Construction Specification for Civil Works

C224 – Open Drains

(including Kerb and Gutter)

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This document was originally based on AUS-SPEC - Development Construction Specification C224 - Open Drains, Including Kerb & Gutter. Substantial parts of the original AUS-SPEC document have been deleted and replaced in the production of this Tamworth Regional Council Specification for Civil Works. The parts of the AUS-SPEC document that remain are still subject to the original copyright.

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REVISIONS: C224 - OPEN DRAINS, INCLUDING KERB & GUTTER

REVISIONS	CLAUSES AMENDED	AMENDMENT DETAILS	DATE
1		Original Issue	20/05/2019
2		Formatting and standard drawing reference updated	01/05/2023

GENERAL

C224.01 SCOPE

This Specification is for the construction, lining and protection of all types of open drains including the construction of rock filled wire mattresses and gabions.

Associated Specifications

This Specification should be read in conjunction with C220 - Stormwater Drainage and other drainage Specifications as applicable:

C221- Pipe Drainage.

C222 - Precast Box Culverts.

C223 - Drainage Structures.

Quality

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in *CQC-Quality Control Requirements – Sub-Annexure B2.*

C224.02 DEFINITION

Open Drains

Open drains are all drains other than pipe and box culverts and sub soil and include catch drains, contour drains, diversion drains, table drains, batter drains, swales, channels, gutters and kerbs and gutters.

The Works

The Works – Defined as follows:

- **Developer Infrastructure Works** - work includes subdivisions and any public infrastructure work associated with an approved Development in the TRC local government area requiring a construction certificate.
- **Contracted Works –** infrastructure work undertaken by a Principal Contractor or subcontractor formally appointed by TRC and supervised by TRC.
- **Internal Works** - infrastructure work undertaken by TRC's day labour workforce.

Constructor

Constructor – Defined as the organisation responsible for construction of the Works and the Principal Contractor as defined in the *Work Health and Safety Act 2011*.

TRC Representative

TRC Representative – Defined as follows:

- **Developer Infrastructure Works** – Nominated TRC officer(s) for the approved Development.
- **For Contracted Works –** the Superintendent.
- **For Internal Works –** TRC Asset Owner

Constructor's Representative

Constructor's Representative – Defined as follows:

- **Contracted Works** – the Principal Contractor's nominated representative as per the relevant contract.
- **Internal Works** – TRC officer responsible for delivery.

Developer's Representative

Developer's Representative– Defined as the person or organisation appointed by the Developer to administer the Constructor responsible for the delivery of **Developer Infrastructure Works**.

C224.03 REFERENCE DOCUMENTS

Documents Standards Test Methods

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

Currency

Where not otherwise specified in the relevant Tamworth Regional Council (TRC) Construction Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the TRC Construction Specifications at the time of the Works approval.

(a) Tamworth Regional Council (TRC) Specifications

C211- Control of Erosion and Sedimentation.

C220 - Stormwater Drainage.

C221 - Pipe Drainage.

C222 - Precast Box Culverts.

C271 - Concrete Works.

C273 – Landscaping.

CQC - Quality Control Requirements

(b) Australian Standards

References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS.

AS 1141.22	-	Wet/dry strength variation.
AS 1289.5.4.1	-	Compaction control test - Dry density ratio, moisture variation and moisture ratio.
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.

(c) Austroads Publications

AUSTROADS	-	Guide to Pavement Technology Part 4G: Geotextiles and Geogrids.
AUSTROADS	-	Guide to Road Design Part 5: Drainage – General and Hydrology Conssiderations.

(d) TRC Standard Drawings Applicable to this Section

RD003 - Kerb Profiles

RD005 - Kerb Ramps

RD010 - Driveways – Urban Residential

RD011 - Driveways – Industrial

RD012 - Driveways – Rural Access Across Table Drain

TRC Standard Drawings shall take precedence over ALL other drawings related to the Works.

Where any TRC Standard Drawings conflicts with this Specification, the requirements of this Specification shall take precedence. Proposals to deviate from this Specification shall constitute a **HOLD POINT**.

