



FNQROC DEVELOPMENT MANUAL

SPECIFICATION

S4

STORMWATER DRAINAGE

Version No. 11/19

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GENERAL

S4.01 SCOPE

1. The specification details are all the requirements pertaining to the construction of stormwater drainage works.
2. Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

S4.02 REFERENCE DOCUMENTS

Note: Where Acts or reference documents are updated, reference should be made to the current version.

Australian Standards

- AS 1597 Precast Reinforced Concrete Box Culverts
- AS2041.4
- AS 2338 Preferred Dimensions of Wrought Metal Products
- AS 2423 Galvanised Wire Fencing Products
- AS 3600 Concrete Structures
- AS 3725 Design for installation of Buried Concrete Pipes
- AS 3996 Metal Access Covers, Road Grates and Frames
- AS 4058 Precast Concrete Pipes (pressure and non-pressure)
- AS 4139 Fibre - Reinforced Concrete Pipes and Fittings
- AS 4680 Hot - Dipped Galvanised Coatings on Ferrous Articles.
- AS 5065 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications

All Australian Standards referenced in this specification shall be the current edition.

Department of Main Roads

- MRTS03 Drainage, Retaining Structures and Protective Treatments.
- MRTS04 General Earthworks

Water Services Association of Australia

- WSA 05-2006 Sewer Inspection Reporting code of Australia

Others

- American Association of State Highway and Transportation Officials (AASHTO) - M197-82 Aluminium Alloy Sheets for Culverts and Underdrains.
- American Association of State Highway and Transportation Officials (AASHTO) - M196-84 Corrugated Aluminium Alloy Culverts and Underdrains.

MATERIALS

S4.03 STEEL REINFORCED CONCRETE PIPES (RCP)

1. Pipes shall conform in all respect to AS 4058.
2. Unless specified otherwise, all pipes used in the works shall be flush (rebated) jointed.
3. In locations where the pipes are to be laid in a subgrade of sand or influenced by saltwater, rubber ringed joints shall be used.
4. Pipes laid in areas influenced by saltwater intrusion or acid sulphate soils, or where any part of the pipe is below the Highest Astronomical Tide (RL 1.80m AHD) the pipe must adhere to exposure classification requirements listed in AS4058.
5. The class of pipe shall be as specified or shown on the drawings. All pipes under roadways shall be a minimum of Class "2".

S4.04 FIBRE REINFORCED CONCRETE PIPES (FRC)

1. The use of fibre reinforced concrete pipes is not supported. Fibre reinforced epoxy lining/relining is permissible.

S4.05 REINFORCED CONCRETE BOX CULVERTS (RCBC)

1. Box culverts shall be of the "Inverted U" type unless specified otherwise and shall conform in all respects to the current edition of AS 1597.
2. Box culverts laid in areas influenced by saltwater intrusion or acid sulphate soils, or where any part of the pipe is below the Highest Astronomical Tide (RL 1.8m AHD) the box culvert are to have cover to reinforcement in accordance with the exposure classification requirements of AS1597 and AS 3600 respectively.

S4.06 POLYPROPYLENE STORMWATER PIPES

1. The use of polypropylene stormwater pipes must be at the express permission of the receiving Council. pipework and fittings must conform in all respects to AS 5065 and installation must be in accordance with AS 2566 and manufacturers specifications.
2. The use of polypropylene(or other flammable material) stormwater pipes under public roads or utilities is not supported in rural areas.

S4.07 CORRUGATED ALUMINIUM ALLOY PIPES

1. The pipes shall be manufactured in accordance with AASHTO M196-84 and to the tolerances shown in AS 1761 and incorporate a staked, double offset lock-seam joint.
2. The base metal shall conform to AASHTO M197-82 and shall comprise "Alclad 3004-H34" alloy or approved equivalent.

S4.08 BEDDING MATERIALS

Reinforced Concrete Pipes

1. Grading of bedding materials shall be in accordance with AS3725 - Design for installation of buried concrete pipes.

Polypropylene Stormwater Pipes

2. Bedding and installation must be in accordance with AS 2566 - Buried flexible pipelines Installation.

Reinforced Concrete Box Culverts

3. The bedding material to be used in conjunction with box culverts should conform to the grading specified in the Main Roads Standard Specification MRTS04 for drainage structures.

