and broadband infrastructure, reticulation of electricity (e.g. Letter of Supply) and the provision of street lighting and gas service providers for provision of gas (if gas is provided).

(h) Payments and bonds

(i) The full payment of fees and bonds, including the maintenance bond and any bonds for incomplete works. The maintenance bond will be 5 per cent of the value of the works as certified by the RPEQ and accepted by council, and must be lodged with council until the development is accepted as off maintenance.

(ii) All outstanding levied rates are paid.

(iii) All infrastructure charges required by the conditions of approval must be paid.

(iv) Accompanied by the prescribed form and fee of an amount in accordance with council's fees and charges current at the time of payment.

(i) Land

The developer must covenant that all transfers of land and interests in land to council are free of encumbrances and registered in the Title's Office at the same time as the Plan of Survey is registered at no cost to council.

(j) As constructed plans

As constructed plans must be submitted in accordance with SC6.4.7.1.2(2) showing all works completed to date, including as a minimum, the requirements above in parts (a) – (i). All works not shown on the as constructed drawings at the time of submission for early release of Plan of Survey, will be required to be bonded in accordance with the requirements of this section.

(4) Timing

All incomplete works must be completed and ready for council inspection within 1 month of council releasing the Plan of Survey. Should the developer not be able to meet this requirement they must submit justification to council detailing exceptional circumstances. The RPEQ must submit for the approval of council, a program of works to certify that the incomplete works can be completed within 1 month (or longer as agreed by council).

(5) Sewer pump stations

Early release of the Plan of Survey may be considered if council developed sewer pump stations are almost complete. See SC6.4.7.1.3(4) for more information.

SC6.4.7.2 On maintenance/final completion/off maintenance requirements

SC6.4.7.2.1 Introduction

This sub-section provides guidance and advice for the requirement for on maintenance/final completion/off maintenance to facilitate the release of the plan of survey (see SC6.4.7.1 Release of the plan of survey).

SC6.4.7.2.2 Lodgement

(1) Requirements for on maintenance:

(a) building approval for all buildings/structures, where required by the *Building Code of Australia* (BCA);

(b) a supervision certificate from the Consulting Engineer and request to have the works accepted on maintenance;

(c) a workmanship guarantee from the Contractor;

(d) submission to and acceptance by council of as constructed information. The RPEQ must certify the "as constructed" drawings by including the following statement on each drawing:

I/We (Name) of (Firm) hereby certify that the works as shown on the as constructed drawings reflect any changes that were made during the course of construction (signed with RPEQ No and dated);

(e) a Registered Surveyor must certify that the locations, surface and invert levels of all works and infrastructure presented on the as constructed drawings and digital submissions have been surveyed and are true and accurate representations of the works by including the following statement on each relevant as constructed drawing:

I/We (Name) of (Firm) hereby certify that this drawing accurately describes and records the nature and the location of the works depicted hereon as they have been constructed for the purposes of the development (signed and dated);

(f) infrastructure agreements, if required, must be in place for the provision of and/or connection to trunk infrastructure;

(g) approval by other authorities, e.g. evidence of NBN Agreement, or Certificate of Acceptance from Ergon;

(h) the works must remain on maintenance for a minimum period of 12 months;

(i) the works subject of other approvals for which the works of this approval are dependent must also have been accepted on maintenance; and

(j) where on maintenance can be achieved within 1 month of the release of the plan of survey then the date for the on maintenance will be backdated to the date of the release of the plan of survey. Otherwise, on maintenance will be from the date that all requirements have been satisfied.

SC6.4.7.2.3 Sewer

(1) Requirements for on maintenance:

(a) pressure test all sewers and manholes in accordance with WSA to ensure the requirements of the specification are met;

(b) check by internal examination (closed circuit television) that all sewers are straight, clean and to grade. Conduit inspection must be undertaken in accordance with SC6.4.2.2.6 Conduit assessment;

(c) check that all manholes are sound, smooth and clean and benched as per the required standard;

(d) check that house connection "jump up" construction complies with council's standards;

(e) performance testing of pumping equipment. This testing will require the connection of the electricity supply and water to the pump station;

(f) certified results of pressure tests on all mains;

(g) certified results of field tests on pumping equipment;

(h) operations manual, performance specifications and maintenance requirements for all pump stations; and

(i) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications.

