

MoES – C 2025 (DRAFT)

Construction (Civil)

Manual of Engineering Standards

maitland
CITY COUNCIL

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C – CONSTRUCTION – ROADS, DRAINAGE, CONCRETE

This Document C: Construction is part of the MoES suite of Documents. Document G: General Requirements serves as the primary source of information and guidance on how this document functions within the entire suite.

This document, found in the Council's Manual of Engineering Standards, provides a comprehensive guide to the principles and practices governing infrastructure construction in the Maitland Local Government Area. It outlines essential standards and procedures that are crucial for safe, efficient, and sustainable construction. Adhering to these guidelines ensures quality assurance, risk mitigation, and consistency in construction practices. Engineers, contractors, and stakeholders will find this document beneficial for executing projects that enhance infrastructure resilience and functionality.

All works shall be performed to the requirements of this Manual and as directed by Maitland City Council.

As the Principal Certifying Authority, Council must be notified two days prior to commencement of any works and may inspect works, where necessary, at any stage of construction.

Appropriately qualified and experienced Contractors shall carry out all work in a competent manner, in accordance with the approved Construction Certificate plans, this manual, relevant occupational health and safety and WorkCover requirements.

In all respects relating to construction activity, the contractor should be aware of his/her responsibility regarding any relevant Act of Parliament and associated Regulations.

1. Traffic

1.1. Traffic Control

Where impacts are expected within the existing road network, traffic control plans in accordance with Roads & Maritime Services “Traffic Control at Worksites” shall be prepared by a certified person and be submitted to Council for acceptance prior to the works commencing.

The control of works shall be undertaken to assist the passage of motorists and pedestrians through the worksite. Signposting shall ensure separation of motorist traffic and pedestrian traffic, and each from workers and machinery.

It is the developer/contractor’s responsibility to maintain all temporary signposting for the duration of the construction works, which includes regular checking of the signposting to avoid accidental disturbance, displacement, interference, or vandalism. Signs and their placement shall be in accordance with Roads & Maritime Services “Traffic Control at Worksites”. Council reserves the right to request additional signposting where it is considered appropriate to enhance safety for road users.

All Traffic Controllers are subject to RMS regulations & WORKCOVER requirements. Controller certification and their traffic control methods are subject to inspection and if necessary, enforced compliance with the relevant standards.

1.2. Partial Road Closure

Minor closures such as footway and parking lanes or road shoulders constitute a temporary partial road closure to vehicular and/or pedestrian access for construction purposes. A more significant partial closure may include the closure of a vehicular traffic lane and the subsequent need for traffic control for single lane flow.

Permission for the closure must be obtained from Council, and such a closure may only occur in normal daylight working hours, unless special circumstances exist where night-work is essential. Such controls must be employed with the standard signposting, and manual or signalised traffic flow controls. Two-way flow for vehicle traffic must be reinstated for each night.

Acceptance of a Traffic Control Plan prepared by a certified traffic controller must be received from Council prior to implementing the plan.

1.3. Full Road Closure

Permission to temporarily close the whole of a public road to vehicular or pedestrian traffic for construction purposes must be obtained from Council - a fee applies. Application for road closure must be received at Council at least six weeks prior to the desired closure date.

1.4. Road Opening Permit

Permission to "open" public roads by excavation for purposes of installing underground structures, services and conduits must be obtained from Council – a fee applies. The area defined by a public road is any part within the road reserve. Council may require under-boring methods under road pavements and paving. General term of conditions is available as part of the application.

1.5. Haulage Routes

Haulage routes to, or from, the development or work site will be subject to approval by Council prior to the commencement of work. The Contractor shall ensure carriers comply with approved routes.

1.5.1. Damage To Roads

Damage to roads directly attributed to operations of construction plant serving the development shall be repaired to the satisfaction of Council, at no cost to Council.

It is advised that the Project Manager accompany Council's representative on the assessment of the approved haulage route and document the condition of the approved route. Such documentation prepared by the Project Manager shall be agreed upon with Council.

Where required by Council, a bond shall be submitted to Council to cover possible pavement rectification due to damage of the haulage route roadway.

1.5.2. Overweight Vehicles

Where required by Council, a vehicle that is suspected of being overloaded, carrying a weight more than the legal limit for the vehicle, the vehicle shall be directed to a public weighbridge for confirmation with compliance, or otherwise, at no cost to Council. The vehicle shall not leave the weighbridge site until any necessary adjustment of weight is rectified.

1.6. Detour Routes

Where it is determined by Council that there is a need for a temporary road detour route to be established during development-related works, the proposed route(s) must be submitted to Council for approval, and the contractor shall be responsible for the on-going maintenance of the road pavement along the detour route.

When choosing a detour route, it must have where possible, a similar capacity for the expected traffic to that of the temporarily closed road.

An assessment of the risks associated with detouring vehicles onto other roads should be made regarding potential inclement weather. The existing condition of the chosen detour route must be recorded prior to the commencement of development works, and any damage caused, rectified, as discussed under “Haulage Routes”.

2. Contractors

Contractors must be experienced and competent to perform all work in compliance with the approved Subdivision Works Certificate and the approved plans, this manual, relevant occupational health and safety standards, and WORKCOVER requirements. They also need to have the appropriate certifications for all aspects of the project.

Contractors need to know and follow their responsibilities according to relevant acts and regulations related to construction.

During the construction startup meeting, the contractor must provide the Council with contact details for all relevant officers and parties involved in the project. This includes, but is not limited to, the Site Supervisor, Site Engineer, Project Manager, Environmental Manager, Geotechnical Officer/Engineer, Surveyor, and ~~representatives from Water, Gas, and Works Assistants~~/Subcontractors.

Any changes to the plan must be approved in writing by the Accredited Certifier or the Council, depending on who issued the Subdivision Works Certificate. These changes might require submitting a new design for approval.

2.1. Sub-Contractors

Upon request the identity of sub-contractors and their proposed scope of works shall be supplied to the certifier or Council. The certifier or Council reserves the right to preclude any sub-contractor.

2.2. Working Hours

Construction workhours, particularly relating to noise generation, shall not be performed outside the hours that apply under legislative requirements or as determined through development consent conditions.

As a guide, time restrictions (as stated by State Government guidelines “*Construction Noise*”) are:

- *Monday to Friday:7am to 6pm*
- *Saturday:8am to 1pm if audible on residential premises,*
- *otherwise 7am to 1pm*
- *Sunday & Public Holidays: No construction work.*

Construction activity such as “emergency” or “night” work should be notified to Council. Construction works that may be considered to generate offensive noise may be subject to restrictions.

2.3. Safety

All adequate safety precautions in accordance with WORKCOVER and relevant legislation and codes of practice shall be the responsibility of the contractor. This will include matters related to public safety where interaction is expected (and may include fencing), traffic related matters discussed above and adequate induction and assistance for site visitors. Council or the RMS will not be liable for any consequence from the developer's inaction or omission.

3. Site Management

3.1. Survey Marks

Adequate precaution shall be taken to protect and preserve all survey marks, such as SSM, PM, etc., relative to or affected by the work. New survey marks and replaced marks shall be installed by a Registered Surveyor. An appropriate plan of survey showing the relocated marks shall be prepared by the Surveyor and lodged for registration in accordance with the Survey Practice Regulation. Survey marks for the purpose of property boundary definition shall not be placed in any concrete path or kerb.

Survey set out for the purposes of construction of the works shall be performed by a surveyor. Recovery marks or stakes are not to be placed in locations that present a hazard to pedestrian or vehicular traffic unless suitably protected.

3.2. Material Storage

Storage of pipes, gravel and other materials on public roads or reserves is not permitted unless extenuating circumstances prevail, whereupon Council approval must be obtained. Any damage shall be made good to the satisfaction of Council or costs met where Council performs the restoration works.

Storage of material shall be in a non-hazardous manner and shall include the use of safety barriers, fencing and sediment controls as appropriate to the material. (See also Document G: General Requirements - Environment)

3.3. Adjoining Land

The Contractor shall liaise with adjoining property owners affected by the work and take precautions to prevent deterioration of or damage to private property, public roads, public utilities, and reserves during construction. Such property may include dwellings. It is recommended that the Contractor organise preconstruction inspections with adequately qualified independent inspectors to identify existing structural conditions that are within proximity of the proposed works and should keep written and photographic records for future reference.

4. Inspections

Inspections are required at certain hold points of construction as set out below. Principal Certifying Authorities and Accredited Certifiers shall be bound by this Manual's construction and inspection requirements.

4.1. Limitations on Approvals

During construction, approval of any critical stage of the work (as nominated below), will be given in regard to structural standard *only at the time of inspection*, and does not absolve the Contractor of responsibility for rectification of any damage or deterioration occurring before "final inspection" and/or "practical completion".

Where a third-party certifier is involved in the inspection regime (such as a geotechnical engineer) who gives approval for works, that approval will not be construed to be an approval of Council. Council reserves the right to take any course of action, or make a decision regarding the progress of works, deemed necessary to rectify a construction problem or disputation.