Corrugated Aluminium Alloy Pipes

4. Where rock is encountered at the foundation, the bedding material shall consist of a loose granular cushion of maximum 12mm aggregated size to a depth sufficient to allow the corrugations to become filled. This material shall form the top portion of the bedding material.
5. Where soft unstable foundation material is excavated below the invert, backfill material shall consist of gravel, crushed stone or other suitable material.
6. All material directly in contact with the pipe shall be within a pH range 4-9 and have a resistivity greater than 500 ohm cms.

S4.09 STEEL WIRE GABION AND MATTRESS PROTECTION WORKS

1. Steel wire gabions and mattresses shall be proprietary products manufactured from heavily galvanised hexagonally woven steel-wire mesh and filled with rock conforming to the material requirement specified in Main Roads Specification MRTS03.

S4.10 CONCRETE

1. The concrete and reinforcement used in the construction of gully pits, manholes, headwalls and aprons etc shall comply with Specification S7 CONCRETE WORKS.

S4.11 MANHOLE COVERS AND FRAMES

1. Cast iron covers and frames are to be supplied for all stormwater manholes and shall be manufactured and tested in accordance with AS 3996.
2. All openings shall conform to the details on Standard Drawing S1065.
3. All covers shall have a raised stud pattern with the letters SW (65mm high) cast into the centre of the lid and "gatic" type lifting holes.
4. Minimum classes of manhole covers shall be as follows:
 - a. Within Residential Properties - Parks - Class B
 - b. Residential Road Reserves - Class D
(Up to collector street status)

- c. Residential Road Reserves (Trunk Collector or higher) - Class D
- d. Industrial, Commercial Road Reserves - Class D

S4.12 GRATES AND FRAMES

1. Grates and frames of gully pits are to be fabricated from grade 250 steel and shall comply with the requirements of AS 3996. They shall be constructed to the dimensions and details supplied on the Standard Drawing S1060 and shall be Hot Dipped Galvanised to the requirements of AS 1650.
2. Grates for structures other than gully pits shall be bicycle safe, and of a classification applicable to its location in accordance with AS 3996.

S4.13 FLOODGATES

1. Floodgates shall be a proprietary product manufactured from non-corrosive material of a type specified on the approved Project Drawings.

S4.14 BACKFILL MATERIAL

1. Backfill material shall be as per the Australian Standard relevant to the pipe type being used.
2. Stabilised Backfill material may need to be required when utilising Corrugated Aluminium Alloy Pipes. Where such materials are required, only approved mixes in accordance with the manufacturers recommendations shall be accepted.

CONSTRUCTION

S4.15 SETOUT

1. The alignment of the stormwater pipes and position of the gully pits, manholes and headwalls shall be as stated in the approved Project Drawings and set out from a datum line established by a Registered Surveyor. The datum line may be either the road centreline, property boundary, a pegged chainage offset line, or any alternative datum suitable for the purposes of accurately setting out the works.
2. The invert levels of the pipes shall be maintained in strict accordance with site bench marks and only approved and tested equipment shall be used to establish and maintain these levels.

S4.16 CLEARING AND GRUBBING

1. All clearing and grubbing works shall be in accordance with Specification S1 EARTHWORKS.
2. Where stormwater lines pass through allotments any trees or obstructions not on the line of the pipes shall be preserved.

S4.17 TRENCHING

1. All trenching and foundation works necessary for the installation of stormwater drainage works, shall be in accordance with Specification S1 EARTHWORKS.
2. Trench or foundation excavation for stormwater drainage works shall be undertaken to the planned level for the bottom of the specified bedding or foundation level. All loose material shall be removed from the bottom of the trench.
3. The width of trenching excavation shall be in accordance with the Standard Drawings S1045 and S1046 at the trench base and comply with all regulations of Workplace Health and Safety Act.
4. In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.
5. Where public utilities exist in the vicinity of stormwater drainage works the Contractor shall obtain the approval of the relevant authority / corporation to the method of excavation before commencing excavation.