SC6.4.7.2.4 Water

(1) Requirements for on maintenance:

(a) pressure test and supervise the swabbing and sterilisation of the water mains (if necessary);

(b) check location of hydrants and valves to ensure they are in their correct location;

(c) check that all valves and hydrants are working satisfactorily(include lid arrangement as per SD-350;

(d) when water mains have been constructed, mains must be commissioned in accordance with council requirements;

(e) certified results of pressure tests on all mains;

(f) certified results of field tests on pumping equipment; and

(g) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications.

(f) no concrete footpaths installed over water main where property connections are yet to be constructed

SC6.4.7.2.5 Earthworks

(1) Requirements for on maintenance:

(a) all survey pegs placed; and

(b) compaction results of each layer of earthworks on roads and on each allotment where depth of fill exceeds 0.5 m. The maximum depth of fill on each lot must be indicated on the as constructed drawings. Allotment fill must be in layers no greater than 200 mm and compacted a minimum standard of 95% standard compaction for residential subdivision and 98% standard compaction for commercial subdivision. The fill material must be free of vegetation and organic material.

SC6.4.7.2.6 Roads

(1) Requirements for on maintenance:

(a) roads must be completed and fully sealed;

(b) all tests and hold point documentation completed and finalised;

(c) pavement line markings completed, including passing and turning lanes at major intersections;

(d) where a double coat bitumen seal has been used, copies of bitumen spray sheets and calculated average spray rate and aggregate spread rate are required;

(e) where asphaltic concrete surfacing has been used, test results on samples of the material supplied to the site must be taken at the Asphalt Plant together with field tests to confirm asphalt depth and percentage of voids filled;

(f) all traffic control devices, including traffic islands, to be completed;

(g) all traffic signage to be in place and completed in accordance with *Manual of uniform traffic control devices'* requirements;

(h) traffic signals, if present, to be installed, completed and fully functional in accordance with the relevant requirements and legislation;

(i) retaining walls within road reserve to be completed and maintenance requirements documented;

(j) fences and noise abatement or screening walls to be completed and maintenance requirements documented;

(k) compaction results of subgrade and each course of pavement; and

(l) grading, Atterberg limits and a California Bearing Ratio (CBR) test of each course of pavement material in accordance with SC6.4.5.3 Quality management system.

SC6.4.7.2.7 Stormwater

(1) Requirements for on maintenance:

(a) stormwater drainage works must be installed with all erosion controls in place and able to function without detriment to the system. Allotments must be provided with the nominated flood immunity. All stormwater systems must be constructed, including kerb and channel. Downstream drainage easements

must have been executed in favour of council, necessary drainage and other easement documentation must have been submitted, and required reserves for drainage, parkland, etc. must have been provided; and

(b) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications. Conduit inspection must be undertaken in accordance with SC6.4.2.2.6 Conduit assessment.

(c) performance testing of pumping equipment. This testing will require the connection of the electricity supply and water to the pump station;

(d) certified results of field tests on pumping equipment;

(e) operations manual, performance specifications and maintenance requirements for all pump stations; and

(f) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications.

This excludes large water sensitive urban design (WSUD) measures such as bio-retention basins and wetlands, where the acceptance of the asset and ongoing maintenance requirements is to be in accordance with SC6.4.3.9 Water sensitive urban design guidelines and SC6.4.6.1 Water sensitive urban design construction and establishment guidelines.

SC6.4.7.2.8 Landscaping and irrigation

(1) Introduction

This clause outlines the conditions and timeframes associated with acceptance by council of landscape and irrigation works (Works) constructed as part of a Development Permit.

(2) Principles

(a) the establishment period will be included within the maintenance period;

(b) council will accept works on maintenance that have reached practical completion and have met the relevant conditions of the Development Permit, but may still require time to establish;

(c) the establishment date will be used to determine satisfactory establishment;

(d) council will accept responsibility for maintenance of hard landscape assets from the on maintenance date;

(e) the Developer will remain responsible for maintenance of soft landscape assets during the maintenance period;

(f) the Developer is responsible for all defects in the works until the off maintenance date; and

(g) council will accept responsibility for maintenance of soft landscape assets from the off maintenance date.

(3) Terminology

In addition to the terms previously defined in SC6.4.7.1.1(2) the following terms and definitions apply to this clause, specific to landscape and irrigation works:

Contractor A person or company who has entered into a contract with the developer to supply and install infrastructure, landscaping and/or an irrigation system.

