TWEED SHIRE COUNCIL

DEVELOPMENT CONSTRUCTION SPECIFICATION

C222

PRECAST BOX CULVERTS

VERSION 1.3

SPECIFICATION C222 – PRECAST BOX CULVERTS

CITATION

This document is named “Tweed Shire Council, Development Construction Specification C222 - Precast Box Culverts”.

ORIGIN OF DOCUMENT, COPYRIGHT

This document was originally based on AUS-SPEC - Development Construction Specification C222 - Precast Box Culverts, April 2000 (Copyright SWR-TM). Substantial parts of the original AUS-SPEC document have been deleted and replaced in the production of this Tweed Shire Council Development Specification. The parts of the AUS-SPEC document that remain are still subject to the original copyright.

VERSIONS, C222 PRECAST BOX CULVERTS

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED (The new version takes effect from this date)	Authorised by the Director of Engineering Services
1.1	Original Version		1 July 2003	
1.2	Expanded CCTV inspection criteria and reporting Renumbered clauses, including *Concrete Acceptance* Delete clause *Defects Revealed in CCTV Inspection* (previously C222.21)	C222.17-23 C222.24-27 C222.27	12 January 2007	
1.3	Expanded CCTV reporting requirements Change reference to SWAC to "Certifying Engineer"	C222.22 Various	12 June 2015	

DEVELOPMENT CONSTRUCTION SPECIFICATION C222

PRECAST BOX CULVERTS

GENERAL

C222.01 SCOPE

1. This Specification is for the installation of precast concrete box culverts and should be read in conjunction with the Specification for STORMWATER DRAINAGE - GENERAL.

2. The work to be executed under this Specification consists of: ***Extent of Work***

   (a) preparation of foundations;

   (b) provision of bedding;

   (c) construction of base slabs;

   (d) installation of precast culvert units;

   (e) headwalls and wingwalls;

   (f) backfilling against structures;

   (g) provision and removal of coffer dams;

   (h) excavation of inlet and outlet channels.

3. Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in the Specification Part for Quality Requirements. ***Quality***

C222.02 REFERENCE DOCUMENTS

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

(a) Other Council Specifications

C213	-	Earthworks
C220	-	Stormwater Drainage - General
C224	-	Open Drains, including Kerb and Gutter
C242	-	Flexible Pavements
C271	-	Minor Concrete Works

(b) Australian Standards

AS1597.1	-	Precast reinforced concrete box culverts - Small culverts
AS1597.2	-	Precast reinforced concrete box culverts - Large culverts
AS/NZS ISO 9002		Quality Systems - Model for Quality Assurance in Production, Installation and Servicing.

(c) Other Standards

AUSTROADS	-	Guide to Geotextiles

(d) Standard Drawings that apply to this Section:

MATERIALS

C222.03 CULVERT UNITS, LINK AND BASE SLABS

1. The supply and testing of precast reinforced concrete box culvert units, link and base slabs shall be in accordance with AS 1597.1 for small culverts not exceeding 1200mm width and 900mm depth and AS 1597.2 for large culverts from 1500mm span and up to and including 4200mm span and 4200mm height with the following alterations or additional requirements: ***Supply***

   (a) Proof load testing shall be arranged by the Subdivider in batches as specified in either AS 1597.1 or AS1597.2 as appropriate.

   (b) Lifting holes, galvanised lifting points or steel lifting eyes shall be provided in the culvert units, link and base slabs.

   (c) The end units shall have factory installed starter bars for headwall and wingwall construction.

   (d) Delivery and unloading shall be the Subdivider's responsibility.

2. The Supplier shall implement and maintain a Quality System in accordance with ISO 9002 to ensure materials, manufacture and proof load testing conform to the appropriate Standards.

3. A conformance certificate, to AS 1597.1 or AS 1597.2, for the box culvert units shall be submitted at least 3 working days prior to despatch.

4. Each unit shall be marked at time of manufacture with:

   (a) Type and size

   (b) Casting date

   (c) Manufacturer’s name

   (d) Inspection pass and date.