4.2. Inspection Meetings

The Contractor shall be present during each inspection to receive approval or otherwise of the works prior to proceeding to the next stage of works. Amended works may be subject to re-test or an additional inspection, and therefore may attract a fee for that inspection.

4.3. Inspections Outside Normal Hours

Inspections of work outside of normal working hours may be possible with prior arrangements. For Council's attendance, the cost of the inspection, in accordance with Council's fees and charges, shall be borne by the Developer/Contractor. At Council's discretion, a suitable qualified person may be appointed for an inspection to which Council cannot attend.

4.4. Approval of Works

Approval to proceed through the critical stages of the various components of works must be obtained. "Critical Stage" approval does not absolve the developer from responsibility to correct defects or failure in the work that may become apparent prior to "practical completion" and/or dedication to Council. It is also the Contractor's responsibility to obtain any necessary approvals from the appropriate Certifier and Council prior to proceeding to subsequent stages.

4.5. Additional Works

Additional requirements beyond the Construction Certificate design plans, which become apparent during construction, shall be completed as directed. Where such works do not require in the opinion of the Principal Certifying Authority, a new design, additional works shall be shown on the Works-As-Executed (WAE) Drawings.

4.6. Inspection Regime

The minimum occasions as "hold points" for the following critical works, requires inspections to confirm that the nominated standards and approvals given under this Manual are met. Pavement reinspection is required after any rainfall event greater than 5mm and after any rainfall event that necessitates a proof roll, at Council's discretion.

A. Traffic

- Temporary signs and markings.

B. Environmental

- Erosion controls.
- Vegetation clearing (optional).

C. Stormwater

- Stormwater basins: inspection of the keyway floor prior to filling and monitoring of Level 1 clay core construction.
- Stormwater Pipes: prior to backfill above the haunch zone of type, class, bed, haunch, alignment, clearances, joints, plugs etc.
- Subsoil drainage pipe: prior to backfill of filter material.
- Stormwater pits: prior to concrete pour of forms and reinforcement.

D. Subgrade (Natural or Select)

- Proof-roll of full prepared width.

- String-line at centre, kerb-line, and intermediate points, alternatively, confirmation by electronic field survey.
- Density test (compaction and moisture including CBR shrink and swell).

E. Sub-base

- Proof-roll under K & G.
- Proof-roll full pavement width.
- String-line at centre, kerb-line, and intermediate points, alternatively, confirmation by electronic field survey.
- Density test (compaction and moisture).
- Inspect road pits to ensure alignment of lintels is consistent and satisfactory.

F. Base

- Proof-roll full pavement width.
- String-line at centre and intermediate points, alternatively, confirmation by electronic field survey prior to application of primer seal.
- Density test (compaction and moisture).
- Benkelman Beam, prior to final wearing course.
- Primer seal prior to final wearing course.

G. Concrete

- Paths, driveways and pits and other structures prior to concrete pour.

H. Retaining Walls

- Foundations, backfill and drainage. Council will accept a geotechnical engineer's report for backfill and reinforced earth where required by design.

I. Final

- General workmanship of all works including pit/lintel/grate finish.

Notes:

- Some items will require certification by a practising professional in the respective discipline.
- Council/PCA reserves the right to request additional tests where considered necessary.
- Council shall not be responsible for expenses arising from testing.
- Inspections requested and either not ready at the appointed inspection time or work is obviously incomplete, may incur a re-inspection fee.
- In the event that a Council officer is unavailable for a particular inspection, an inspection report from an independent professional may be permitted, with prior approval from the principal certifier (Council).
- Inspections are only appropriate where the work is uncovered and capable of being inspected. IT IS NOT POSSIBLE to certify an inspection retrospectively where work has been completed and covered prior to being inspected.
- Failure to call for an inspection or failure to carry out any rectification works found to be defective may result in certification being withheld.
- Where an inspection reveals unsatisfactory or defective results, a re-inspection may be required, and fees may be applied for any subsequent or additional inspections. Continuation

of further works reliant on defected works is PROHIBITED until such times as a satisfactory inspection has been carried out and/or approval to continue is obtained.

- All inspections must be booked with Council 24 hours in advance no later than 3.00 p.m. on the day before the inspection is required. Inspection bookings may be made by telephone to Council in normal office hours.
- Inspections will generally be carried out between 8.30 am and 4.30 pm on the requested day (Mon-Fri).
- A pavement re-proof roll is required after any rainfall event greater than 5mm, after any rainfall event that necessitates a proof roll at Council's discretion, and following any extended period of inactivity.

5. Environment

This section relates to environmental controls and safeguards within a construction site and the requirement to maintain a "clean" environment in the surrounding area where works may impact that area.

5.1. Contamination

Measures must be taken to ensure that no contaminated material or noxious weeds are transported off site without due care, and with diligence and authorisation for removal and/or disposal. No contaminates, contaminated material or noxious weeds shall be transported onto the site. The contractor shall employ methods to discourage illegal dumping of waste materials on the construction site, and if occurring, remove the waste to an approved waste disposal depot.

Transported loose material must be covered to prevent loss.

5.2. Erosion

The Contractor shall take any necessary steps to prevent erosion occurring on the construction site. Effective sediment control measures must be employed. For works where there is a possibility of dust or water erosion problems, the Engineer's endorsement of treatment methods is required.

It is an offence under the Protection of the Environment Operations Act to pollute the environment as a result of sediment leaving the site, and that a breach may result in the issue of an infringement notice, attracting a monetary fine. Reference should be made to Council's Standard Drawings and the Landcom/Dept of Housing manual, "Managing Urban Stormwater - Soils & Construction" for examples of methods of control.

Regarding erosion control, Council may request certain preventative measures to be implemented, such as watering loose surface areas or constructing silt traps. Silt traps shall be employed in advance of existing downstream systems, basins, wetlands, natural gullies, etc.

For medium and large subdivisions, an earthwork plan with agreed allotment sizes and an indicative sequencing plan must be provided (if not already included in the SWC/construction plans). A cut sequence and a fill sequence may be necessary. The contractor shall not disturb more land than can be suitably worked to the design height and stabilised within 3 months, and in a size that can be managed 24/7, including non-workdays, to control dust, erosion, and sedimentation. It is not acceptable to rely only on water carts during working hours. Details of how the allotments will be stabilised, such as with hydro-spray applications, dust fences, and other techniques, must be provided with the plan.

The contractor must schedule the construction program to ensure that bulk earthworks are completed, and the area is brought to size within 3 months of commencing work. Once the area is properly shaped, or if it is not being worked for 20 days, it must be rehabilitated and/or stabilised.

Bulk earthworks for medium and large subdivisions must not expose more than three (3) hectares of earthworks (unstabilised to wind and rain) at any point in time, as per the MCC DCP.

Progressive stabilisation can exclude, within reason, the road corridor. Lots and open space drainage areas must be stabilised progressively to minimise erosion, sedimentation, and dust. Small corridors, such as those for retaining walls, may be excluded, provided the adjacent area is fenced off or otherwise protected to prevent further disturbance. All disturbed ground due to the development must be progressively stabilised and rehabilitated so that it no longer acts as a source of sediment.

For building works, all landscaping must be installed in accordance with the approved landscape or rehabilitation plan before occupation or use of the premises. Such works must be maintained in a stable and effective condition.

5.2.1. Maintenance of Devices

Erosion control devices must be inspected on a regular basis, particularly following any rainfall event, and cleaned where necessary or as instructed, to ensure the devices are in working order.

5.3. Tree Clearing

For purposes of road infrastructure construction, the extent of clearing shall be limited to the road reserve and associated drainage facilities, and service corridors.

Unless inherent within the engineering design or explicit within Development Consent, approvals must be sought and obtained for site clearing beyond these limits prior to works commencing.

The Contractor should be made or make him/herself aware of the developer's responsibility regarding tree and habitat disturbance, and of the services of a suitably qualified ecologist engaged to supervise the site's clearing activities. (See also Document G: General Requirements - Environment).

Any trees associated with the development/subdivision works, considered by the engineer to be hazardous to traffic or pedestrian activity, shall be removed or pruned accordingly.

5.4. Vegetation Disposal

Disposal of vegetation that is chipped or tub-grinded may be either, spread over the site at specified locations, (particularly avoiding stormwater inundation or significant/major flow-path areas) as stabilising mulch (approximately 100mm thick), or stockpiled. Excess material not used as mulch shall be removed from site.

Approval for disposal by dumping to Council's "waste facility" may be considered.

6. Earth – Fill

This section relates to earth-fill material within subdivision construction projects, and within existing and/or proposed public land projects, its quality, importation, placement and retention with walls or batters.

The Protection of the Environment Operations (Waste) Regulations allows for certain materials to be used under the resource recovery exemptions. These materials are permitted to be used if they are

shown to Council to be fit for purpose. Usage of the materials must be in accordance with the approved development consent.

6.1. Standards

Filling of lots for residential development must be performed under specific controlled conditions. Lot-fill on residential land shall be consistent with the requirements of AS 2870, and reported by a geotechnical engineer verifying that compaction of fill-material on the lots is in accordance with AS 3798, providing 95% Minimum Relative Compaction (for cohesive soil) employing a "Level 1" inspection and testing regime adopting Type 1 Density Test frequency.