HOLD POINT

All proposed deviations from the approved design drawings, TRC Standard Drawings, this Specification or the documents referenced within it, shall be submitted for approval to the TRC Representative with supporting evidence at least five (5) working days prior to the work being undertaken.

Hold Point

PROCESS HELD: The lot or element affected by the proposed deviation.

UNLINED OPEN DRAINS

C224.04 GENERAL

Shape

Unless shown otherwise on the approved design drawings, drains shall be of trapezoidal cross section and shall not be less than 300mm deep.

Grade

Open drains shall be graded to ensure free flow of water and, shall not have a grade of less than 1%.

Trees and Rock Outcrops

Where trees marked for preservation or rock outcrops occur in the line of a drain, the drain may be diverted subject to approval by the TRC Representative.

Open Drains

Open drains shall be extended as necessary to lead the water clear of the work to natural drainage depressions, culverts, or pits connected to underground drainage systems. The drains shall follow existing watercourses and depressions in the natural surface, unless other locations are shown on the approved design drawings.

Control of Erosion

All work shall be undertaken in accordance with the requirements of *C211 - Control of Erosion and Sedimentation*.

C224.05 TYPES

Catch Drains

Catch drains shall be provided above the tops of cuttings or the toes of embankments where shown on the approved design drawings before construction of the adjacent roadway. The edges of catch-drains shall not be positioned less than 2m from the tops of cuttings or the toes of embankments nor more than is necessary to maintain the fall of the drains.

Diversion & Contour Drains

Minor diversion and contour drains shall be constructed where shown on the approved design drawings. Minor diversion drains shall have the same capacity as the nearest pipe culvert on the line of the drain.

Table Drains

Table drains, swales and depressed medians shall be constructed to the line and level shown or calculated from the approved design drawings.

Channels

Inlet, outlet and diversion channels shall be excavated as shown on the approved design drawings and shall extend to join the existing stream bed in a regular manner, avoiding disturbance in stream flow. The channel shall be excavated to the full width of the structure but the existing stream bed shall be preserved as far as possible outside the limits of the excavation.

C224.06 CONSTRUCTION

Excavated Material

Material excavated from drains shall be placed on the lower sides of the drains and formed as banks with slopes not steeper than 4H:1V on the cross section of the bank to increase the capacity of the drains. This material shall be compacted in accordance with AS 1289.5.4.1 and shall be not less than 95% for standard compactive effort or equivalent modified compactive effort. Excavated materials not placed will be spoiled in accordance with *C213 - Earthworks*.

Constructor's Responsibility

The Constructor shall ensure that none of the activities associated with the work disturbs any watercourse outside the site through the suitable implementation of erosion and sedimentation control measures in accordance with *C211 – Control of Erosion and Sedimentation*. 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.

Excess Material

Any excess material shall be legally and responsibly disposed of by the Constructor.

Revegetation

Unlined drains and areas adjacent to open drains shall be revegetated immediately after the drains are complete, in accordance with the approved design drawings. A suitable allowance shall be allowed downstream of open drains for the placement of surface

treatments such as turf or rip rap.

Revised Position

Deviations from the design position or cross section of the open drain shall be proposed to the TRC Representative for approval. The suitability of the revised location shall be validated by the Designer. Verification of the conformance of unlined drains shall be undertaken in accordance with *C213 -Earthworks*.

Hold Point

HOLD POINT

Deviations from the design position shall be submitted to the TRC Representative at least three (3) working days prior to constructing the affected lot.

Supporting information shall be submitted detailing the revised position and the reasons for the deviation.

PROCESS HELD: Construction of the open drain.

LINED OPEN DRAINS

C224.07 GENERAL

Shape

Lined open drains shall be formed as for unlined open drains with the inclusion of a lined invert in accordance with the approved design drawings.

Profile

Lining shall conform to the profile of the drain and shall be provided as soon as possible after forming the drain.

Compaction of Foundations

Before placing any lining material, the foundation material shall be shaped and compacted to form a firm base for the lining. Other than for kerb and gutter constructed on pavement courses in accordance with *C242 – Flexible Pavement* compaction requirements, the relative compaction, as determined by AS 1289 5.4.1 shall not be less than 98% for standard compactive effort.