C222.04 CONCRETE

1. The concrete and reinforcement for cast-in-situ base slabs shall comply with the Specification for MINOR CONCRETE WORKS. ***Quality***

C222.05 SELECTED BACKFILL

1. The quality of selected backfill shall comply with the requirements in AS 1597.2. ***Quality***

C222.06 ORDINARY BACKFILL

1. Ordinary backfill is material obtained from culvert excavations, cuttings and/or borrow areas which is in accordance with the requirements for the upper 1.0m of embankment construction as detailed in the Specification for EARTHWORKS. ***Quality***

CONSTRUCTION

C222.07 COFFER DAMS

1. At some sites it may be expedient for the Subdivider to construct a coffer dam. All costs associated with the construction of coffer dams shall be borne by the Subdivider. ***Subdivider’s Costs***

2. Coffer dams shall be sufficiently watertight to prevent damage of the concrete by percolation or seepage through the sides, and shall be taken sufficiently below the level of the foundations to prevent loosening of the foundation materials by water rising through the bottom of the excavation. Coffer dams shall be adequately braced and shall be so constructed that removal will not weaken or damage the structure. ***Construction***

3. A coffer dam may be constructed to the actual size of the reinforced concrete invert slab and used as side forms for the concrete. The details of the coffer dam and formwork, and the clearances proposed shall be subject to the approval of the Certifying Engineer, but the Subdivider shall be responsible for the successful construction of the work. ***Subdivider's Responsibility***

4. Coffer dams which have tilted or have moved laterally during sinking, shall be righted or enlarged to provide the clearances specified. This work will be at the Subdivider's expense. ***Specified Clearances***

5. No timber or bracing shall be left in the concrete or in the backfill of the finished structure. Coffer dams, including temporary piles, shall be removed at least to the level of the invert after completion of the structure. ***Removal***

C222.08 EXCAVATION

1. Excavation shall be carried out in accordance with the provisions in the Specification for STORMWATER DRAINAGE - GENERAL. ***Specification***

2. The trench width shall be the width of the base slab plus 150mm minimum each side. ***Trench Width***

C222.09 FOUNDATIONS

1. Rock foundations shall be neatly excavated to the underside of the mass concrete or selected fill bedding shown on the design plans. All minor fissures shall be thoroughly cleaned out and refilled with concrete, mortar or grout. All loose material shall be removed. ***Rock Foundations***

2. Where rock is encountered over part of the foundation only, or lies within 300mm below the underside of the mass concrete or selected fill, all material shall be removed to a depth of 300mm below the mass concrete or selected fill for the full width of the foundation over the length where the rock is encountered. This additional excavation shall be backfilled with ordinary backfill material. ***Additional Excavation***

3. Over-excavation or uneven surfaces shall be corrected with mass concrete so as to provide a uniform surface at least 50mm above the highest points of rock. ***Uniform Surface***

4. Earth foundations shall be finished to line and level to the underside of bedding shown on the design plans. Care shall be taken to avoid disturbing material below this level. ***Line and Level***

5. All soft, yielding or unsuitable material shall be removed and replaced with ordinary backfill material as directed by the Certifying Engineer and backfilled in accordance with the Specification for STORMWATER DRAINAGE - GENERAL. ***Unsuitable Material***

C222.10 BEDDING

(a) Cast In-Situ Base Slabs

1. No bedding material shall be placed until the foundations have been inspected and approved by the Certifying Engineer. ***Inspection***

2. Bedding shall be either mass concrete or lightly bound DGB20 in accordance with the Specification for FLEXIBLE PAVEMENTS, whichever is shown on the design plans. ***Type***

3. Mass concrete bedding shall be of the same compressive strength as for the base slab and shall not be less than 50mm thick over any point in the foundation. It shall be laid to the line and level of the underside of the base slab to a tolerance of ± 10mm in level and ± 5mm in line. The bedding shall be finished to a smooth surface. ***Mass Concrete***

(b) Precast Base Slabs

1. Precast base slabs, U-shaped culvert units and one piece culvert units shall be supported on a bed zone of selected fill of minimum compacted depth 150mm in accordance with AS 1597.2. ***Selected Fill***

C222.11 CAST IN-SITU BASE SLABS

1. Cast-in-situ base slabs shall be constructed to the dimensions shown on the design plans and in accordance with the requirements of the Specification for MINOR CONCRETE WORKS. The invert levels shall be within -10mm to +10mm of the design level, grade 5mm in 2.5m (1 in 500) and plan position ±50mm. ***Construction***