S4.18 DIVERTING WATER AND DEWATERING

1. During construction all care should be taken to ensure any water, which may interfere with the progress of the works, be diverted to keep the trenches and excavations free from water so as to prevent any damage to the works due to flooding or other causes.
2. The necessary pumping items shall be kept on hand to ensure the excavation is constantly dewatered during the progress of the works.
3. Discharge for dewatering pumps shall be directed to location approved by and to the satisfaction of Council.
4. Care shall be taken to ensure that discharge flows do not cause any flooding, erosion or environmental harm, where necessary appropriate measure shall be put in place to trap and dispose of entrained sediments.
5. In areas where acid sulphate soils are present, discharge flows shall be in disposed of and/or treated in accordance with an approved acid sulphates soils management plan.

S4.19 BEDDING**General**

1. Pipe support and bedding shall be in accordance with AS 3725 for pipe support types shown on the approved Project Drawings. Where the pipe support type is not shown on the Drawings, the minimum pipe support type shall be HS2 within road reserves and H1 elsewhere.
2. The bedding and haunch zone material shall be placed and compacted in accordance with AS 3725, with care be taken around the Haunch zone area to avoid disturbing the position of the pipe. The surface of every pipe should have full and even contact with the bedding material.
3. In trenches with bad ground water conditions and/or unsuitable material the trench should be over excavated to allow a foundation layer of crushed rock material (min. depth 250mm) to be placed to provide an adequate foundation. A geofabric to engineering design should be placed for the full width of the trench and overlapped 450mm prior to placing the bedding material and laying the pipes in this instance.

Corrugated Aluminium Alloy Pipes

4. Where soft unstable foundation material is encountered below the pipe invert, the minimum width of replacement material under the pipe shall be twice the pipe diameter. The depth of replacement material shall be such as to achieve a good foundation for the constructed works.
5. When rock is encountered in the foundation, the rock shall be excavated and replaced with suitable bedding material to a depth of $D/4$ or 250mm, whichever is lesser (where D is the pipe diameter).

Box Culverts

6. Bedding for precast and cast insitu base slabs shall be selected backfill to a compacted depth of 150mm laid to the line and level of the underside of the base slab. The bedding shall be finished to a smooth surface with a tolerance of ± 10 mm in level and ± 50 mm in line.

S4.20 LAY AND JOINT PIPES**Concrete and Fibre Reinforced Concrete Pipes**

1. Pipe laying shall begin at the downstream end of the line with the socket or grooved end of the pipe facing upstream. When the pipes are laid, the barrel of each pipe shall be in contact with the bedding material throughout its full length.
2. When elliptical pipes with circular reinforcement or circular pipes with elliptical reinforcement are used, the pipes shall be laid in such a position that the manufacturer's marks, designating the "Top" or "Bottom" of the pipe shall not be more than 5 degrees from a vertical plane through the longitudinal axis of the pipe.
3. External joints shall be taped with the manufacturers supplied tape or rubber external sand bands upon final bedding and alignment.
4. Lifting holes in pipes shall be plugged with mortar, precast tapered concrete / plastic plugs, or other approved means prior to backfill material being placed.
5. Joints shall not be made under water. The trench must be de-watered to facilitate joint making and inspection. Precautions must be taken to prevent erosion of joint material by moving currents of water.
6. Drainage lines shall be constructed with a tolerance of ± 15 mm in line or level over any section 30m in length (providing each pipe unit has a fall in the direction of flow) from the alignment and levels shown on the approved Project Drawings.

Reinforced Concrete Box Culverts

- 7. The base of the box culvert shall be laid true to line and grade before the crown units of the box culvert segments are laid.
- 8. All construction methods, tolerances and requirements for box culverts shall conform to the requirements detailed in Main Roads Standard Specification MRTS03.

Helical Lock Seam - Corrugated Aluminium Alloy Pipes

- 9. Coupling of one pipe segment to another shall be by means of an external coupling band.
- 10. Large diameter pipes may be end match marked in the factory in order to simplify installation. Where multiple cell structures are being installed, each difference shall be marked in a unique manner for ease of identification.
- 11. Bands have corrugations or dimples that correspond to those of the pipe sections. They shall be fitted so as to overlap each pipe section equally. Where the pipes have not been re-corrugated and "dimple" bands are being used, the pipes shall be rotated sufficiently for the helical corrugations to match adjacent pipes.
- 12. To speed the coupling operation, especially for large diameter structures, a chain or a cable-cinching device may be used to help draw the band tight. On large structures merely tightening the bolts and nuts will not assure a tight joint, due to the friction between the band and the pipe ends. In such installations, the band shall be tapped with a rubber or wooden mallet as the band is tightened to reduce any tendency for the band to bend on the pipe.
- 13. The coupling bands shall be evenly tightened to provide a firm tough clamp to the jointed pipes.