The geotechnical engineer's report verifying satisfactory results shall be submitted to Council.

Further:

- Where isolated surface disturbance (such as tree removal) is filled, the filling shall be reported in accordance with the Australian Standard.
- Road fill batters that extend onto lots are considered lot-fill under this clause.

Filling of land for purposes other than residential development (such as open space, parks or playing fields) may be at a reduced standard than that for residential, subject to its type of use and the possibility of future building construction, as determined by Council for each specific site.

6.2. Topsoil

The contractor shall reclaim, and stockpile topsoil won from construction works where it is suitable for re-use on site. Where topsoil is imported it shall be in accordance with the resource recovery exemptions under the Protection of the Environment Operations (Waste Regulation) and shall be friable, of porous nature, relatively free of weeds contain no rocks, tree roots, clay lumps, chitter, ash or building waste. Topsoil shall have a maximum thickness of 150mm in road reserves and 300mm maximum in lots.

6.3. Retailing Walls

Retaining wall location and design is addressed in Council's Manual of Engineering Document D: Design. The subsoil shall be connected to either the kerb and gutter, road pits, or interallotment drainage system by gravity and shall not be directly connected to the road subsoil.

The removal of any existing fence adjoining the works for purposes of constructing a retaining wall is the responsibility of the developer/contractor, together with the need for shoring and/or negotiations with adjoining owners regarding any adverse works affecting those properties.

6.4. Dams / Basins

Earth embankments constructed for the purpose of retaining stormwater runoff with or without permanent water storage shall be constructed in accordance with an engineer's design as part of a Subdivision Works Certificate.

6.4.1. Redundant Dams

Where redundant dams are to be removed and filled, the contractor shall attend to the following matters:

- Flocculation of turbid water prior to release.
- Dewatering without causing erosion, such as by pumping.

- The removal of silt and organic matter prior to filling and its disposal in an approved manner.
- Backfilling under geotechnical supervision, and in accordance with this Manual.

7. Road Formation (Subgrade)

Material for road formation shall generally be won as a cut/fill operation within the site. Where material is imported to balance earthworks, it shall comply with Section 6 above.

7.1. Materials & Testing

All materials required for the project, whether won as natural earth or as a processed soil or granular or man-made, shall be in as new/original condition and of an approved standard, free of contamination or defects. If required, the contractor shall provide full testing information with respect to the materials. Test results of particular proposed imported materials shall be submitted to the Certifier and/or Council for approval prior to placement.

Materials (from established suppliers) that are subjected to a regularly testing programme and have been accepted by the Engineer as Quality Assured material, may be used without further testing. The Engineer/Council may instruct the amendment or removal of works or material not in accordance with the approved plan, specification, standards, or best practice.

In the event of dispute of material quality, the subject material will be submitted for testing/examination by an independent certified body or company registered with NATA qualification. The cost of testing shall be met by the developer/contractor.

7.1.1. Compaction Tests

Compaction of the natural or select subgrade to a minimum of '100% standard' shall be confirmed by a geotechnical engineer/NATA laboratory and tested at 50 metres intervals or part thereof for compliance under AS1289. The location of intermediate tests shall be at random locations. Additional test locations may be required if there are changes in the soil profiles.

Where subgrades are modified or stabilised, the application process shall be tested and reported for compliance with an approved geotechnical report.

Moisture content of the fill material shall be specified by the geotechnical engineer and shall be observed and/or tested.

7.1.2. Proof-Roll Test

Monitoring the results of natural or select subgrade compaction by "proof-roll" testing shall be observed by Council, or at Council's discretion, by an appropriate Certifier. The contractor should be confident that the prepared surface is ready for test, prior to the inspection. If re-inspection is required, an additional fee may apply.

Acceptable machinery for testing the subgrade includes a large grader. For proof rolling on gravel layers, the contractor may use a fully laden water cart or a three-point roller, with the preferred option listed first. The proof roll test shall be performed by an experienced road construction testing professional representing Council and/or the geotechnical engineer, as directed by Council. Any works that are considered by that person to be deficient, shall be rectified.

7.2. Fill

Fill material shall be approved by a geotechnical engineer and shall be uniform, sound, and free from deleterious material. Approved fill shall be placed in compacted layer thickness of 200mm (max) and

spread evenly for the width of formation, subject to the discretion of the geotechnical engineer. Placement of loose material over partially compacted filling to achieve road width is unacceptable.

Adequate support benching shall be provided in fill, on side grades in excess of 20%, or where considered necessary by the engineer to improve stability. Fill containing rocks or clay lumps will not be permitted in footways.

Batter faces shall be stabilised in accordance with erosion control procedures, typically, scarified, topsoiled and strip turfed and seeded between strips. The turf strips shall be run either along the contour or at a flat angle to the contour in order to intercept runoff.

7.3. Cut

7.3.1. Catch drains

Are required at the top of cuttings intercepting large catchments or as directed. Catch drains shall be sized for the contributing catchment.

7.3.2. Batter faces

All batters must be cut clean and free of loose or overhanging rocks. If the cut is more than 5.0 meters high, it must be benched with catch drains at the bottom of each step. For cuts higher than 2.0 meters, a geotechnical assessment is needed to determine the appropriate slope or treatments, see the Document D: Design Document - Batters for more details. The cut faces should be stabilised using erosion control methods, such as scarifying, adding topsoil, and planting turf and seeds between strips. The turf strips should run along the contour or at a flat angle to intercept runoff.

7.4. Sub-Grade (Natural)

The road subgrade shall comprise of sound material compacted and trimmed evenly to design levels and cross-fall. The depth of cut/fill to subgrade level shall be governed by the approved pavement depth making allowance for cross-fall at any point of measurement, in particular at the centreline and the gutter lip ensuring a straight profile between each point.

Any unsuitable material shall be removed and replaced with approved material in layers and compacted to the required density.

The Geotech engineer shall undertake all necessary observations, additional testing, and any other matters in accordance with the approved (pre-construction) geotechnical report, MoES, and the Austroads and TfNSW documents as listed in Appendix E.

A (sub)report, including results, observations, and revised CBR, shrink and swell, pavement designs, and any need for select or working layers, shall be presented in writing to Council for approval. The report shall include any other matters such as construction techniques, concerns, and other issues as required or mentioned in the pre-construction (SWC) pavement design. The design shall be in accordance with Document D: Design - Pavement Design requirements.

The Geotechnical consultant will supply a 'component' compliance certificate for the natural subgrade prior to the placement of any layer (i.e., select, working platform, subbase), certifying the revised CBR, pavement design, and that the construction and site conditions, including moisture conditions, fall within the design ranges. The component certificate shall provide the minimum information in accordance with the requirements in Document G: General and list the location specifically with road name, chainages, and offsets where part widths are being certified.

Where subgrade replacement with a granular pavement material (i.e. not using the natural soil or clay) is proposed, the excavation shall extend and grade to a subsoil drainage system, extending at least

500mm minimum behind the back of the kerb. Subgrade replacement shall be inspected and tested as per normal sub-grade inspection requirements.

Rock sub-grade shall be thoroughly ripped up to a depth of 300mm below sub-grade level and shall extend to the edge of the pavement. Ripped material shall be compacted to provide a sub-grade layer of homogenous density.

Construction works shall not proceed until the sub-grade has been certified as complying.

For subgrade bearing capacity under pavements, the use of geotextile materials is permissible, subject to recommendations by the Geotechnical Engineer, the suitability of the materials for the location, and only at the discretion of Council.

7.5. Sub-Grade (Select)

A "select" subgrade where required, shall be of an approved material and be constructed similar to the requirements for natural sub-grade. The geotechnical engineer will confirm in writing to Council that the material specification is consistent with and fit for purpose according to the expected performance requirements of the geotechnical engineer's approved (construction) pavement design. Council's subdivision engineer shall approve the proposed material for use as "select".

8. Stormwater Drainage

8.1. Subsoil Drainage

Subsoil drainage shall be provided on both sides of the road pavements and in all road stormwater pipe trenches in accordance with Council's Standard Drawings SD035 & SD003, and additionally as required by Council, or the geotechnical engineer where for example, drains are considered necessary where sub-soil moisture problems are encountered. The type, location and extent of subsoil drainage may vary depending on pavement materials or in-situ conditions.

A subsoil drain "lead-in", 3.0 metres long, shall be installed in Inter-Allotment Drainage lines where the line connects to the road pit, and at every second pit upstream within the IAD pipeline.

Subsoil drainage shall be installed at new pavement interfaces with existing pavements at Council's discretion or under the direction of a geotechnical engineer, refer to Council's Manual of Engineering Document D: Design and Standard Drawing SD032.

All subsoil pipes shall be, nominally, 100mm diameter, and be "socked".

8.1.1. Trenches

Trench dimensions shall suit the size of the pipe/conduit used but generally trenches shall be a minimum of 200mm wide. The depth of trench shall be 600mm below subgrade level or deeper where it is necessary to drain intersecting service trenches. Depths less than 600mm may be considered by Council where sub-grade warrants exist, such as in rock.