2. Recesses to accommodate the walls of the precast crown units shall be formed in the base slab to the dimensions shown on the design plans. ***Recesses for Walls***

C222.12 INSTALLATION OF PRECAST UNITS

1. Precast units shall not be installed until the base slab has attained a minimum compressive strength of 20MPa. ***Minimum Strength***

2. Precast crown units shall be placed on a bed of mortar in the recesses in the base slab. Any gaps between the side walls and the sides of the recesses shall be packed with cement mortar. Lifting holes and butt joints between units shall be packed or sealed with cement mortar or grout. ***Mortar Bed in Recess***

3. Before placement of top slabs on U-shaped units or link slabs on adjacent crown units, the bearing areas of the supports shall be thoroughly cleaned and covered with a bed of mortar of minimum thickness 5mm after placement of precast unit. ***Mortar Bed on Supports***

4. Steel lifting hooks shall be cut flush with the surface of the concrete, cleaned to bright metal and coated with two (2) coats of coal tar epoxy. Alternatively, they shall be cut off 12mm below the surface of the unit and the recess sealed with epoxy mortar. ***Lifting Hooks***

5. In the case of multi-cell culverts, a nominal 15mm gap shall be provided between adjacent cells. This gap shall be filled with cement mortar or grout. ***Gap Between Cells***

6. All mortar joints shall be protected from the sun and cured in an approved manner for not less than 48 hours. ***Curing of Joints***

7. All external surfaces of joints between precast crown units, both laterally and longitudinally, shall be covered full length, and minimum 250mm width, with strips of non-woven geotextile of minimum mass 270 grams per m² in accordance with AUSTROADS Guide to Geotextiles. ***Joint Covering***

8. The Subdivider shall present the laid and jointed precast units for inspection by the Certifying Engineer prior to commencement of trench backfilling. ***Inspection by Certifying Engineer***

C222.13 BACKFILL

1. All bracing and formwork shall be removed prior to backfilling. ***Removal of Formwork***

2. Selected fill shall be placed in the side zones of the box culverts and wingwalls, and to a depth of 300mm in the overlay zone of the culverts, in layers with a maximum compacted thickness of 150mm in accordance with the backfilling and compaction requirements of AS 1597.2. The remainder of the excavation shall be backfilled with ordinary embankment fill in accordance with the Specification for EARTHWORKS. ***Selected Fill***

3. No backfill shall be placed against wingwalls until 21 days after casting. ***Wingwalls***

4. Backfill layers shall be placed simultaneously on both sides of the culvert with a maximum 600mm level difference to avoid differential loading. Backfilling and compaction shall commence at the wall and proceed away from it. ***Sequence***

5. Where the slopes bounding the excavation are steeper than 4:1, they shall be cut in the form of successive horizontal terraces of at least 1m before the backfill is placed. ***Horizontal Terraces***

C222.14 EXCAVATION OF INLET AND OUTLET CHANNELS

1. Excavation of inlet and outlet channels shall be carried out as shown on the design plans and shall extend to join the existing stream bed in a regular manner as detailed in the Specification for OPEN DRAINS INCLUDING KERB AND GUTTER. ***Extent***

C222.15 CONSTRUCTION LOADING ON CULVERTS

1. Construction vehicles and plant shall not pass over the culvert until 28 days after the casting of the base slab or until the cylinder compressive strength of the base slab concrete has reached 32MPa. ***Traffic Over Culvert***

2. Construction vehicle loads on culverts for various design fill heights shall be in accordance with AS 1597.2. ***Loading Restrictions***

LIMITS AND TOLERANCES

C222.16 SUMMARY OF LIMITS AND TOLERANCES

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C222.1 below:

Item	Activity	Limits / Tolerances	Spec Clauses
1.	**Mass Concrete Correction**		
	a) Over highest points of rock	50mm	C222.09
2.	**Mass Concrete Bedding**		
	a) Level	± 10mm	C222.10
	b) Line	± 5mm	C222.10
3.	**Culvert Location**		
	a) Invert Level	±10mm	C222.11
	b) Grade	5mm in 2.5m (1 in 500)	C222.11
	c) Plan Position	±50mm	C222.11

