WATER SERVICES ASSOCIATION OF AUSTRALIA

WSA 02:2014: Gravity Sewerage Code of Australia Version 3.1

Amendment No 1

Revised text amendment

The 2014 edition of WSA 02 is amended as follows:

SUMMARY This amendment applies to the following elements:

Forward, Scope of Code, Appendices, Work Health and Safety (WHS) Laws, National Standard for Construction Work, Safe Design of Structures, Glossary of Terms I, Abbreviation II,

Clauses 1.2.2, 2.4.2, 3.3.2, 4.2 Table 4.1, 4.5.1, 4.5.3, Table 4.2, Clauses 4.5.5, 4.6.1,4.7, 4.8, 4.13.1, 4.13.2, 4.14.1, 4.15.1, 4.15.3, 4,15.4, 4.15.5, 5.5.5.1, 5.5.5.2, Table 5.6, Clauses 7.9.1, Table 7.5, Clauses 8.8.1, 9.4.5,14.12.5,16.17.3, 16.8. 21.2.4.1 Table 21.3 and Appendix C. Appendix I, Appendix L, Pipe Sizing calculator.

Published on To be advised

Approved for publication on behalf of the Water Services Association of Australia on TBA.

SCOPE OF CODE

Delete '2013' from the last sentence.

> The Code does not specifically address sanitary drains used in private and community title developments that are connected to a Water Agency's reticulation sewers. However, where those drains are likely to be maintained by the Water Agency or its contractor, it is recommended that the Gravity Sewerage Code be adopted as a "deemed-to-comply" solution for the sanitary drains specified in the National Construction Code Series Volume Three – Plumbing Code of Australia ~~2013~~.

APPENDICES

Delete 1st paragraph.

> Appendices are located on the WSAA website and are linked to this Code. Appendices may be updated from time to time without any change to the version numbering of this Code.

WORK HEALTH AND SAFETY (WHS) LAWS

Delete the last paragraph and replace it with the following

> For information on the operation of WHS laws in your jurisdiction, please contact your WHS regulator.
>
> SafeWork NSW
>
> Workplace Health and Safety Queensland
>
> Worksafe Victoria
>
> WorkSafe ACT

SafeWork SA

NT WorkSafe

Worksafe WA

WorkSafe Tasmania

NATIONAL STANDARD FOR CONSTRUCTION WORK

Replace the entire section with the following

In those jurisdictions that have implemented the harmonisation Work Health and Safety (WHS) laws, the adopted National Standard for Construction Work [NOHSC:1016 (2005)] was superseded by the model WHS Regulations and the Model Code of Practice: Construction Work.

This model Code of Practice has been developed to provide practical guidance to principal contractors and other persons conducting a business or undertaking who carry out construction work on how to meet the health and safety requirements under the WHS Act and Regulations applying in a jurisdiction relating to construction work.

This model Code should be read in conjunction with other codes of practice on specific hazards and control measures relevant to the construction industry including:

a) How to manage and control asbestos in the workplace
b) Managing noise and preventing hearing loss at work
c) Confined spaces
d) How to safely remove asbestos
e) Preparation of safety data sheets for hazardous chemicals
f) Labelling of workplace hazardous chemicals
g) Managing risks of hazardous chemicals in the workplace
h) Abrasive blasting
i) Spray painting and powder coating
j) Welding processes
k) First aid in the workplace
l) Managing the risk of falls at workplaces
m) Hazardous manual tasks
n) Managing the risk of falls in housing construction
o) Safe design of structures
p) Managing electrical risks in the workplace
q) Demolition work
r) Excavation work
s) Work health and safety consultation, cooperation and coordination
t) Managing the work environment and facilities
u) How to manage work health and safety risks
v) Construction work

The model Code should be read in conjunction with other codes of practice on specific hazards and control measures relevant to the construction industry.

To have legal effect in a jurisdiction, the model Code of Practice must be approved as a code of practice in that jurisdiction. To determine if this model Code of Practice has been approved as a code of practice in a particular jurisdiction, check with the relevant regulator.

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SAFE DESIGN OF STRUCTURES

Insert a new element for Safe Design of Structures as following:

Safe Design is concerned with eliminating hazards at the design stage or controlling risks to health and safety as early as possible in the planning and design of products, process or systems and items that comprise a workplace, or are used or encountered at work.

The model WHS laws, Regulations and model Codes of Practice also impose duties on a range of parties to ensure health and safety in relation to particular products, such as:

a) designers of plant,
b) buildings and structures building owners and persons with control of workplaces manufacturers,
c) importers and suppliers of plant and substances, and
d) persons who install, erect or modify plant.

These obligations will vary depending on the relevant state or territory OHS legislation.

The Australian Safety and Compensation Council (ASCC) Guidance on the Principles of Safe Design for Work has been developed to eliminate hazards at the design stage. The purpose of this document is to provide guidance and information to persons who are directly or indirectly involved with the design or modification of products, buildings, structures and processes used for work. It focuses on the key principles of safe design and sets the framework for the development of further detailed and practical guidance material. It contains 10 principles that demonstrate how to achieve good design of work and work processes. The principles are all general in nature so they can be applied to any workplace, topic or industry.