S4.21 BACKFILL

Concrete and Fibre Reinforced Pipes

- 1. Compaction standards for backfill material shall conform to Table S4.1.

Table S4.1 Backfill Compaction

Location	Minimum Dry Density Ratio (Cohesive soils)	Minimum Density Index (Cohesionless soils)
Under Road embankments		
> 0.3m below pavement subgrade	95% Standard	65%
< 0.3m below pavement subgrade	98% Standard	80%
Elsewhere	95% Standard	65%

Note: Compaction requirements are with reference to the relevant Test Methods Contained in AS 1289.

- 2. For trench installations, mechanical compacters shall be used. Where impact tampers are used caution must be exercised not to allow a direct blow on the pipe. The material should be compacted at near optimum moisture content and should be brought up evenly in layers not exceeding 150mm on both sides of the pipe up to 150mm over the pipe. It should not be bulldozed into the trench nor dropped directly on the pipe.

3. Heavy mechanical equipment must not be used for tamping of backfill or be permitted to run over pipelines at shallow depths except at prepared crossing places and where approved.
4. For trenches not contained within the road reserve the trench shall be refilled to natural surface level with fill material placed evenly in 150mm to 300mm layers, tamped thoroughly.
5. The backfilling should be completed as soon as possible after pipe laying, and before the pipeline is charged with water. This will avoid the risk of pipes floating if the trench becomes flooded.

Helical Lock Seam - Corrugated Aluminium Alloy Pipes

6. Backfill material shall be placed in layers not exceeding 200mm loose thickness both sides of the structure such that the difference in fill height either side of the pipe is minimal.
7. Tamping may be done with hand or mechanical equipment, tamping rollers or vibrating compacters. Each layer shall be compacted to a standard of compaction in accordance with Table S4.1
8. Where very fine granular material is encountered in conjunction with a high ground-water table, special provision may need to be made to prevent infiltration of the surrounding material into the pipe (such as at coupling band joints), which could cause loss of backfill material surrounding the pipe. Geotextile fabrics or gasket material are typically used.

S4.22 DRAINAGE STRUCTURES

1. Gullies, manholes and field inlets shall be constructed to the form and dimensions shown on the plans and in accordance with Standard Drawings S1050, S1055, S1060, S1065, S1066, and S1070. Where the ground is solid, back forms need not be used in the construction of drainage structures, the concrete being poured against the earth. Where this is done, the thickness of the wall of such gully or manhole shall be increased to a minimum of 50mm greater than the dimension shown on the plan.
2. The joints between drainage structures and pipes shall be made watertight using cement mortar. The mortar shall be used within one hour of mixing and shall not be retempered. The joints shall be finished to provide smooth surfaces, uniform with the inner surfaces of the structure.
3. Concrete benching shall be shaped as specified and shall have smooth, even surfaces and neat edges.
4. All manhole installations must have 1.5m clearance available on three sides to facilitate confined space access.
5. Concrete top slabs in Manholes shall be joined to the walls using cement mortar or epoxy mortar. The opening in the top slab shall be closed with temporary covers, after which excavations shall be backfilled. Cast in situ concrete surrounds shall be constructed on the top slabs to encase the frames. Alternatively, precast concrete surrounds may be employed, using epoxy mortared joints. Only approved covers in accordance with this Specification shall be installed in the frames.
6. Temporary covers to Gullies and Manholes may remain in position and installation of the frames and surrounds deferred until pavement construction has reached a stage where the frames and surrounds can be positioned accurately. Where construction is in a staged format, the joint between each pour shall be suitably roughened to ensure an adequate bind and seal is achieved between the successive concrete pours.
7. Compaction of material surrounding drainage structures shall be in accordance with Table S4.1
8. Precast Gullies Manholes and Field Inlets may be used, subject to approval by Council. RPEQ certification must be provided by the manufacturer.

S4.23 STEEL WIRE GABIONS AND MATTRESS PROTECTION

1. These proprietary products shall be assembled and installed in accordance with the Main Roads Standard Specification MRTS03.