Table C222.1 - Summary Of Limits And Tolerances

SPECIAL REQUIREMENTS

CCTV INSPECTION

C222.17 WHEN IS A CCTV INSPECTION REQUIRED

1. A minimum of two (2) CCTV inspections will be required to be undertaken for all installed box culverts, to demonstrate to the Certifying Engineer that the standard of the constructed drainage infrastructure is acceptable. **CCTV Inspections**

2. For stormwater infrastructure installed under road pavement, the first CCTV inspection shall be undertaken after the pavement AC seal has been placed and not more than two (2) weeks before the final, "On Maintenance" inspection. **First CCTV Inspection**

   For stormwater infrastructure installed within the road reserve (but not under road pavement), the first CCTV inspection shall be undertaken within two (2) weeks of the final, "On Maintenance" inspection.

   For stormwater infrastructure installed outside the road reserve, the first CCTV inspection shall be undertaken after the final placement of topsoil and not more than two (2) weeks before the final, "On Maintenance" inspection.

3. A second CCTV inspection of all box culverts is required to be undertaken on or immediately after the expiration of the maintenance period. **Second CCTV Inspection**

4. Additional CCTV inspections are required of any remediation / repair works undertaken to the stormwater infrastructure, or as directed by the Certifying Engineer and/or Council to demonstrate that the standard of the drainage system is acceptable.

Other CCTV Inspections (as required)

5. The CCTV assessment shall also include any existing stormwater infrastructure that is to be utilised within the design. Council will advise if any repair / upgrades to the existing system are required.

Use of existing infrastructure

C222.18 WHAT IS TO BE INSPECTED

1. All stormwater networks with box culverts up to 2000mm in height are to be CCTV inspected.

   Box culverts greater than 2000mm in height are to be assessed by visual inspection.

CCTV up to 2000mm in height

2. Box Culverts shall be inspected and reported on the following:

   a. Horizontal alignment
   b. Vertical alignment
   c. Cracks and defects
   d. Culvert joints
   e. Joints to manholes and other culverts
   f. Shape

Assessment Criteria

C222.19 PRE INSPECTION CRITERIA

1. All box culverts are to be inspected upon delivery. A "No cracks policy" is to be adopted, giving the site supervisor the authority to reject any box culvert with a crack when delivered.

   Hairline cracks or crazing cracks associated with concrete shrinkage are permitted.

No cracks policy

2. The acceptance of culverts upon delivery to the site shall be in accordance with the following table (which has been simplified from AS4058)

Acceptance criteria

Defect Description	Acceptability
Type 1 & 2 • In culverts with a leg of less than 900mm in height Cracks up to 0.10mm not extending through the wall;	• Acceptable after repair
Type 1 & 2 • In culverts with a leg of 900mm or more in height Cracks up to 0.10mm not extending through the wall;	• Acceptable
Type 3 • Cracks over 0.10mm or cracks extending through the wall;	• Acceptable after repair and passes standard load test
Type 4 • Dents, bulges, chips and spalls up to 2.5mm deep/high and up to 50mm long. • Surface blowholes less than 4mm deep and less than 10mm in diameter.	• Acceptable • Acceptable
Type 5 • Dents, bulges, chips, spalls and bony patches up to 5mm deep/high and up to 50mm long. • Bony patches on socket back walls less than 5mm deep: • Surface blowholes less than 4mm deep and more than 10mm in diameter; • Visible inclusions of foreign matter less than 0.1% of either the inside or outside surface with no individual area more than 400mm^2 in area	• Acceptable after repair • Acceptable after repair • Acceptable after repair • Acceptable after repair
Type 6 • Dents, bulges, chips, spalls and bony patches more than 5mm deep/high and up to 50mm long. • Bony patches on socket back walls more than 5mm deep: • Surface blowholes more than 4mm deep • Defects as described above that are confined to the joints	• Not acceptable • Not acceptable • Not acceptable • Acceptable after repair
Type 7 • Visible inclusions of foreign matter more than 0.1% of either the inside or outside surface or with an individual area more than 400mm^2 in area • Defects as described above that are confined to the joints	• Not acceptable • Acceptable after repair

C222.20 INSPECTION CRITERIA

1. The CCTV Inspection shall be carried out in accordance with the Water Services Association of Australia (WSAA) "Sewer Inspection Reporting Code of Australia" and the "Sewerage Code of Australia" (Sydney Water Edition).