For more information on safe design refer to the Principles of Good Work Design Handbook and the model Code of Practice: Safe Design of Structures and WHS Regulations.

Part 0: Glossary, Abbreviations and References

I GLOSSARY OF TERMS

Add new a definition as follows

Designated bushfire prone area

An area that is subject to, or likely to be subject to, bushfire attack (Source - AS 3959:2018: Construction of buildings in bushfire-prone areas)

II ABBREVIATIONS

Add new abbreviation as follows

ABBREVIATION	INTERPRETATION
AEP	annual exceedance probability

III REFERENCED DOCUMENTS

Revise and update the Reference documents as follows:

AS

2187.2	Explosives - Storage, transport and use - Use of Explosives	14.4
3680	Polyethylene sleeving for ductile iron pipelines	16.10
~~3778~~	~~Measurement of water flow in open channels~~	
ISO 22301	Security and resilience - Business continuity management systems - Requirements	1.2.6.3
ISO 31000	Risk management - Guidelines	1.2.6.3, A2, A3

AS/NZS

1170.0	Structural design actions – General principles	9.4.5

ASTM

~~F1759~~	~~Standard Practice for Design of High-Density Polyethylene (HDPE) Manholes for Subsurface Applications~~	~~9.3.3~~

PIPA

~~POP015~~	~~Design Guidance for Polypropylene Structured Wall Pipes~~	~~9.3.1~~

WSAA

~~WSA 108~~	~~Fibre Reinforced Plastic Ladders~~	~~10.4.1~~
~~WSA 132~~	~~Access Covers for Water Supply and Sewerage~~	~~4.15.3, 4.15.4, 4.15.5, Table 7.4~~
~~WSA 133~~	~~Lightweight Macro-Composite Access Covers and Frames~~	~~4.15.4, Table 7.4~~

Sewer Corrosion and Odour Research (SCORe) Project
https://www.waterportal.com.au/score-kms/index.html

Clause 1.2.2
Replace the third paragraph with the following:

> System design and drawings shall set out essential inputs to be used in design, such as catchment area, flows, containment standard, annual exceedance probability (AEP) [environmental sensitivity factor], sizing, upstream controls, recommended sewer layout and particular requirements of the Water Agency.

Clause 1.2.6.3

The second paragraph, replace the reference to HB 293 with the following:

AS ISO 22301 as a guide to business continuity management.

Clause 2.5.1

Seventh paragraph, add additional sentence as follows:

The Hydrogen Sulphide Control Manual provides more detailed information on the impact and control of H_2S in the sewer system. More recent research is also available from the SCORe project.

The eighth paragraph amend as follows:

A web-based knowledge management system to make the findings of the research into corrosion and odour in sewer systems that have come from the ARC Sewer Corrosion and Odour Research (SCORe) Linkage Project (LPO882016) is readily available to the water industry.

The knowledge management system consists of:

a) *Fact sheets for each 8 individual research projects*
b) *Direct outputs from the SCORe Project including final reports, literature reviews, publications, case studies, etc.*

The SCORe knowledge management system website is currently located

https://www.waterportal.com.au/score-kms/index.html

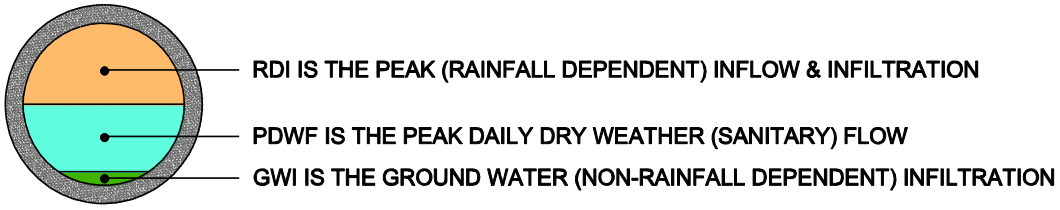
Clause 2.4.2

Delete Second paragraph and replace it with the following

Equivalent future population shall be calculated for each land use type to be developed by identifying the number of units to be developed from the categories in APPENDIX B — ESTIMATION OF EQUIVALENT POPULATION (EP) or Water Agency supplements or from the developers or local or planning authorities. For residential areas without density classifications or areas where future changes to residential zonings are anticipated, a most likely density consistent with town planning policies shall be determined. In summary:

Clause 3.2
Replace FIGURE 3.1

Figure 3.1 FLOW COMPONENTS IN A GRAVITY SYSTEM



Clause 3.3.2

Replace Second paragraph with the following:

A "traditional" approach has been to estimate the equivalent population to be serviced by the sewer and to calculate flows on the basis of an allowance per EP. APPENDIX C — FLOW ESTIMATION FOR DEVELOPMENT AREAS details a default model for estimating the design flow, primarily for undeveloped areas, albeit it may be used for developed areas for which gauged data is not available.