Establishment period The period of time between when council accepts the works on-maintenance until when council accepts the works as established (the established date).
Works are deemed established when:

(i) all the defects identified at the on-maintenance and practical completion;

(ii) defects identified at inspection have been rectified unless agreed otherwise;

(iii) all turfed areas have "taken root" and there are no obvious gaps between strips of turf;

(iv) all turfed areas have been rolled and/or topdressed to fill any depressions;

(v) all plants are showing signs of healthy, new growth, and that the planting design intent is starting to take shape;

(vi) generally, the landscape works indicate that they are being maintained in accordance with the Development Permit; and

(vii) revegetation areas have achieved specified cover.

Hard landscaping Structures, paths and facilities such as playground equipment constructed from building materials (but excluding irrigation systems).

Maintenance period The period of time between when council accepts the works on-maintenance until council accepts the works off maintenance. This includes any establishment periods and the defect liability period. This is to be:

(i) a minimum of 12 calendar months; and

(ii) include the establishment period and the defect liability period.

Off maintenance date The date the works are fully accepted by council following an inspection by council, which considers that all works are satisfactory, and the defects liability period concludes.
This date must be:

(i) after the established date;

(ii) after all defects have been remedied;

(iii) at least 12 months after the on maintenance date;

(iv) after an inspection by council which considers that all works are satisfactory.

Soft landscaping Trees, plants, grass and vegetation generally and any irrigation system associated with such vegetation.

(4) Ownership and responsibilities

The ownership of the works transfers to council on the earlier of:

(a) the date when the land on which the works are constructed is transferred to council; or

(b) the on maintenance date.

(5) Typical timelines

(a) Construction

(i) achieve practical completion;

(ii) conduct inspections to determine the on maintenance date; and

(iii) release Plan of Survey if applicable.

(b) 0 weeks

(i) on maintenance date.

(c) 12 weeks

(i) normal established date;

(ii) landscape inspection to be carried out; and

(iii) if works are unsatisfactory, establishment date will be deferred.

(d) 52 weeks

(i) normal off maintenance date;

(ii) landscape inspection to be carried out; and

(iii) if works are unsatisfactory the off maintenance date will be deferred.

(6) Landscape works on maintenance/practical completion

(a) Requirements for on maintenance:

(i) maintenance inspection;

(ii) the Registered Landscape Architect must certify as constructed drawings by including the following statement on each drawing:

I/We (Name) of (Firm) hereby certify that the works as shown on the "as constructed" drawings reflect any changes that were made during the course of construction;

(iii) all asset transfer documentation is submitted and approved by council including the following:

(A) Open Space Asset Data Collection Form – This form contains the asset information relating to the construction of new assets, or

(B) Asset Change Form – This form contains information about minor changes to existing assets; and

(C) warranty details for all items with a value greater than $500.00. This information is required by council to assist in future warranty claims;

(iv) plantings, gardens and turfed areas must be exhibiting a "strike", but compliance with full establishment requirements is not essential at on maintenance;

(v) the defects liability period for soft landscape works shall be concurrent with the defects liability period for any associated irrigation system; and

(vi) the defects liability period for landscape works shall not commence until:

(A) the associated irrigation system has been commissioned; and

(B) all requirements of the Special Conditions of Approval have been met.

(7) Landscape works defects liability period

(a) Establishment

(i) All soft landscaping will be subject to a 12 week landscape establishment period. The landscape establishment period is included in the 12 month maintenance period. The Developer is responsible for establishing the works during the establishment period until the established date as advised by council.

(ii) The developer may be required to undertake additional works during the establishment period such as additional watering, formative pruning, topdressing, turfing, replenishment of mulch and replacement of plants.

(iii) At the conclusion of the landscape establishment period a landscape establishment inspection may be conducted, and if the landscaping establishment is not satisfactory additional works may be requested and/or the maintenance period may be extended.

(b) Landscape maintenance period requirements and responsibilities

(i) Council is responsible for maintenance of hard landscaping during the maintenance period.

(ii) The developer is responsible for maintenance of soft landscaping during the maintenance period until the off maintenance date.

(iii) Water costs

(A) The developer is responsible for the cost of water during the maintenance period.

(B) Council is responsible for cost of water from the off maintenance date.