The minimum grade on subsoil drainage shall be 0.5%.

8.1.2. Filter Material

Unless approved otherwise, the filter material shall conform to RMS (3580) or Austroads specification for subsoil drainage, reproduced as follows.

Other materials, not meeting the specifications in this Manual, may be considered subject to confirmation from a geotechnical engineer of compliance as free draining to achieve a sustained flow

rate of 8 metres per day. (See Common Trenching with Subsoil Drainage where stormwater pipe support should be considered)

Where “one-size” aggregate material is proposed as a medium surrounding the subsoil pipe, the material shall be wrapped in a geotextile fabric at its interface with adjoining natural or imported material and the pipe shall be un-socked.

RMS Type A Filter Material

GRADE	AGGREGATE SIZE (mm)
F20	20
F14	14
F10	10
F7	7
F5	5

RMS Type S Filter Material

SIEVE SIZE (mm)	WEIGHT PASSING (%)
4.75	100
2.36	95 - 100
0.425	20 - 80
0.300	0 - 30
0.150	0 - 10
0.075	0 - 1

Austroads Type A (sand) Filter Material

TYPE A	PERCENTAGE PASSING SIEVE (%)					
	A1	A2	A3	A4	A5	A6

Description of Filter	Dune Sand	Course Washed Sand		5mm One Size	6 – 8mm One Size	Sandy Gravel
37.5mm						100
26.5mm						
18.0mm					100	85 - 100
13.2mm					90 - 100	
9.50mm		100	100	100	70 - 100	65 - 100
4.75mm		90 - 100	90 - 100	70 - 100	28 - 100	45 - 82
2.36mm	100	75 - 100	70 - 100	0 - 50	0 - 28	30 - 60
1.18mm	95 - 100	50 - 98	40 - 65	0 - 10	0 - 8	15 - 40
600µm	70 - 98	30 - 80	12 - 40			5 - 25
300µm	30 - 60	10 - 40	0 - 16	0 - 5	0 - 5	0 - 10
150µm	0 - 12	0 - 7	0 - 4			0 - 5
75µm	0	0 - 3	0 - 3	0 - 3	0 - 3	0 - 3

Austroads Type B (Aggregate) Filter Material

TYPE B	PERCENTAGE PASSING SIEVE (%)			
	B1	B2	B3	B4
Description of Filter	5mm One Size	6 – 8mm One Size	10mm One Size	19mm One Size
37.5mm				
26.5mm				100
18.0mm		100	100	70 - 100
13.2mm		90 - 100	90 - 100	0 - 30

9.50mm	100	70 - 100	40 - 70	0 - 10
4.75mm	70 - 100	28 - 100	0 - 15	
2.36mm	0 - 50	0 - 28	0 - 5	0 - 5
1.18mm	0 - 10	0 - 8		
600µm				
300µm	0 - 5	0 - 5		
150µm				
75µm	0 - 3	0 - 3		0 - 3

Glass sand requires pre-approval by Council, with considerations including respiratory and safety concerns.

8.1.3. Common Trench (with water main)

Where it is practical to provide common trenching with a water-main, the location and materials are specified on Council's Standard Drawing SD035.

8.1.4. Flush Points

Flush points shall be provided generally at the crest point of the road and adjacent to drainage pits or at intervals of approximately 60 metres. Flush points shall be plastic screwcaps with concrete surrounds, placed behind the kerb and gutter in urban areas, or in road shoulders in rural areas. Flush points shall not be placed within stormwater pits.

8.2. Pipe Conduits

Unless nominated on the construction plans, all drainage pipes within Council controlled drainage systems shall be of steel reinforced concrete (SRC) or fibre reinforced concrete (FRC), rubber ringed jointed spigot and socket type and installed in accordance with the manufacturer's guidelines. Conduits that will not be under Council ownership/control (such as IAD systems) may be, concrete (as noted above), polyethylene, or UPVC complying with AS 1254 for un-plasticized PVC (UPVC), and PE & PP pipes.

8.3. Pipe Installation (concrete)

Concrete Pipes shall be laid in the location as shown on the engineering plans, or as varied by the superintendent, with Council's approval. In general, the road formation should be completed to at least subgrade level, or top of select, prior to pipe installation. The appropriate excavation, bedding, backfill and cover shall be provided as specified by the manufacturer and/or in accordance with the Concrete Pipe Association of Australia (CPAA) or Australian Standard 3725 "Loads on Buried Pipes".

The minimum pipe support type under roads shall be "HS2".

The minimum pipe support type in other public areas shall be "H2".

For pipes of 900mm diameter and less, the trench excavation shall provide a minimum of 150mm clearance to the pipe. Pipes greater than 900mm diameter, should provide a clearance of 'D/6'.

Thrust blocks/collars shall be provided at every pipe joint, or as directed by Council, being generally where pipe grades exceed 12% and/or in embankments for storing water, to prevent seepage piping.

8.4. Pipe Bed, Haunch & Sides

The "bed zone" shall be a minimum of 100mm thick for pipes up to 1500mm drain. For pipes greater than 1500mm, the bed thickness shall be a minimum of 150mm.

The bed, haunch and side zone material shall be a graded material in accordance with AS3725 or similar.

Bed & Haunch Zone

SIEVE SIZE (mm)	WEIGHT PASSING (%)
19.0	100
2.36	50 - 100
0.600	20 - 90
0.300	10 - 60
0.150	0 - 25
0.075	0 - 10

Side Zone

SIEVE SIZE (mm)	WEIGHT PASSING (%)
75	100
9.5	50 - 100
2.36	30 – 100
0.600	15 - 60
0.075	0 - 25

Compaction of the bedding material shall comply with AS3725 providing 60% Density Index for cohesionless material, and 90% Dry Density Ratio for cohesive materials. Where FRC pipes are

proposed bedding shall be a cohesive material (such as road-base) compacted to 95% Dry Density Ratio.

With all pipes the “haunch and side zones” shall be compacted to a minimum overall depth of 50% of the pipe diameter, with the haunch zone height being 0.3 x Diameter. For practical purposes the side zone material may be substituted with the haunch material.

In wet ground conditions pipes shall be laid on crushed rock and/or low strength concrete to the requirements of the engineer. Unsuitable material such as soft clays, irregular broken rock or saturated soils shall be removed and replaced with an approved support material.

The side zone shall not be considered to be effective in supporting pipes unless the trench walls or surrounding embankment have density and stiffness not less than those of the adjacent compacted fill. (AS3725)

The contractor shall produce, when requested, evidence that the specified or approved material is the material in use.

8.4.1. Common Trench (with subsoil drainage)

It should be noted that where subsoil drainage is installed with the stormwater pipeline the haunch, side and overlay/backfill zone materials must display, when compacted, both the desired characteristics of those zones for pipe support/cover, and the characteristics of a filter medium in terms of “filter material” for subsoil drainage, within the area of the trench effectively acting as “subsoil drainage”.

The material should exhibit zero or low occurrence of fine particles and may be a uniformly graded aggregate either compacted or otherwise to achieve the objectives for a cohesionless material nominated above. A geotechnical engineer’s concurrence, that the proposed material meets these objectives, shall be submitted to Council.

Pipe support material for each side of the pipe, must be the same material.

The contractor shall produce, when requested, evidence that the specified or approved material is the material in use.

8.5. Pipe Overlay

Other than in roadways the “overlay zone”, shall be an approved suitable/workable natural material, (not being large lumps of clay) compacted to a minimum depth of 150mm above the top of the pipe, not containing any stones larger than 150mm, nor more than 20% with a size between 75mm and 150mm.

The “overlay” zone in the roadway shall satisfy the parameters detailed under “pipe backfilling” below.

8.6. Pipe Backfilling

Other than in roadways, backfilling shall comprise of natural available earth material, suitable for adequate compaction to avoid surface slumping.

Where pipes are laid in roadways, backfill to the road sub-grade level shall be with approved crushed rock or sand filter materials. Compaction shall be by mechanical, and/or flooding or other approved means. Mechanical tampers shall be utilised for compaction in layers of not more than 300mm to “95% Modified” (for cohesive materials) and 65% density index (for sand) in accordance with AS 1289.

8.7. Trench Compaction Testing

Compaction of backfill materials in excavations for conduits and pits, usually within road and public reserves (or elsewhere as directed by Council), shall be certified by a geotechnical engineer as compliant with the standards within this Manual. Testing locations shall be chosen by the engineer at random locations that are considered to be representative of the works, generally being one test per 200m of stormwater pipe trenching and at two service crossings per project.

8.8. Precast Box Culverts

Precast concrete box section crown units and slabs shall comply with RMS Specifications for supply and delivery of precast RCBC sections and shall be installed to comply with AS 1597. Only cast in-situ slabs are permitted for box culverts. Refer to Document D: Design, D19.2, for further information.

Where rock is encountered it shall be neatly excavated to the underside of the bedding material. Unsound material shall be removed and replaced with compacted and approved select material.

Bedding shall be either mass concrete or lightly bound approved granular material unless otherwise approved by geotechnical and structural recommendations.

No bedding shall be placed until the foundations have been inspected and approved by the engineer or Council.