C224.08 CONCRETE LINING

Method

Concrete lining for open drains shall be cast-in-situ or sprayed concrete supplied and placed in accordance with *C271 - Concrete Works*. Weepholes shall be provided in the concrete channels greater than 0.5m in height at intervals of 2m.

Jointing

Contraction joints in concrete lining, consisting of narrow transverse and vertical grooves, 20mm deep, shall be formed neatly in the surface of the freshly placed concrete at intervals of 3m unless specified otherwise in the approved design drawings. Expansion joints shall be placed at intervals shown in the approved design drawings, but not more than 15m. Expansion Joints shall consist of a preformed jointing material of bituminous fibreboard and shall be of sufficient depth to fill the joint.

Concrete Mix Design

A concrete mix design, complying with *C271 - Concrete Works* shall be submitted for approval to the TRC Representative and/or the Developer's Representative (for Developer Infrastructure Works) along with other verification records for reinforcement details where applicable.

HOLD POINT

Hold Point

Prior to the placement of concrete, records demonstrating conformance of the foundation, accompanied by a concrete mix design, shall be submitted by the Constructor to the TRC Representative and/or the Developer's Representative (for Developer Infrastructure Works) for approval at least three (3) working days prior to pouring the concrete lined drain.

PROCESS HELD: Delivery and placement of insitu concrete.

C224.09 BATTER DRAINS

Type

Batter drains shall be constructed using precast nestable concrete units or as detailed on the approved design drawings.

Installation

The units shall be installed in carefully excavated and template controlled trench to produce an even rim line of +0mm to –50mm from the batter line at the underside of topsoil.

Compaction

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.

Topsoil and Turfing

When topsoil is placed it shall be tapered over a width of 1m to zero thickness at the rim of the drain. Both sides of the drain shall then be turfed for minimum width of 600mm and

pinned down as provided in *C273 - Landscaping*.

C224.10 PROPRIETARY PRODUCTS

Manufacturer's Instructions

Unless shown on the approved design drawings, proprietary products may only be used with the approval of the TRC Representative. Where specified, they must be used strictly in accordance with the manufacturer's instructions.

C224.11 KERB AND GUTTER / CHANNEL

Method

Kerb and/or gutters may be constructed in fixed forms, by extrusion or by slip forming, in accordance with AS 2876. For standard kerb and gutter shapes refer to TRC Standard Drawing RD003.

Pavement under new kerb and gutter shall be subbase material in accordance with *C242 – Flexible Pavement* and extend a minimum of 500mm behind the invert of the kerb and gutter, refer to TRC standard drawing RD002.

For pavement under kerb and gutter repair or replacment works, subbase material in accordance with *C242 – Flexible Pavement* shall extend 500mm behind the invert and 1000mm infront of the invert of the kerb and gutter at a minimum of 150mm.

Construction Details

The foundation shall be constructed in accordance with *C242 – Flexible Pavement* subbase compaction requirments. The concrete quality, curing and testing details shall be in accordance AS 2876. The proposed methodology for laying the kerb, along with the proposed concrete mix design shall be submitted to the TRC Representative and/or the Developer's Representative (for Developer Infrastructure Works) for approval prior to commencement.

HOLD POINT

The Constructor's methodology for laying the kerb, accompanied by the concrete mix design and conformance of the foundation, shall be submitted to the TRC Representative and/or the Developer's Representative (for Developer Infrastructure Works) for approval at least five (5) working days prior to commencement.

Hold Point

PROCESS HELD: Laying of kerb.

Finish

The top and face of the finished kerb and gutter shall be true to line and the top surface shall be of uniform width, free from humps, sags or other irregularities. Kerb and gutter shall have a steel float finish unless stated otherwise.

Tolerances

The level at any point on the surface of the gutters shall be within ±10mm of design levels. When a straight edge 3m long is laid on top of or along the face of the kerb or on the surface of gutters, the surface shall not vary more than 5mm from the edge of the straight edge, except at kerb laybacks, grade changes or curves or at gully pits requiring gutter depression.