S4.24 HEADWALLS, WINGWALLS AND APRONS

Cast Insitu

1. Where necessary, localised excavations shall be carried out to allow construction of cast insitu end structures.
2. Cast insitu endwalls, wingwalls and aprons, shall be constructed to the dimensions and other requirements shown on the approved Project Drawings and in accordance with Standard Drawings S1075, S1080, S1085, and S1090.
3. Concrete work shall comply with Specification S7 CONCRETE WORKS. Construction of endwalls and wingwalls shall include the construction of integral cut-off walls, where required.

Precast

4. Where necessary, localised excavations shall be carried out to allow installation of precast concrete end structures.
5. End structures shall be laid on foundation bedding, which provides continuous even support to the structures. Foundation bedding material shall be compacted to the relevant standard specified below:
 - a. Cohesive material - to not less than 95% Standard Compaction.
 - b. Non-cohesive material - to a density index of not less than 65.
6. The joints between end structures and culverts shall be filled with cement mortar. The joint areas shall be thoroughly cleaned and wetted just prior to filling. All points shall be finished smooth and uniform with the surfaces of the end structures.
7. Any holes and recesses provided in end structures to assist installation shall be neatly plugged or filled with cement mortar.
8. Mortared joints and filled holes and recesses shall be cured for a period of not less than 48 hours. Backfill operations against end structures shall not be carried out during this curing period.

S4.25 FLOODGATES

1. Floodgates can be sleeved over the end of the pipe, secured with stainless steel bands or fixed to with a flange to headwalls. Installation shall be in accordance with the manufacturers recommendations.

S4.26 TOLERANCES

1. Tolerances for the construction of Stormwater Drainage Works shall comply with Table S4.2.

Table S4.2 Construction Tolerances

Location	Tolerance
Invert Levels	+10mm - 10mm
Surface Levels	+50mm - 50mm in Allotments +10mm - 10mm in Roadways
Structure Locations	Within 100mm of design in Allotments or Park Within 50mm of design longitudinally along roadway Within 10mm of design at right angles to road centreline
Crest and Spillways of Detention Basins	Trimmed to +25mm - 10mm

S4.27 CCTV INSPECTION OF STORMWATER DRAINAGE SYSTEM COMMENTARY AVAILABLE, TRC, MSC

CCTV INSPECTION – UNDERGROUND STORMWATER PIPE DRAINAGE

WHEN IS A CCTV INSPECTION REQUIRED

1. A minimum of one (1) CCTV inspection will be required to be undertaken for all installed pipe drainage infrastructure, to demonstrate 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 Works Acceptance (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 Works Acceptance (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 Works Acceptance (on Maintenance) inspection.

3. A second CCTV inspection of all pipe drainage may be required to be undertaken on or immediately after the expiration of the defects liability period at Final Works Acceptance. Council will determine using a risk management approach, if this additional inspection is required based on the results of the first inspection at Works Acceptance. **Second CCTV Inspection**

STORMWATER DRAINAGE

- | | | |
|----|--|---|
| 4. | Additional CCTV inspections are required of any remediation / repair works undertaken to the stormwater infrastructure, as directed by 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. The extent of inspection of the existing infrastructure shall be confined to areas immediately adjoining the new infrastructure. Council will advise if any repair / upgrades to the existing system are required. | Use of existing infrastructure |

WHAT IS TO BE INSPECTED

- | | | |
|----|--|------------------------------|
| 1. | All underground stormwater networks with 375 diameter pipes up to 2000mm in diameter are to be CCTV inspected.

Pipe greater than 2000mm diameter are to be assessed by visual inspection. | CCTV up to 2000mm dia |
| 2. | Pipes shall be inspected and reported on the following:
a. Horizontal alignment
b. Vertical alignment
c. Cracks and defects
d. Pipe joints
e. Joints to manholes/structures and other pipes
f. Ovality | Assessment Criteria |

PRE INSPECTION CRITERIA

- | | | |
|----|--|----------------------------|
| 1. | All pipes are to be inspected and assessed for acceptance for incorporation into the works upon delivery to site. All defects including cracking shall be assessed. The acceptance of pipes upon delivery to the site shall be in accordance with AS4058 for reinforced concrete pipes and the relevant Australian Standards and manufacturers recommendations for other pipe materials. | Acceptance criteria |
| 2. | It is the contractors responsibility to make this assessment. | |

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" | 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°.
- 3. CCTV Field Assessors must be experienced and competent personnel for CCTV inspections.
- 4. All pipes must be free of debris and silt at the time of inspection.