Mass concrete bedding shall be not less than 50mm thick. Granular bedding shall be a minimum of 100mm thick, compacted to 95% modified maximum dry density in accordance with AS 1289.

8.9. Base Slabs

In-situ base slabs shall be constructed as shown on the approved engineering plans. Slabs shall not be poured until the reinforcement, and formwork has been inspected and approved by the engineer or Council, and upon completion, the slab shall be cured in adverse weather conditions. Cells shall not be applied to the slab until the concrete has reached at least 70% of the design strength. Cells shall subsequently be placed on a bed of mortar in the recessed edge of the slab. Transverse cell joints shall be covered with a bituminous strip located centrally over the joint and adequately secured. Longitudinal joints in multi-cell components shall be mortar-filled.

8.10. Pits

Pits and associated drainage structures shall be constructed in concrete, in accordance with (firstly) Council's standards or the approved plans, thereafter RMS Standards, and in accordance with the requirements of AS 3600 - Concrete Structures. All drainage structures (pits, wingwalls, slabs etc) shall be constructed on a compacted granular foundation.

Pits shall be benched in the base, and subsoil drainage pipe outlets within pits shall be installed at the same level as the invert of the upstream pipe, regardless of pit-benching.

Grates at road kerb inlets shall be galvanised and of the type that provides an RHS support along both edges of the grate, (see SD039), and shall be hinged within a frame with a lock-down J-bolt.

Where pits are greater than 1.2 metres in depth step-irons shall be installed (see SD039).

8.10.1. Cast In-Situ Pits

All cast-in-situ pits shall be constructed with 25 MPa (minimum) concrete, including soffits and grate support, and shall be constructed using formwork. The base (reinforced concrete floor) shall be poured

first. Standard pits, up to 2.5 metres high, shall be reinforced as noted on the Standard Drawings in this Manual. Reference should be made to an engineer's design for non- standard pits. Minimum floor, wall and soffit thickness for in-situ pits shall be 150mm.

All "cold" joints shall have "starter" reinforcing steel consistent with drawing SD039 or the special pit design. Pit wall-to-base connections shall have "starter" reinforcing of N12 "L" bars (450 legs), at 400mm (max) centres.

8.10.1. Precast Pits

All precast pits require prior approval from Council before any work commences. Their shop drawings must be submitted to PCA and Council for review before installation to demonstrate compliance with requirements in Document D for precast pits, D.18.4.3.

Where precast units are utilised, the units shall be transported, stacked, stored, and installed in accordance with the manufacturer's specifications.

8.10.2. Pit Formwork & Backfill

All external formworks shall be removed (stripped) before backfilling. Reference should be made to the requirements of AS 3610, but also generally, as follows. Formwork shall not be removed from:

- Walls:
  - within an **18**-hour period from the time of the pour (i.e. when air shade temperature is between 5^0C and 12^0C); or
  - within a **12**-hour period from the time of the pour (i.e. when air shade temperature is between 12^0C and 20^0C).
- Soffits:
  - within a **5**-day period from the time of the pour.
  - No backfill shall be placed against a wall, within an **18**-hour period from the time of the pour, and then only loose material for purposes of a working platform.
  - No compaction of backfill by means of "flooding" shall occur within a **24**-hour period from the time of the pour.
  - No compaction of backfill by means of mechanical vibration shall be applied adjacent to a wall until the concrete has reached a compressive strength of at least **15MPa**, (generally achievable after 96 hrs - 4 days with 25MPa design strength) unless effectively supported by horizontal struts, and then not before a **48**-hour period has expired.
  - No backfill shall be placed on a soffit for a period of **5** days from the time of the pour unless effectively supported by propping and then not within a **3**-day period, preferably with internal formwork in place.
  - No construction loads or compaction of backfill by means of mechanical vibration shall be applied over a soffit for a period of **7** days from the time of the pour, and then not without effective propping supports, preferably with internal formwork in place.
  - Whilst under construction loads, propping shall remain in place until full design strength is reached (nominally 28 days).

The above criteria may be *extended or shortened* by the engineer subject to air shade temperature falls or rises beyond that specified. Backfill material shall be placed, and be of a type, similar to that required for pipes. All strutting and propping shall be to the satisfaction of the engineer.

8.11. Gross Pollutant Traps

Gross pollutant traps shall be constructed as shown on the approved plans, with all steel items being hot-dipped galvanised or stainless steel. Large top grates shall be lockable and removable, with lifting hooks, and shall include a hinged access grate component.

8.12. Scour Protection

Scour protection at headwall outlets, shall be caged rock or plain concrete, or large rocks that will remain stable under full flow conditions, to a distance of generally 4 times the pipe diameter (see Standard Drawing SD045), and be returned up the bank adjacent to the end of the wing-wall approximately 300mm. Rock mattresses shall have a geo-textile fabric underlay. Rocks within a wire cage shall be a size sufficient (100mm to 150mm) to be contained by the cage. Gabions should be avoided due to high velocity.

8.13. Open Drains

Temporary catch drains shall be constructed in accordance with the plan or where considered necessary by the Engineer. Drains shall be sized to suit the catchment area. Drains may require erosion prevention measures. Temporary drains shall be backfilled and restored to the natural surface upon completion of works.

Permanent catch drains and batter drains shall be lined for protection against erosion, to the shape and location as shown on the approved plans. Prior to the placing of the lining material the foundation shall be shaped and compacted to form a firm base. Concrete lined inverts shall be a minimum of 600mm wide.

Concrete wing drains shall be constructed as cast-in-place or sprayed concrete. Weepholes shall be provided at regular intervals.

Stone pitching of open drains shall be of sound durable rock not less than 100mm thick and laid on approved geotextile fabric.

8.14. Inter-Allotment Drainage

Inter-allotment drainage details are also referenced in the above sections of this Document.

Pipes shall be constructed as shown on the approved plans, and laid centrally within easements, subject to sewer pipe location.

The following installation criteria shall be employed:

- Pipe “cover” shall be a minimum of 300mm (where vehicle loads are not expected).
- Trench “side” clearance to the pipe shall be a minimum of 100mm.
- The “bed” shall be a free-draining sand (or crushed rock aggregate – 14mm max.) and shall have a minimum compacted thickness of 75mm.
- The “side” support shall be a compacted, free-draining sand (or crushed rock aggregate) and shall extend to the top of the pipe.
- The “overlay” shall be an approved suitable/workable natural material, (not being large lumps of clay) compacted to a depth of 150mm above the top of the pipe, not containing any stones larger than 150mm, nor more than 20% with a size between 75mm and 150mm.
- The installed pipe shall be inspected prior to placement of the overlay zone.

- The “backfilling” shall comprise of natural available earth material, suitable for adequate compaction to avoid surface slumping.
- A 3 metres length of socked subsoil pipe shall be installed upstream at every second pit within IAD pipe system.
- All disturbed surfaces shall be fully restored.

Each IAD pit shall have a capped stub for the dwelling connection, and all pit/pipe joints shall be mortared flush with the pit. (see SD043).

8.15. Culverts

Culvert type road crossings shall be constructed such that granular bedding or subsoil drainage is well confined by a cut-off wall, wingwall and compacted clay embankment backfill. Where subsoil pipes are approved the inlet end shall be raised to the surface and capped.

8.16. Pipe Tolerances

Allowable construction tolerances for pipelines shall be as follows:

Pipe Construction Tolerances

ALLOWABLE CONSTRUCTION TOLERANCES FOR PERMANENT PIPES, CULVERTS AND DRAINS	
Grade Line (Vertical Alignment)	Tolerance per 2.4 metres Length or part thereof deviation from the design grade line level
Less than 1%	10mm
1% to 4%	15mm
4% to 7%	20mm
>7%	25mm
Horizontal Alignment	50mm

Notwithstanding the above each 2.4 metres length of pipe shall have fall in the direction of the design grade line.

8.17. CCTV Requirements

Requirements for CCTV are provided in Document G: General Requirements

9. Pavement Construction

Subgrade preparation shall be carried out in accordance with Section 7: Road Formation of this Document.

9.1. Flexible Pavement

A flexible granular pavement, whether of modified material or otherwise, shall be constructed in accordance with the approved construction plans or as amended through geotechnical advice, with Council approval.

Nominated pavement depths refer to the compacted material depths of each layer.

9.1.1. Tolerances

The following table of construction tolerances, relative to the approved design for flexible unbound pavements, shall apply to subgrade, sub-base and base courses, and asphaltic concrete (AC10) wearing surface.

The approved design thicknesses/levels are to be achieved generally throughout the work. Variations of "Construction Tolerance" should not be assumed as a general variation and will only be accepted as an exception for minor areas.

Pavement Construction Tolerances

TOP OF LAYER	CONSTRUCTION TOLERANCE (FROM DESIGN LEVEL)	SHAPE (DEVIATION FROM 3 METRES STRAIGHT EDGE)
Sub-Grade	+ 0 to – 50mm	
Sub-Base	+ 10mm to – 20mm	Not greater than 20mm
Base	+ 15mm to – 0mm	Not greater than 10mm
Wearing Surface, AC Thickness (1)	-5mm to + 20mm	Not greater than 7mm

Notes:

- The minimum AC Thickness is 40~~30~~mm.