(iv) Vandalism, theft and damage caused by unexpected events or third parties

(A) For soft landscaping, the developer is responsible for rectification works to remedy vandalism, theft and damage caused by unexpected events during the maintenance period.

(B) For hard landscaping, the council is responsible for rectification works to remedy vandalism, theft and damage caused by unexpected events during the maintenance period.

(v) Extended maintenance periods

(A) In addition to provisions detailed, where negotiated as conditions of the development approval, extended maintenance period beyond the 12 month period may apply

(B) Where the landscape maintenance period is extended as a condition of development approval or due to provisions within this policy, this extension may concurrently apply to any irrigation system associated with the landscape works.

(vi) General maintenance activity requirements

(A) All maintenance activities must be undertaken in accordance with council's public open space maintenance specifications. Any maintenance activities that deliver a level of service above and beyond council's specification is at the discretion and cost of the developer.

Editors Note - council's Public open space maintenance frameworks are currently under development.

(B) Maintenance activities include, but are not limited to mowing, top dressing, litter collection, watering, pruning, fertilising, weeding, mulching, pest and disease control.

(C) All maintenance work to new and existing landscaping shall be carried out in accordance with the best horticultural practices.

(vii) Watering requirements

(A) All soft landscaping shall be watered regularly (either by hand watering or by irrigation) to ensure the continuing healthy establishment and growth of all plants taking into account soil type, plant type and size, prevailing weather conditions and seasonal variations.

(B) Watering methods are to be suitable for watering the root ball of newly planted plants during the critical first several weeks of establishment.

(C) Watering shall not cause displacement of mulch or erosion of garden mix soil.

(viii) Weeding, pest and disease control

(A) Gardens and turf shall be regularly weeded. Six weeks prior to the end of the defects liability period ("off maintenance"), the area shall be inspected for weed growth and treated with an appropriate selective herbicide. All chemicals shall be used in accordance with the manufacturer's recommendations.

(B) Plants shall be regularly inspected for pest and diseases throughput the defects liability period. Any pest or disease detected shall be reported to the Superintendent. Acceptable horticultural techniques shall be employed by the Contractor to manage any infestations as directed by the Superintendent. 12 weeks prior to the end of the defects liability period ("off maintenance"), the area shall be inspected for pests and disease and treated with an appropriate pest and disease control.

(ix) Planting and tree maintenance

(A) All maintenance work to new and existing trees shall be carried out by an arborist with formal qualifications or at least 5 years recognised experience in Arboriculture. The works shall be carried out in accordance with the AS 4373 *Pruning of Amenity Trees* and shall not proceed without the written approval of the Superintendent.

(B) Stakes and ties and guying shall be checked for firmness and support and shall be adjusted as necessary to prevent any damage to the bark or roots of the tree. Stakes and ties or guying shall be removed when the tree is self-supporting and/or as directed by the

Superintendent.

(x) Planting, trees, turf and hydroseed failure and replacement

(A) Plants and trees lost through vandalism, theft or that have died shall be replaced by the Contractor on a monthly basis.

(B) Plants, trees, and turf supplied by the Contractor that have failed to become established during the defects liability period or are diseased and/or dying shall be removed and replaced by the Contractor twelve weeks prior to the end of the defects liability period ("off maintenance") and at no cost to council. If the loss is significant, it will be at the discretion of the Superintendent if an extension on the defects liability period for the failed landscaping is warranted

(C) Areas of hydro seeding/mulching that have failed to become established or have died during the defects liability period shall be removed and retreated by the Contractor at no cost to council. If the area is of significant size it will be at the discretion of the Superintendent if an extension to the defects liability period for the failed area is warranted.

(8) Landscaping inspections during the defects liability period

In addition to the requirements outlined in SC6.4.7.2.8(2) Principles, the following requirements apply to landscaping works:

(a) any work inspected that does not comply with the specification and/or the design plans or has not been adequately maintained in accordance with SC6.4.7.2.8(2) will not be accepted by council and will be noted for rectification. The contractor is required to rectify these items as soon as is practical and as a minimum before the next scheduled inspection; and

(b) failure by the Contractor to rectify unacceptable items prior to the next inspection may result in the defects liability period for those items being extended by the number of weeks that have lapsed prior to the rectification work being completed.

(9) Landscaping off maintenance/final completion

(a) Final inspection and completion

(i) Soft landscaping shall be inspected by the Superintendent for acceptance ("off maintenance") at the end of the defects liability period, subject to any special conditions of approval.