CCTV Inspection Procedure

2. CCTV surveys are to be undertaken using a camera with the ability to capture footage in colour and pan and tilt 360^o.

3. CCTV Field Assessors must have NATA accreditation under the Sydney Water Field Testing Services Program for CCTV inspections. Field Assessors must also have professional indemnity insurance adequate to cover the value of the works they are inspecting.

CCTV Field Assessors

4. All box culverts must be free of debris and silt at the time of inspection.

5. The box culverts shall be assessed at the following speeds

Speed

Box Culvert Height	Allowable Camera Speed
Height < 200mm	0.1m/s *
200mm ≤ Height < 300mm	0.15m/s *
Height ≥ 300mm	0.2m/s *
* - Or as agreed by Council	

6. The camera must stop perpendicular to all cracks, defects, joints and manholes and pan 360°. Particular attention should be paid to any infiltration at joints and connections.

Stop and pan 360°

C222.21 ACCEPTANCE CRITERIA

1. The box culverts will be acceptable if the Certifying Engineer is satisfied that the CCTV inspection does not reveal any defects that would constitute a departure from this specification or any other relevant Tweed Shire Council Development Specification.

Acceptance of CCTV Inspection

2. The misalignment of the ceiling at the inside of a joint between two connecting box culverts shall not exceed 5mm.

At Joints

3. The following criteria governs whether a crack or impact damage is acceptable without repair being required.

Criteria for crack or impact damage acceptance

a. Minor in nature - not more than 0.2mm in width
b. No sign of displacement across the crack
c. The edges of the crack are not crushed
d. No sign of entry of sand or debris to the box culvert
e. No rupture of the box culvert surface at the site of a dent or bulge

Defects that defer from the above criteria are required to be repaired.

Types of Defects

4. Structural Defects include;

   a. Cracks and fractures
   b. Deformed, collapsed and broken box culverts
   c. Dropped ceilings
   d. Displaced and open joints
   e. Surface damage
   f. Defective connections

   Serviceability Defects include;

   a. Debris and silt
   b. Obstructions
   c. Infiltrations
   d. Roots
   e. Encrustation and scale

5. All cracks are to be assessed by the Certifying Engineer and / or a Council representative to determine the significance of the crack and thereby the acceptance, rejection or remedial repairs required.

   It shall be at the sole discretion of the Certifying Engineer and / or the Council representative as to whether the identified defects is considered significant or not. Council may seek written advice from the Pipe Surveyor or the Box Culvert Manufacturer on this matter.

6. All manhole and gully pit connections are to be mortared flush with the walls and that no culvert reinforcement is exposed.

Acceptance criteria

7. The acceptance of culverts during and after installation shall be in accordance with the following table (which has been simplified from AS4058).

Construction Stage	Type of Defect	Acceptance and Remedial Action
After Installation	**Type 1 & 2 Defects** Considered to be insignificant cracking and is defined as cracking that is less than or equal to 0.15mm in width	(a) Any Circumferential Crack - No remedial action required. (b) Longitudinal cracks less than 300mm in length - No remedial action required. (c) Longitudinal cracks exceeding 300mm in length - Must be repaired, i.e. cracks to be filled and sealed to ensure a design life of 100 years is achieved. Contractor to provide written certification by a suitably qualified engineer or Certifying Engineer that the work is acceptable and has been carried out in accordance with the manufactures specification. A complete CCTV resurvey will also be required to show the condition of the repaired culvert.
After Installation	**Type 3 Defects** Considered to be significant cracking and is defined as cracking that is more than 0.15mm in width	(a) The culvert is to be either replaced or (b) Structurally Reline (liner and grout) a section of the pipeline for a minimum of 200mm each side of the crack or from manhole to manhole. The relined section must conform to the original hydraulic design criteria. Contractor to provide certification by a suitably qualified engineer or Certifying Engineer on the acceptability of any remedial works undertaken. (b) Resurvey will be required after the repair or replacement has been completed and all works reinstated.
During and After Installation	**Type 3 Defects** (i) Significant damage to culvert ends of pipe during installation or (ii) Significantly gouged or damaged through other construction activities	culverts to be replaced, preferably at time of installation culvert to be replaced, preferably at time of installation

8. Sections of the box culverts that fail the simple dimension and shape test are to be excavated and the trench and embedment replaced.