Contraction Joints

Unless shown otherwise on the approved design drawings, contraction joints, shall be formed every 3m of gutter length for a minimum of 50% of cross sectional area. The joint shall be tooled 20mm in depth to form a neat groove of 5mm minimum width.

Expansion Joints

Unless shown otherwise on the approved design drawings, expansion joints, 15mm in width for the full depth of the kerb and gutter, shall be constructed at intervals not exceeding 15m and where the gutter abuts against gutter pits, retaining walls and overbridges. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

Adjacent Concrete Pavement

Where kerbs and/or gutters are 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/or gutter.

Stormwater Outlets

All stormwater outlets shall be provided and/or extended, to match the existing type and size of pipe, through the kerb as shown on the approved design drawings. Pipework shall be in accordance with the requirements for UPVC pipes as per *C221 -Pipe Drainage*.

Vehicular or Pedestrian Access

Opposite all approved driveways, where shown on the approved design drawings, barrier kerb shall be discontinued to provide for vehicular or pedestrian access. At such locations, kerb laybacks shall be constructed in accordance with TRC Standard Drawing RD010. Footpath crossovers shall be constructed to meet the laybacks as shown on the approved design drawings, or reinstated to match existing materials where not otherwise shown.

Kerb Ramps

Kerb ramps shall be installed in accordance with TRC Standard Drawing RD005.

Backfill Timing

After the new kerb and gutter has been constructed and not earlier than three (3) days after placing, the spaces on both sides of the kerb and/or gutters shall be backfilled and reinstated in accordance with the approved design drawings.

Backfill Material

Backfill material behind the kerb shall consist of granular material, free of organic material, clay and rock in excess of 50mm in diameter.

Behind Kerb

Backfill material behind the kerb shall be compacted in layers not greater than 150mm thick, to a relative compaction of 95% when tested in accordance with AS 1289.5.4.1, 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

Pavement material adjacent to the new gutter shall be placed in accordance with the approved design drawings.

ROCK FILLED WIRE MATTRESSES AND GABIONS

C224.12 GENERAL

Geotextile and Location

Rock-filled wire mattresses and gabions shall be placed at the locations shown on the approved design drawings. Installation shall be in accordance with the manufacturer's instructions. A geotextile, as shown on the approved design drawings, shall be placed between the wire cage and the material being protected.

C224.13 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.

(a) Gabions

Dimensions

The gabions shall be of the sizes shown on the approved design drawings and fabricated of woven heavily galvanised wire mesh and PVC coated where specified on the approved design drawings. Each gabion shall be divided by diaphragms into cells whose length shall not be greater than the width of the gabions plus 100mm. Gabions shall have a nominal mesh size of 80mm x 100mm and body wire shall be heavily galvanised with a minimum diameter of 2.7mm. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 3.4mm and 2.2mm respectively.

(b) Wire Mattresses

Mattress Dimension

Unless specified otherwise, the wire mattresses shall be supplied in units having dimensions of 6m x 2m x 230mm, and shall be cut to suit areas as shown on the approved design drawings. The mattresses shall be divided by diaphragms into cells of length not exceeding 600mm. Unless otherwise specified, they shall be fabricated of woven heavily galvanised wire.

Wire Dimensions

Mattresses shall have a mesh size of 60mm x 80mm and body wire shall be heavily galvanised with a minimum diameter of 2.0mm. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 2.7mm and 2.2mm respectively.

(c) Geotextile

Type

A chemically and biologically stable geotextile with a minimum strength rating (G) of 1350 and minimum mass of 180 grams per square meter, in accordance with AUSTROADS Guide to Pavement Technology Part 4G: Geotextiles and Geogrids, shall be used.

Sample

Samples, manufacturer's specification and instructions on installation shall be submitted to the TRC Representative at least five (5) working days before the intended use of geotextile.

(d) Rock Fill Material

Rock Quality

The rock fill shall consist of clean, hard and durable rock with a minimum wet strength of 100kN and maximum wet/dry strength variation of 35%.