(ii) In addition to the requirements outlined in SC6.4.7.2.8(2), the final inspection and completion requirements apply as detailed below.

(b) Final acceptance criteria (Gardens)

The acceptance criteria for gardens shall be:

(i) gardens shall be free from weeds, stones, roots, sticks, rubbish and other deleterious material;

(ii) gardens shall be free of disease and pests;

(iii) mulch shall be to the minimum thickness specified;

(iv) plants shall be as specified; and

(v) plants shall be placed at the spacings nominated and in the quantities nominated as detailed on the drawings or as specified.

(c) Final acceptance criteria (plantings)

The acceptance criteria for plants shall be:

(i) plants shall exhibit signs of healthy active growth;

(ii) plants shall show no signs of yellowing or wilting;

(iii) plants shall be well formed;

(iv) plants shall be free of disease and pests;

(v) plants shall have healthy root systems and shall not be root bound; and

(vi) plants are true to cultivar, type or form as specified.

(d) Final acceptance criteria (turf)

The acceptance criteria for turf areas shall be:

(i) the achievement of an even green colour with a dense sward over the entire area with no open joints;

(ii) turf shall exhibit signs of healthy active growth;

(iii) turf shall be free from weeds, stones, roots, sticks, rubbish and other deleterious material; and

(iv) turf shall be free of disease and pests.

(e) Final acceptance criteria (hydro seeding/mulch)

The acceptance criteria for hydro seeding/mulch areas shall be:

(i) the achievement of an even green colour over the entire area and exhibiting healthy active growth with acceptable vegetative cover. Of this cover 95% shall be the nominated dominate grass species with the remaining 5% made up of annual and perennial grasses;

(ii) free from weeds, stones, roots, sticks, rubbish and other deleterious material;

(iii) free of disease and pests; and

(iv) the area shall not be mowed for at least 5 days prior to the inspection.

(f) Final inspection documentation

(i) Following the final inspection (off maintenance) council will issue a site inspection report (defects list). Any items not acceptable to council will be noted for rectification.

(ii) The Contractor is required to rectify these items and apply for a re-inspection when all rectification items have been completed.

(iii) A certificate off final completion will be issued by council following the rectification of all defects noted at the off maintenance inspection.

(10) Irrigation works on maintenance/practical completion

(a) Requirements for on maintenance:

(i) all as constructed drawings and documentation nominated in SC6.4.7.2.8(2) is submitted and approved by council;

(ii) all asset transfer documentation including the following:

(A) Irrigation Asset Data Collection Form – This form contains the asset information for the construction or

(B) Irrigation Asset Change Form – This form contains information about minor changes to existing assets;

(C) Irrigation Network Controller Setup Request Form – This form is used to provide information to the infrastructure Services Irrigation Technician who will configure the telemetry network. The form shall be submitted to council a minimum of 4 working days prior to commissioning of the system;

(D) Irrigation Program Setup Request Form – This form is used to provide information to the infrastructure Services Irrigation Technician who will setup the irrigation controller program. The form shall be submitted to council a minimum of 4 working days prior to commissioning of the system. After the program has been set up, the Infrastructure Services Irrigation Technician will issue a copy of the program to the Contractor;

(E) Warranty details for all irrigation components with a value greater than $500.00 excluding GST. This information is required by council to assist in future warranty claims; and

(F) Plumbing and Drainage Application Forms 1, 2 and 7 are to be completed by a licensed plumber and submitted to the Hydraulic and Building Services Unit of the Townsville City Council. The Backflow Test Certificate must be lodged with Hydraulic and Building Services Unit of the Townsville City Council. A copy of the Backflow Test Certificate must also be supplied to Infrastructure Services; and

(iii) commissioning of the irrigation system shall not proceed until all of the above documentation is submitted and approved by the council.

(11) Irrigation defects liability period

(a) A defects liability period applies to all irrigation systems installed by contractors. The defects liability period shall be undertaken in accordance with this policy and any special conditions of approval

(b) If applicable the defects liability period for the irrigation system shall be concurrent with the Defects Liability Period for any associated landscaping works.

(c) The defects liability period for an irrigation system shall not commence until:

(i) all of the documentation nominated in SC6.4.7.2.8(10)(a) above is submitted and approved by council;

(ii) all requirements of the special conditions of approval have been met;

(iii) if applicable the associated landscaping works are accepted “on maintenance”;

(iv) the irrigation system has been commissioned; and

(v) the site has been jointly inspected by the council and contractor and the irrigation system is free of defects at the time of inspection.