9. Box culverts that are crushed or creased are to be replaced.

C222.22 SUBMISSION

1. The Applicant must submit both a hardcopy report and an electronic report (submitted in USB portable medium in a format suitable to Council - as outlined below) of the CCTV inspection. The CCTV Inspection Report is a pre-requisite for issue of an *Off Defects Liability Compliance Certificate*.

USB portable drive contents and format:

a. Individual video files representing each section of pipe from node to node. (e.g. from MH 5A to MH 6A)

b. Each video file is to be named appropriately to enable easy identification, utilising names as shown on the as-constructed or approved design drawings. (e.g. *MH5A-MH6A*)

c. Video file format is to be MPG/MPEG format (Motion Picture Experts Group).

d. Copy of pipe survey report in PDF format.

2. The reports must include

a. Name of asset owner.
b. Name of the company performing the inspection and name of the operator.
c. Operator's job reference.
d. Coding system employed (i.e. WSA 2013)
e. Method of inspection.
f. Details of equipment used.
g. Specify the date of the inspection
h. Time of commencement of inspection.
i. Specify location (including Street Name and number)
j. Specify details of the reach being inspected(including line and structure numbers)
k. Provide footage in colour
l. Whether the maintenance structure was pre-cleaned.
m. Precipitation at the time of inspection.
n. Description of any measures taken to control flow during the inspection.
o. Cover details.
p. Details of steps and ladders.
q. Type of node.
r. The vertical reference point, if recording vertical location.
s. The circumferential reference point.
t. Video or digital image storage details.
u. Identify all faults, features and connections in the box culvert.
v. Clearly show chainage along the box culvert
w. Suggest appropriate remediation measures, as required.

3. For box culverts greater than 2000mm in height, a written report shall be submitted including;

For box culverts greater than 2000mm in height

a. Certification of the box culvert by the Certifying Engineer,
b. Digital photographs of any identified defects,
c. Digital photographs of any remediation works undertaken.

C222.23 IF REMEDIATION WORKS ARE REQUIRED

1. Any defects identified by the inspection must be repaired or replaced in accordance with the provisions of this Specification, or as directed by the Certifying Engineer / Council.

2. All costs associated with the CCTV inspection and rectification works shall be borne by the Applicant.

Costs

3. Defects identified by the inspection requiring repair may be repaired using one of the following repair techniques;

Acceptable repair methods

a. Tiger patch liner
b. Econoliner
c. PL Quick Sleeve System
d. Flexi-Bond method
e. Other such technique as approved by the Certifying Engineer and / or Council

4. Circumferential cracks are to be repaired by installation of either a bandage for cracks on the outside or by Relining and Grouting for cracks on the inside or alternatively as approved by Council.

Circumferential cracks

Longitudinal cracks

5. Longitudinal cracks are to be repaired by filling with an approved epoxy resin. The epoxy resin shall not be less than 1mm thick and extended at least 100mm from the crack in all directions. The repair is to be reinspected after curing is complete.

6. A follow-up CCTV assessment is required of any repaired or replaced infrastructure, to demonstrate that the remediation measures undertaken are satisfactory to Council.

C222.24 RESERVED

C222.25 RESERVED

ACCEPTANCE

C222.26 CONCRETE ACCEPTANCE

1. Where any concrete does not reach the strength specified the Certifying Engineer may order its rejection and removal.

2. Where any concrete does not reach the strength specified by up to a maximum deficiency of 10%, the Certifying Engineer may accept the concrete, if in the opinion of the Certifying Engineer, the concrete strength as measured will not result in:

   (a) Any adverse impact on the structural integrity, safety or functionality of the associated infrastructure and

   (b) Will not result in any increased long term ownership costs due to increased operation/maintenance/cleaning costs or reduced life span

C222.27 DELETED