Sub-grade, sub-base and base course finished surface levels, at the gutter lip-line and the "crown", shall be verified by Council. Where requested by Council such measurements may be subject to verification by survey prior to adding of any subsequent layers.

The finished wearing surface shall not be lower than the lip of the gutter or edge constraint.

9.1.2. Pavement Materials

All pavement materials shall comply with the requirements of:

- RMS Specification QA 3051 for unbound base and unbound sub-base or,
- ARRB Special Report No 41 and APRG Report No 21 for granular materials; or
- The material properties detailed at Appendix D.

The use of materials not meeting these specifications may be considered for Council's approval, subject to an evaluation by a geotechnical engineer. Materials subjected to treatment by a suitable modifying/stabilising agent must be through a mechanical mill and must meet the relevant specification for modified material. Each pavement layer at compaction shall have moisture content between 60% and 90% of Optimum Moisture Content (OMC).

For subgrade bearing capacity under pavements, the use of geotextile materials is permissible subject to recommendations by the Geotechnical Engineer and suitability of use with location.

Where a combined sub-base/base single-layer constructed pavement is proposed, such a layer shall consist of base course material only. (See 'testing" below).

The following table provides details of acceptable material types:

Acceptable Material Types

DESIGN TRAFFIC	BASE	SUB-BASE
= > $1x10^7$	DGB20, GMB20	DGS20, DGS40, GMS40
=> $4x10^6$ & < $1x10^7$	DGB20, GMB20	DGS20, DGS40, GMS40
=> $1x10^6$ & <$4x10^6$	DGB20, GMB20	DGS20, DGS40, GMS40
=> $1x10^5$ & < $1x10^6$	DGB20, GMB20, NGB20-2c	DGS20, DGS40, GMS40, NGS20, NGS40
< $1x10^5$	DGB20, GMB20, NGB20-2c, NGB20-2d	DGS20, DGS40, GMS40, NGS20, NGS40

Generally, plasticity indices shall be restricted to 6 (max) for base material and 12(max) for sub-base material.

The pavement designer should be satisfied that the pavement material type and quality will, with suitable construction methods, meet the requirements of this Manual in respect to compaction and deflection standards for the nominated CBR & ESA requirements.

For select materials, the plasticity index must be limited to a maximum of 15. The material shall be well-graded, homogeneous, and generally meet subbase quality grading standards. It must have a ~~swell of 2.5% or less and a minimum CBR of 15~~ swell of 1% or less and a minimum CBR of 8%.

9.1.3. Pavement Compaction

Unless the subject of special design, pavement layers (including "select material") shall be placed in compacted layers not exceeding 200mm and not less than 100mm thick.

Minimum dry density compaction requirements are as follows:

Pavement Compaction Requirements

LAYER	COMPACTION REQUIREMENT (MIN)	STANDARD
Sub-Base	95% Modified	AS1289
Base	98% Modified	AS1289

Where a combined sub-base/base single-layer constructed pavement is proposed, testing shall be undertaken in accordance with RMS RN73 Clause 9. Such a layer shall be base course material only.

9.1.4. Pavement Testing

Pavement testing for compaction density and deflection shall be undertaken by a NATA registered laboratory and a certificate of compliance shall be issued together with test results. All layers shall be tested.

Density testing by sand replacement, nuclear densometer or other NATA approved means is required at the start and finish limits of the work (within the first and last 5.0 metres) and thereafter as "Random Testing" in accordance with RMS or Australian Standards. A minimum of two tests shall be carried out for any road less than 50 metres in length.

Testing within cul-de-sac turning heads is also required..

The location of tests within the road cross section shall be randomly selected to ensure that the full width of the road pavement undergoes representative testing.

Proof-roll testing shall be observed at each layer using acceptable machinery to perform the test, such as a three-point roller, a fully laden watercart or a large grader, with preference in that order. The test shall be performed by a person experienced in road construction testing representing Council or geotechnical engineer.

Individual pavement layers shall not be covered by succeeding layers until test results have demonstrated that the layer has passed the nominated standard. Where a combined sub-base/base single-layer constructed pavement is proposed, testing shall be undertaken in accordance with RMS RN73 Clause 9.

All test results shall be submitted to Council and accepted as compliant, prior to granting of "practical completion".

Where test results fail to meet nominated standards, additional testing shall be carried out to isolate the failed area prior to reworking and retesting showing that nominated standards have been achieved.

Prior to application of the wearing surface, an assessment of the pavement shall be undertaken according to the elastic rebound deflection test, in accordance with Test Method T160, utilising the Benkelman Beam or an equivalent method. The resultant Characteristic Deflection for a section of pavement, calculated as the "mean" plus "standard deviation", should not generally exceed the values (for unbound pavements) in the table below.

As part of the assessment, for roads greater than Distributor (secondary) status, a "reliability" product factor (f=1.65) should be applied to standard deviation. The coefficient of variation ("standard deviation" divided by "mean") should not exceed 0.3. Subject to assessment, upon failure of a test,

further testing may be employed to “track” possible improvement and ultimate compliance of test results.

The frequency of testing shall be conducted on alternate wheel paths at intervals of up to 15 meters. For short road constructions, the testing frequency shall be reduced accordingly to ensure an accurate analysis on characteristic deflection.

Benkelman Beam Deflection Requirements Update Road Type & ESA to Doc D (check Lake Mac and Auspec)

ROAD TYPE	ESA’S	CHARACTERISTIC DEFLECTION	MAXIMUM DEFLECTION
Local - Place	1 x10 ^{5}	1.20	1.80
Local - Access	1 x10 ^{5}	1.20	1.80
Local - Secondary	2 x10 ^{5}	1.15	1.60
Local - Primary	5 x10 ^{5}	1.10	1.40
Collector - Secondary	1 x10 ^{6}	1.10	1.40
Collector - Primary	1.5 x10 ^{6}	1.00	1.30
Distributor - Secondary	2 x10 ^{6}	0.90	1.10
Distributor - Primary	5 x10 ^{6}	0.77	1.00
Sub-Arterial	1 x10 ^{7} min	0.70	1.00
Industrial - Secondary	5 x10 ^{6}	0.77	1.00
Industrial - Primary	1 x10 ^{7}	0.70	1.00
School Bus / Public Route	2/5 x10 ^{6} min	1.00 min	1.30 min
Business / School Precinct	1 x10 ^{7}	0.70	1.00
Residential (R5-V)	Apply deflections as per lot catchment and ESAs defined under road type and dimensions table		

Residential (R5-X)	Apply deflections as per lot catchment and ESAs defined under road type and dimensions table		
Residential (R5-Y)	Apply deflections as per lot catchment and ESAs defined under road type and dimensions table		
Residential (R5-Z)	Apply deflections as per lot catchment and ESAs defined under road type and dimensions table		
Rural	1 x10 ^{5} min	1.10	1.60

9.1.5. Pavement Joints

Where new pavements abut existing pavements (whether longitudinal or transverse pavement joints), benching of the base course to a minimum width of 300mm shall be provided to achieve an effective key-in. Longitudinal joints located along wheel paths should be avoided. (See SD032)

Pavement joints and the wearing course shall be positioned away from lane edge lines and under wheel paths to avoid accelerated wear and cracking. This approach enhances the pavement's durability, minimises maintenance requirements, and ensures a smoother and more aesthetically pleasing surface.

9.2. Rigid Pavement (Roads)

Rigid concrete pavements shall be constructed in accordance with RMS R82 "Lean-Mix Concrete Sub-Base & R83 "Plain Concrete Base" guidelines. Australian Standards shall apply with respect to concrete:

- supply - materials
- delivery - mixing, transport, time, consistency
- placement - compaction, evaporation rates, texture
- curing - method/product, protection
- texture – cove, broom, rake etc.
- jointing - cutting, filling

9.2.1. Materials

Material quality requirements for base and sub-base concrete, shall be as specified in the RMS Concrete Pavement Guidelines.

9.2.2. Components

The following limited details are summary guidelines for good-practise concrete road construction.

9.2.3. Subbase

Concrete shall be compacted by means of "needle" immersion vibrators. Screeding may be by hand or vibrating screed. The surface shall be finished with a steel float and shall be covered with an approved curing agent. A bond-breaker shall be applied to the surface of the sub-base.

The sub-base shall not be subjected to traffic until the concrete has attained a compressive strength of 4MPa.

9.2.4. Base

Concrete shall be compacted by means of “needle” immersion vibrators and two passes of a vibrating screed. If required, the surface shall be finished with a steel float.

The surface shall be covered with an approved curing agent.

The base shall not be subjected to traffic until joints are sealed and the concrete has attained a compressive strength of 20MPa (generally at 7 days for specified 32MPa). High early strength concrete may be used if earlier traffic use is necessary, where approved by the engineer.

9.2.5. Anchors & Terminal Slabs

Anchors shall extend over the full width of the base (not under the kerb and gutter) and the associated joints shall be no closer than 2 metres from other pavement joints. Terminal slabs shall be constructed adjoining bridges and at junctions with flexible pavements.