CCTV Field Assessors

- 5. The pipeline shall be assessed at the following speeds

Speed

Conduit Diameter	Allowable Camera Speed
Dia. < 200mm	0.1m/s *
200mm ≤ Dia. < 300mm	0.15m/s *
Dia. ≥ 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°

ACCEPTANCE CRITERIA

- 1. The pipe drainage will be acceptable if Council is satisfied that the CCTV inspection does not reveal any defects that would constitute a departure from this specification or any other relevant Development Specification.
- 2. The misalignment of the lip at the inside of a joint between two connecting pipes shall be in accordance with AS4058 for reinforced concrete pipe or any other relevant Australian Standard for different pipe materials.
- 3. The following criteria govern whether a crack or impact damage is acceptable without repair being required.
 - a. Minor in nature and within the relevant Australian Standards
 - 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 pipeline
 - e. No rupture of the pipe surface at the site of a dent or bulge
 Defects that defer from the above criteria are required to be repaired.

Acceptance of CCTV Inspection

At Joints

Criteria for crack or impact damage acceptance

4. Structural Defects beyond the recommendations of the Australian Standards will be deemed to be unacceptable as below;

Types of Defects

- a. Cracks and fractures
- b. Deformed, collapsed and broken pipes
- c. Dropped inverts
- d. Displaced and open joints
- e. Surface damage
- f. Defective connections

Serviceability Defects include;

- a. Debris and silt
- b. Obstructions
- c. Infiltrations, unless there are special design considerations
- d. Roots
- e. Encrustation and scale

5. All cracks are to be assessed by an appropriately experienced RPEQ and pipe surveyor to determine the significance of the crack and thereby the acceptance, rejection or remedial repairs required.

Council will review the RPEQ assessment and determine whether the identified defect is considered significant or not. Council may also seek written advice from the Pipe Surveyor or the Pipe Manufacturer on this matter.

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

7. The acceptance of pipes during and after installation shall be in accordance with AS4058, manufacturers recommendations and any other relevant Australian Standard particular to the pipe material used.

Acceptance criteria

8. Sections of the pipeline that fail the ovality test are to be excavated and the trench and embedment replaced.

9. Pipes that are crushed or creased are to be replaced.

SUBMISSION

1. The Applicant must submit both a hardcopy report and an electronic report (submitted in CD or DVD 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 a Works Acceptance Certificate or Final Works Acceptance Certificate if required at this final stage.

CD or DVD 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 format.
- d. Copy of pipe survey report in PDF format.

2. The reports must
 - a. Specify the date of the inspection
 - b. Specify location (including Street Name and number)
 - c. Specify details of the reach being inspected(including line and structure numbers)
 - d. Provide footage in colour
 - e. Identify all faults, features and connections in the pipeline.
 - f. Clearly show chainage along the pipeline
 - g. Suggest appropriate remediation measures, as required.

3. For all CCTV inspections a written report shall be submitted including;
 - a. Certification by an RPEQ that the pipes have been installed in accordance with the relevant Australian Standards and Manufacturers recommendations. In addition the certification is to include an assessment of any cracks or defects as listed above with regard to compliance with the Australian Standards and Manufacturers recommendations.
 - b. Recommendations on remedial works if compliance is not in accordance with Australian Standards and Manufacturers recommendations.
 - c. Digital photographs of any identified defects,
 - d. Digital photographs of any remediation works undertaken.

For pipes greater than 2000mm dia

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 RPEQ or Council.
2. All costs associated with the CCTV inspection and rectification works shall be borne by the Applicant.
3. Defects identified by the inspection requiring repair may be repaired using one of the following repair techniques;
 - a. Tiger patch liner
 - b. Econoliner
 - c. PL Quick Sleeve System
 - d. Flexi-Bond method
 - e. Other such technique as approved by 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.
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.

Costs

Acceptable repair methods

Circumferential cracks

Longitudinal cracks