(12) Irrigation inspections during the defects liability period

During the defects liability period, council may require access to the site to undertake the following tests:

(a) main lines pressure test – the main line is pressurised to test for leaks. All valves are shut and the pressure is taken over a determined length of time;

(b) sprinkler pressure test – the sprinkler pressure is taken at the nozzle using a pitot pressure gauge and is then compared to manufacturer recommendations;

(c) dripper pressure test – measurement at flushing valves are taken and the pressure gauged to make sure it conforms to the manufacturer recommendations. The inlet pressure is then tested under the same conditions to check it does not exceed 300Kpa; and

(d) lateral pressure loss test – the first and last sprinklers of the lateral line are pressure tested. The variation in flow is then calculated and compared with the limits nominated in the specification.

(13) Irrigation off maintenance/final completion

(a) Final inspection and completion
Final completion shall be managed in accordance with this policy and any special conditions of approval.

(i) Following the final inspection, council will issue an irrigation inspection defects list detailing items that do not comply with the specification and/or design plan.

(ii) The contractor is required to rectify these items and apply for a reinspection when all rectification work has been completed.

(iii) After reinspection of the rectification work, and if the work is satisfactory to council an Irrigation Inspection Report (Defects List) will be issued with the status noted as “Ready to proceed to off maintenance”.

(iv) A Certificate of final completion will be issued by the Superintendent when the Contractor has met all obligations under the Contract.

SC6.4.7.2.9 Quality assurance documentation

(1) Requirements for on maintenance

(a) Copies of the Test Certificates from a National Association of Testing Authorities (NATA) registered laboratory; and

(b) A single quality control document must be submitted, including but not be limited to:

(i) pavement levels;

(ii) compaction tests;

(iii) pavement materials tests;

(iv) concrete tests;

(v) asphalt tests;

(vi) sewer pressure tests;

(vii) water pressure tests;

(viii) water bacteriological tests;

(ix) landscaping soil tests;

(x) playground and fitness equipment certification;

(xi) softfall under surfacing certification;

(xii) structural certification (forms 15, 16 and 21);

(xiii) electrical safety, testing compliance certification; and

(xiv) backflow certificate.

SC6.4.7.2.10 Defects liability period

The defects liability period for all works is a minimum of 12 months from the date of the release of the formal plan of survey or from the date of acceptance on maintenance, whichever is later, at which time the bond will be refunded subject to the off maintenance requirements being completed to the satisfaction of council. If for any reason during the maintenance period, a defect of substantial proportions is discovered then council reserves the right to extend the defects liability period for a further 12 months from the date of correction of the defects, or as negotiated e.g. infrastructure is required to be reconstructed after a significant failure due to deficiency in design/construction.

SC6.4.7.2.11 Bonds and fees advice

(1) Requirements for on maintenance

(a) A works inspection fee (at the rate applicable at the time of payment) must be paid prior to the works being accepted.

(b) A reinspection fee (at the rate applicable at the time of payment) will be applicable where an additional inspection is required due to works being incomplete or unsatisfactory at the initial inspection. The reinspection fee must be paid prior to the additional inspection being conducted.

(c) A maintenance bond (5% of the value of the works as determined and certified by a Registered Professional Engineer of Queensland (RPEQ) or Registered Landscape Architect) and supporting Schedule of Works with costs certified by the RPEQ or Registered Landscape Architect must be lodged with council. The bond must be in favour of council and in the form of cash or an unconditional bank guarantee (non-expiring). If the security is in the form of a bank guarantee, the guarantor must be a bank or financial institution acceptable to council.

(d) In the event of a default by the developer relating to defects, council may undertake whatever action required to secure compliance with the conditions of approval and may apply the security for that purpose. The security (or balance) will be returned to the developer upon satisfaction of the conditions of approval relating to maintenance responsibility.

SC6.4.7.2.12 On maintenance inspection and final inspection and compliance check

(1) Requirements for on maintenance:

(a) The developer must provide council at least 5 business days' notice, requesting the works be checked for compliance with the approvals and be accepted on maintenance.

(b) A report must be submitted, showing the scope of works, date and outcome of works inspected by the supervising Registered Professional Engineer of Queensland or supervising Registered Landscape Architect.