For Gabions

Rock fill for gabions shall have particle sizes between 100mm and 250mm and preferably not greater than 200mm.

For Wire Mattresses

Rock fill for wire mattresses shall have particle sizes between 75mm and two-thirds of the mattress thickness, or 250mm, whichever is the lesser. 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 25mm to 50mm to allow for settlement and to provide an even tight and smooth surface of the required contour.

HOLD POINT

The methodology for the construction of gabions or rock mattresses, accompanied by evidence that the gabions baskets or wire mattress, the rock and geotextile meets the specified requirements, shall be submitted for approval to the TRC Representative and/or the Developer's Representative (for Developer Infrastructure Works) at least five (5) working days prior to commencement. Conformance of the respective foundations shall also be provided.

Hold Point

PROCESS HELD: Commencement of construction of gabion and rock mattresses.

C224.14 ASSEMBLY AND ERECTION

Procedure

Before laying out the gabions or wire mattresses, geotextile shall be placed on the founding material. Preparation of the founding material shall be in accordance with the approved design drawings. The edges of wire mattresses shall be firmly tied to galvanised star pickets driven a minimum of 900mm into the surrounding ground at 1m maximum intervals and the star pickets cut off level with the top of the mattress. The upstream edge of wire mattresses shall be folded down into a trench of minimum depth 300mm and filled with rock fill. This edge shall be tied to star pickets.

Placement of rock fill material shall be by hand or suitable mechanical device to ensure fill is tightly packed with a minimum of voids. The front face, and all other faces that will remain visible shall be packed in a manner which provides a neat face free from excessive bulges, depressions or voids. Where rock is placed using mechanical devices care shall be taken to avoid damage to either the basket, mattress and associated wire coatings. The rock fill shall be levelled off 25mm to 50mm above the top of the mesh to allow for settlement.

LIMITS AND TOLERANCES

C224.15 SUMMARY OF LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C224.1 below.

Item	Activity	Limits/Tolerances	Spec Clause
1	**Open Drains – General**		
	(a) Grading	Grade > 1%.	C224.04
	(b) Depth	> 300mm.	C224.04
	(c) Waterway Area	> 0.2m$^{2.}$	C224.04
	(d) Catch Drain Location	> 2m from top of cuttings or toes of embankments.	C224.05
	(e) Compaction	> 95% (standard compaction).	C224.06
2	**Open Drains – Lining**		
	(a) Compaction of Foundation	> 98% (standard compaction).	C224.07
3	**Batter Drains**		
	(a) Rim line	+0mm, -50mm from batter line.	C224.09
4	**Kerb and Gutter**		
	(a) Compaction of foundation	Minimum Charecteristic Value Q = 100% (subbase)	C224.11 and C242.17
	(b) Level of gutter surface	Level ± 10mm of design level.	C224.11
	(c) Surface uniformity	Deviation of kerb and gutter surface from 3m straight edge ≤ 5mm.	C224.11
	(d) Contraction Joints		
	(i) Area	≥ 50% of cross sectional area.	C224.11
	(ii) Groove Width	≥ 5mm.	C224.11
	(e) Expansion Joint Interval	≤ 15m.	C224.11
	(f) Backfill behind Kerb		
	(i) Layer thickness	≤ 150mm.	C224.11
	(ii) Compaction	> 95% (standard compaction).	C224.11
5	**Rock Fill for Gabions and Wire Mattresses**		
	(a) Wet Strength	> 100kN.	C224.13d
	(b) Wet/Dry Strength Variation	< 35%.	C224.13d
	(c) Particle size for Gabions	> 100mm < 250mm.	C224.13d
	(d) Fill Level	> 25mm < 50mm above top of mesh.	C224.13d
	(e) Particle size for Wire Mattresses	> 75mm < 150mm.	C224.13d
6	**Erection of Wire Mattresses**		
	(a) Star pickets for ties	Depth in ground > 900mm. Spacing < 1m.	C224.14
	(b) Trench depth for upstream edge	Depth > 300mm.	C224.14

Table C224.1 - Summary of Limits and Tolerances

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