Characteristic concrete strength shall be a minimum of 32MPa.

9.2.6. Sub-grade Beams

Sub-grade beams shall be constructed flush with the sub-grade level. The beams shall be compacted by mechanical vibrator equipment, finished with a steel float, and cured and de-bonded as per the sub-base specification.

Characteristic concrete strength shall be a minimum of 25MPa.

9.2.7. Tie Bars

Tie bars shall be N12(min) galvanised bar of a minimum length of 25 times bar diameter and spaced at 900mm (in a 200mm thick slab).

9.2.8. Curing & Texture

Control of moisture for evaporation and curing shall comply with the requirements of RMS R83. Methods for moisture-loss control shall be by the application of an evaporation retardant (such as an aliphatic alcohol) followed by curing with a water-based hydrocarbon resin or similar. Unless approved otherwise, road pavements shall be texture with an RMS type “rake” finish.

9.2.9. Concrete Testing

Concrete testing for hand-paved placement shall be sampled in accordance with AS1012 and AS1379, and tested at a minimum for each continuous pour, as follows:

9.2.10. Base & Sub-Base

a. Slump

- The first three truckloads of the project first day pour and,
- Each truck load during continuous pour-days at compression testing site visits.

b. Compression - one test being, 1 pair at 7day & 1 pair at 28 days.

- One test from the first load,
- Thereafter one test per 50m^3 or part thereof.
- For small quantity "infill" pours, compression testing may be waived at Council’s discretion (with 24 hrs notice to batching plant)

9.2.11. Base

a. Flexural (Steel Fibre Reinforced Concrete SFRC only)

- One test per 50m^3 or part thereof.

10. Kerb & Gutter

Kerb and gutter and other concrete edged construction shall be graded and aligned in accordance with the approved engineering plans. Kerb, gutter and edge restraint profiles shall be provided as shown on Standard Drawing SD004.

Kerb and gutter shall be laid on an approved sub-base material of a minimum 150mm compacted thickness in accordance with the requirements for sub-base within this Document, with no loose material beneath the concrete, and may be placed on an approved and tested “kerb-run” of sub-base material of an adequate width or be the prepared road sub-base.

Minor construction variations of up to 20mm in line and 10mm in level over a distance of 5 metres may be accepted, providing the design layout (particularly for traffic control devices), appearance and drainage are not compromised. Construction works that exhibit ponding will not be accepted.

Kerb Outlets for roof stormwater discharge to the street for allotments shall be provided in the kerb usually on each side of each lot (or as directed by Council for unusual lot layouts or as appropriate for corner-lots), within 1.0 metre from the side boundary alignment, in accordance with Council’s Standard Drawing SD036.

Pipe crossings (x2) to each lot within a subdivision that drains to the road shall be provided across the footway generally adjacent to each side boundaries of each allotment, connected to kerb outlet inserts and extended into the lot being serviced. The pipe shall be 100mm sewer grade PVC.

10.1. Concrete Supply & Placement

All concrete for kerb and gutter shall have a minimum compressive strength of 32 MPa at 28 days. Documentary evidence of concrete testing for compliance shall be submitted to Council as part of the final report. Concrete Slump shall be as follows:

- Machine extruded: 10-20mm.
- Manually formed and poured: 70-80mm.

Contraction joints shall be cut to within 50mm of the base of the kerb front and rear at 3 metres intervals. Gutter crossing laybacks, where required, shall be poured integral with the gutter. Kerb transitions are to be shaped into a lipless flattened section for a future (dowelled) pram ramp connection.

Concrete in kerb and guttering shall be placed in accordance with the general requirements for concrete within this Manual and Australian Standards. The surface shall have a smooth steel-trowel finish.

Excessive amounts of concrete expelled from the extruder onto the sub-base material shall be removed to leave a near vertical face.

11. Wearing Surface

The wearing surfaces shall generally be as follows: -

Acceptable Wearing Surfaces

ROAD TYPE	ACCEPTABLE STANDARD
Residential	Asphalt (AC10 “residential mix”) 40mm (min) depth
Business and Industrial	Asphalt (AC14) “Heavy Duty” 50mm depth.
Rural	Bitumen flush seal 1st coat 14mm, 2nd coat 10 or 7mm.
Classified Roads	Bitumen flush seal 1st coat 14mm, 2nd coat 10mm, OR Asphalt (AC14) “Heavy Duty” - 50mm depth.

Variations to the above table may be required where an existing road surface type may dictate the specification for any abutting works.

The application of a single coat reseal shall be nominally, a 10 or 7mm seal. Documentary evidence of wearing surface testing and/or application shall be submitted to Council as part of the final report.

11.1. Bitumen Flush Seal

All design material, quality and field procedures for sprayed sealing shall be in accordance with the Roads & Maritime Services Sprayed Sealing Guide and Australian Road Research Board Sealed Local Roads Manual.

Works shall be carried out by contractors with established competence in hot bitumen sealing.

All new roads shall be surfaced for the full extent as shown on approved plans and shall merge with the existing to neatly match levels. Minimum overlap for top-coat spray seals onto existing bitumen surfaces shall be 300mm.

All flush seals shall comprise of two coats of bitumen and two coats of aggregate.

All aggregates shall be “pre-coated”.

Areas of high torsional loads may require polymer modified asphalt.

All binders for sprayed sealing shall have added an approved adhesion agent in accordance with manufacturer’s recommendations.

11.2. Primer Seal

A 7 or 10mm primer seal with C320 binder??? shall be placed under all asphaltic concrete wearing surfaces.

A minimum of fourteen days duration shall apply prior to application of subsequent asphalt layer(s). That period may be extended or shortened by Council subject to justifiable reason such as:

- providing an extended “test” period to monitor performance.
- reduction (minor) due to weather or contractual influences.

Primed areas subjected to damage shall be re-primed prior to placement of asphalt to the satisfaction of Council.

11.3. Asphalt

Asphalt wearing surfaces shall be provided in all new residential, commercial, and industrial roads, other than where concrete or segmented block paving is proposed. No asphalt shall be placed until the base course construction has been approved by Council.

The asphalt mix shall be designed in accordance with Roads & Maritime Services Specification R116 or similar for dense graded asphalt.

Works shall be carried out by contractors with established competence in asphalt application.

Construction practice for asphalt works shall be in accordance with Roads & Maritime Services Specification R106 and R116 and Australian Road Research Board Sealed Local Roads Manual.

Hand placement of asphalt shall be kept to a minimum and only permitted for minor correction works or in areas where placement by paver is impracticable.

The contractor shall rectify any damage to the pavement surface adjoining the area of works. Minor depressions may be filled with asphalt and compacted as directed prior to placement of the final pavement wearing surface.

The finished asphalt surface adjacent to the concrete gutter lip or edge restraint shall not be lower than the concrete surface.

12. Concrete Items

Premixed concrete shall be from an approved supplier and must conform to Australian Standard 1379. Formwork shall conform to Australian Standard 3610 – Formwork for Concrete. All concrete components shall be designed in accordance with Australian Standard 3600 – Concrete Structures.

12.1. Driveway Access Handles

Construction shall be in accordance with the approved plans, or where additional detail is required, Council’s Standard Drawing SD012. Inspection is required of formwork and reinforcement prior to concrete placement.

12.2. Paths

Concrete footpaths shall be constructed and provided where detailed on the engineering plans, and in accordance with Council’s Standard Drawings SD002, SD007, SD012 & SD019. Variations on the location of the footpath may be required depending upon special site circumstances.

Joint layouts shall ensure that acute angles forming narrow triangular shapes are avoided.

Protrusions into paving such as service authority pits should be avoided, but where necessary shall have full depth compression joint fillers on all sides and at least two joints projecting from opposite corners of the pit to the edge of the paving.

Unplanned cracks in paving slabs may render such slabs unacceptable, resulting in their removal and replacement.

Adjacent surface levels shall be such that they do not intercept, pond, or concentrate stormwater flows onto footpaths.

12.3. Concrete Linings

Where concrete lining of small open drains inverts is required, the minimum thickness of concrete shall be 100mm. Sprayed concrete less than 1.0 metre wide, will not be permitted in drains, and the final surface being uniform and free of depressions.

Sprayed concrete shall conform to Australian Standard 3600 and all contractors shall be skilled and experienced in its application. Mix proportions, procedures etc. shall be submitted to Council or the Engineer for approval prior to placement.

Earth subgrade surfaces shall be graded, compacted, shaped, and dampened prior to applying concrete. Concrete can either be coloured to match surrounding conditions or natural (plain).

12.4. Concreting Placement & Practise

12.4.1. Sub-Base

Concrete shall be placed on an approved base material comprising either 50mm of sand, or 100mm compacted approved granular material or minimum 50mm thickness mass concrete, with this being placed on a firm subgrade. An approved plastic sheet underlay or sufficient wetting of the subgrade surface shall be provided.