(c) Council must be satisfied with the results of an on maintenance inspection and compliance checks against the development approvals. Council will issue an On Maintenance Certificate, identifying the relevant works and any defects applicable.

(d) Prior to requesting an on maintenance inspection, the developer must correct any defects arising from faulty workmanship, materials or design identified in the On Maintenance Certificate or during the maintenance period (or extended period following rectification of such defects).

(e) The on maintenance date may be backdated to the date of the initial on maintenance inspection date or the release of the plan of survey (whichever is the latter), if all outstanding requirements were met within 4 weeks of identification.

SC6.4.7.2.13 Off Maintenance

(1) The works will become off maintenance subject to:

(a) rectification of all defects identified at on maintenance or during the maintenance period;

(b) council being satisfied with the results of an off maintenance inspection and compliance check against development approvals conducted by council officers following the end of the maintenance period;

(c) the development will only be accepted off maintenance in its entirety and all works must be performing satisfactorily at this stage;

(d) the developer, or their representative, must arrange with council an inspection of all defects 1 month prior to the work being due off maintenance;

(e) the whole of the works must be inspected at the off maintenance inspection. The consulting engineer is responsible for thoroughly inspecting the development and any necessary remedial work prior to the off maintenance inspection; and

(f) acceptance of the works off maintenance does not discharge the developer from their obligation to provide a development free of defects. Any defect that is discovered after the acceptance off maintenance, which attributed to the failure to deliver a development in accordance with the conditions of the development permit, must be repaired at the developer's expense.

SC6.4.7.3 Sewer pump-out agreements

SC6.4.7.3.1 Introduction

(1) Purpose

In accordance with SC6.4.7.1 Release of the plan of survey, council may consider early sealing of the survey plan for a development if:

(a) incomplete or non-commissioned trunk infrastructure is preventing the developer providing infrastructure from being fully commissioned; and

(b) the non-delivery of this trunk infrastructure is impacting on council's process for signing of the survey plan.

(2) Scope

This sub-section sets out the circumstances in which a sewage pump out agreement may be entered into, and the mandatory requirements that will be included in such an agreement under Section 348 of the *Sustainable Planning Act 2009.*

(3) Reference and source documents

This section shall be read in conjunction with the following standards and legislation:
Environmental Protection Act 1994
Local Government Act 2009
Plumbing and Drainage Act 2002
Sustainable Planning Act 2009
Water Supply (Safety and Reliability) Act 2008
WSA 02-2002 2.3 *Sewerage Code of Australia*
WSA 04-2005 2.1 *Sewerage Pumping Code of Australia*

SC6.4.7.3.2 Sewage pump-out deed of agreement requirements

(1) A Deed of Agreement relating to the incomplete or non-commissioned trunk infrastructure must be entered into. The agreement must ensure that all risks associated with the temporary pumping out and disposal of sewage are adequately addressed by the developer. The following sections must be addressed within the Deed of Agreement at a minimum:

(a) Timing

The trunk infrastructure must be programmed to be commissioned prior to when the completion of dwelling construction is envisaged.

(b) Supply of electricity

(i) Sewer pump stations must be provided with a continuous and reliable electrical supply. Details of the provision of power supply must be provided with the sewage pump station design.

(ii) Alternatively, if temporary power supply is proposed to be supplied by a generator, details of this arrangement must be included as part of the agreement.

(c) Lawful effluent disposal and access arrangements

Access arrangements for pump stations and/or other wastewater maintenance holes required for the pump-out service must be specified, and the wastewater maintenance hole or licensed septic disposal facility designated. The disposal of all sewage must be as directed by Townsville Water from time to time by a registered operator following agreed transport routes, for the duration of the agreement, and under the supervision of a suitably qualified engineering consultant.

(d) Developer's provision of pump-out service
A minimum standard for the developer's provision of a pump-out service must be specified.

(e) Management of odour complaints, fish kills and wastewater spills
Details of management of overflow/spills or environmental harm must be included in the Deed of Agreement and actions undertaken in accordance with the *Environmental Protection Act 1994.*

Click here to obtain a copy of the following form.

SC6.4.7.3.3 Template agreement

Council's Template Agreement for Sewage Pump-Out may be used to assist in the preparation of the Deed of Agreement (see SC6.4.7.3 Attachment A).