12.4.2. Reinforcement

All reinforcement shall conform to Australian Standard 1302 – Steel Reinforcing Bars for Concrete, Australian Standard 1303 – Steel Reinforcing Wire for Concrete and Australian Standard 1304 – Welded Wire Reinforcing Fabric for Concrete and be free of excessive rust, oil, grease, or other deleterious matter.

All steel shall be overlapped as specified on the approved drawings (or if not stated, generally 30 x diameter) and securely tied at joints to provide a rigid matrix and correct load transfer.

Steel shall be supported by “bar chairs” or metal hangers of the necessary dimensions to provide the specified cover and adequate support at maximum 1.0 metre spacings ensuring that the steel is not dislodged during the concrete pour and compaction.

12.4.3. Placement

Concrete shall be compacted to expel air voids and where specified or directed, vibration by mechanical means. “Vibrators” shall not be left in one position for greater than 30 seconds and shall not vibrate reinforcement or formwork.

12.4.4. Joints

Joining of works shall provide the completed section with a clean cut off with residue concrete removed and an approved joint placed before recommencement of works. Expansion, contraction, tied, dowelled, longitudinal and construction joints, including joints between precast units, shall be provided where shown on the approved plans or where is has been nominated by the Engineer.

Generally, contraction joints, consisting of narrow transverse vertical grooves 30mm deep shall be formed or cut at intervals that provide individual slab side/length ratios of approximately 1:1.5. Expansion/construction joints with a filler material shall be full depth (see Standard Drawings). Joint filler material shall extend the full depth of the joint.

12.4.5. Surface

Pedestrian trafficked areas shall have an approved non-slip finish as a light broom finish. Trimming with steel edging tools shall be overworked with a textured finish (broom). Minor imperfections in stripped concrete shall be repaired.

12.4.6. Curing

Newly placed concrete shall be protected from rain by PVC sheeting. Curing of concrete shall be obtained with an approved curing compound or covering.

12.4.7. Damage

Concrete that is damaged or vandalised shall be repaired or replaced at the discretion of Council.

12.4.8. Testing

Council may require testing of concrete by slump or core samples (post-construction), if it is considered that the concrete mix may be sub-standard.

12.4.9. Weather

Concrete works shall not be carried out during adverse weather conditions such as when ambient temperatures are higher than 30^0C or lower than 10^0C without taking appropriate precautions. If temperatures exceed 35^0C or fall below 5^0C, placement should not take place. Council may direct that concrete placement be postponed. The following graph may be used as a guide to determine acceptable whether conditions to allow unprotected placement in order to achieve a rate of evaporation of 1.0 or less.

Precautions shall be taken to ensure that moisture content in the concrete is not reduced due to dry foundations.

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A4.3.5 Prevention of Moisture Loss

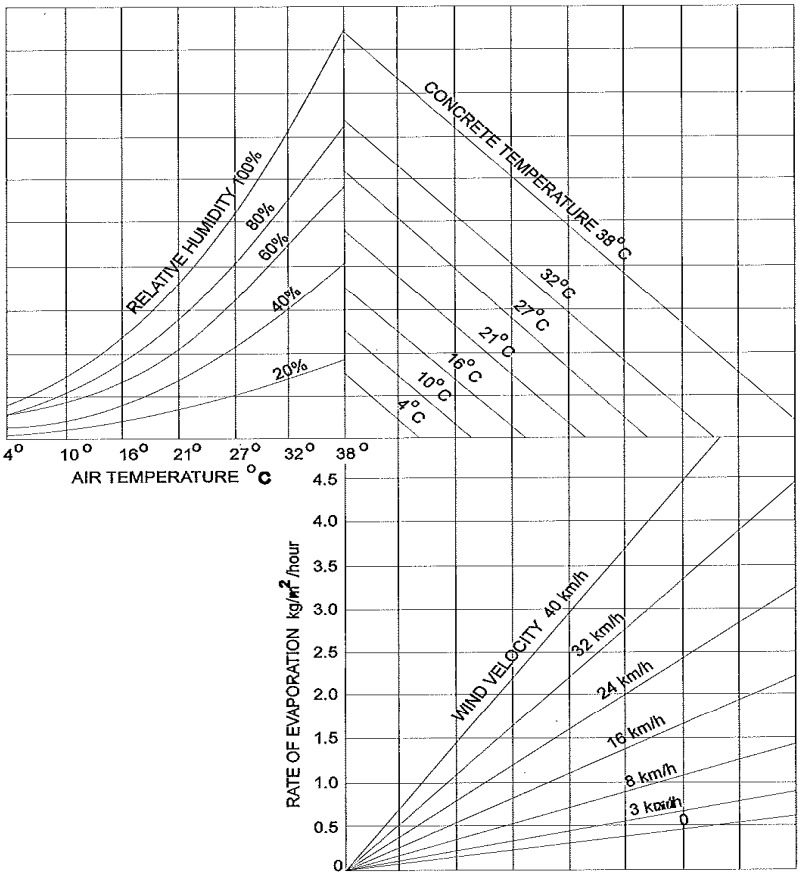


Figure A3.2 - Evaporation from Concrete Freshly Placed on Site

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. An example follows:

With air temperature at 27°C, relative humidity at 40%, concrete temperature at 27°C, and a wind velocity of 26 km/h, the rate of evaporation would be 1.6 kg/m²/hour. To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27°C), 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 27°C). 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.

Source: Gelber, S, 1984, "Predict evaporation rate and reduce plastic shrinkage crack", Concrete International (ACI) v5 n4, 19-22

13. Conduit & Road Crossings

All “Road Crossings” for primary services shall be laid in conduits and backfilled and thoroughly compacted no later than subgrade stage and shall be at a depth to ensure they are not damaged during the pavement construction process.

In urban areas the location of all crossings shall be marked (but not painted) on the top of the kerb as follows:

- Flushing points - “FP”
- Water - “W”
- Power - “E”

- Communications - “T”
- Gas - “G”

Water supply shall be provided to a point within each lot.

14. Surface Restoration

14.1. General

Any existing pavements, lawns etc, adjoining the works shall be protected from damage. If damage does occur, all remedial works shall be performed to restore the original item or surface, to the satisfaction of Council.

Restorations within Maitland CBD (the Levee and Mall restorations) are to be completed by Council in accordance with Council’s fees and charges, which must be paid by the applicant prior to the commencement of works.

14.2. Footways

Footway verges shall be constructed as shown on the plans and shall be fully topsoiled 150mm thick and stabilised with grass seed or be fully turfed. Where concrete paths are provided, the area between the kerb and the path shall be fully turfed.

A turf strip shall be placed along the edge of all concrete slabs. Additional turf strips may be required across the footpath on steeper longitudinal grades to prevent erosion.

Turf type is optional and may be Couch, Buffalo, or Kikuyu.

14.3. Trenches

Backfill of trenches shall be placed sufficiently high to allow for settlement. Further backfilling shall be carried out to restore ground conditions over trenches to match adjacent surface levels.

Backfilling of trenches through existing road pavements must be immediately restored to the existing surface. Where the trench crosses a bitumen or asphalt surface, pre-mixed asphalt shall be used for restoration. Any subsequent settlement of trenches not adequately filled or compacted shall be made good by the contractor.

14.4. All- Weather Surfaces

An all-weather surface is defined as a surface capable of being trafficable in all-weather condition and will generally consist of an approved gravel material. For minor access treatments, a pavement 4 metres wide and with 150mm compacted pavement thickness should be the minimum treatment. Cement modifying material may be utilised to bind the surface if bitumen seal is not proposed.

Where bitumen seal is proposed, the pavement thickness shall be increased to 200mm. Pavement crossfall, of 4% minimum shall be applied, and adequate longitudinal and transverse drainage installed. The engineer may consider the use and treatment of alternate materials where proposed.

14.5. Mulch and Turf

All disturbed earth areas shall be topsoiled (150mm maximum thickness in road reserves and 300mm maximum in lots) and seeded, together with turf strips on slopes likely to scour. Distinct flow-paths shall not be protected with mulch/woodchip. Holding-berms shall be installed as directed. All batters shall be similarly treated and must include turf strips. For areas that will be maintained by Council, turf

and grass shall be “couch”. Other areas may employ species other than couch grass, such as Buffalo or Kikuyu.

All constructed earth drainage structures, such as basins, channels, overland flow-paths etc, shall be topsoiled (150mm maximum thickness) and fully turfed with couch grass to a point where scour is unlikely. Grassing of footways adjacent to lots may be Couch, Buffalo, or Kikuyu types.

14.6. Street Trees

Street trees in the footway shall be planted and located in accordance with Standard Drawings SD001, SD002 & SD049.

15. Locks & Keys

Where requested by Council, items such as gates, nominated grates, bollards etc, shall be locked with a padlock (and chain where necessary). The keys shall be delivered to Council.

16. Site Preservation

Upon completion of works, all buildings, construction plant, spoil, debris, and excess material used for the development shall be removed and the site left in a safe, clean, and restored condition. Where a significant time delay between “practical completion” and issue (or registration) of the Subdivision Certificate has occurred, Council will reinspect the works for any possible defects that may have arisen. Inspection fees may apply. The developer is responsible for the continued maintenance of all roads/drainage systems and reserves during the period, prior to “dedication”.