Clause 4.2
Replace Table 4.1 with the following:

TABLE 4.1

COLOUR IDENTIFICATION OF COMPONENTS IN RETICULATION SEWER SYSTEMS

RETICULATION SEWERS ≤DN 300			
COMPONENT		**GRAVITY SEWERS**	**PRESSURISED SEWERS[1]**
Pipe	Ductile Iron	Red external coating [2,4] with grey sleeving	Red external coating [2,4,10] with cream sleeving
	PE[11]	Grey, or black with grey stripes or cream jackets [9]	Cream, or black with cream stripes or cream jackets
	PE[13]	Black[9]	N/A
	PP[13]	Grey[9]	N/A
	PVC U [14]	Grey	N/A
	PVC M [15] PVC O [15] PVC U [15]	N/A	Cream
	VC	Natural brown	N/A
	GRP	Beige [5]	Beige [5]
Fitting	DI	Colour not required[3,4]	Colour not required [3,4]
	PE[12]	Black, grey, or black with grey stripes or grey jackets	Black, cream, or black with cream stripes or cream jackets
	PE[13]	Black[9]	N/A
	PP[13]	Grey[9]	N/A
	PVC U [14]	Grey	N/A
	PVC M [15] PVC O [15] PVC U [15]	N/A	DI fittings- Colour not required[3,4]
	VC	Natural brown	N/A
	GRP	Beige [5]	Beige [5]
Valve (spindle cap, handle)		N/A	Cream coating
Valve (body)		N/A	Colour not required [6]
Scours (outlets)		N/A	Cream coating
Marking tapes		Grey	Cream
Surface fittings and surrounds		Note 7	Note 7
Signage (marker posts, plates etc.)		Note 7	Note 7

PROPERTY CONNECTION SEWERS[8]			
COMPONENT		GRAVITY SEWERS	PRESSURISED SEWERS[1,8]
Pipe	DI	Red external coating [2,4]	Red external coating [2,4,10]
	PE[12]	Grey, or black with grey stripes or grey jackets [9]	Cream, or black with cream stripes or cream jackets
	PE[13]	Black	N/A
	PP[13]	Grey[9]	N/A
	PVC U [14]	Grey	N/A
	PVC M [15] PVC O [15] PVC U [15]	N/A	Cream
	VC	Natural brown	N/A
	GRP	Beige [5]	Beige [5]
Fittings	PE[10]	Black, grey, or black with grey stripes or grey jackets [9]	Black, cream, or black with cream stripes or cream jackets
	PE[11]	black	N/A
	PP	Grey[9]	N/A
	PVC U [14]	Grey	N/A
	PVC M [15] PVC O [15] PVC U [15]	N/A	DI fittings - Colour not required[3,4]
	VC	Natural brown	N/A
	GRP	Beige [5]	Beige [5]

1 Includes pressure and vacuum sewers and pressure (rising) mains.

2 DI pipe coatings in accordance with AS/NZS 2280. A polyurethane coating or an epoxy finishing layer coloured red for pipes with CAC cement mortar lining.

3 DI fittings shall be thermal-bonded polymeric coating in accordance with AS/NZS 4158.

4 Where PE sleeving is specified, the colour shall be cream for pressure sewerage applications or grey for non-pressure sewerage applications.

5 Depending on the resin used for specific applications, may be slightly greener.

6 Some Water Agencies may require colour differentiation to be provided.

7 To be coloured in accordance with Water Agency requirements.

8 Includes pressure laterals and property discharge lines.

9 If condition assessment using CCTV inspection is anticipated, then use grey or cream or black with cream stripes or jackets with a co-extruded internal white, light grey or yellow liner.

10 Colour coding of pipe classes

PN	Socket end Marking
20	Green
35	Red
FLCL	white

11 Polyethylene pipe manufactured to AS/NZS 4130 and the relevant WSA Product Specifications.

12 Polyethylene fittings manufactured to AS/NZS 4129 and the relevant WSA Product Specifications.

13 Polyethylene or Polypropylene pipe and fittings manufactured to AS/NZS 5065 and the relevant WSA Product Specifications.

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14 PVC-U pipes for sewer, drain waste and vent applications manufactured to AS/NZS 1260 and the relevant WSA Product Specifications.

15 PVC-M, PVC-O and PVC-U (Series 2) pipes for pressure applications manufactured AS/NZS 4765, AS/NZS 4441 and AS/NZS 1477 and the relevant WSA Product Specifications.

Clause 4.5.1

Replace the Product Specifications titles with the following

WSA PS–200 DUCTILE IRON PIPES (CIOD) FOR PRESSURE APPLICATIONS – DRINKING WATER, NON-DRINKING WATER SUPPLY AND SEWERAGE

WSA PS–201 DUCTILE IRON FITTINGS (CIOD) FOR PRESSURE AND NON-PRESSURE APPLICATIONS – DRINKING WATER, NON-DRINKING WATER SUPPLY AND SEWERAGE

WSA PS–244 DUCTILE IRON FITTINGS (CIOD) WITH RESTRAINED FLEXIBLE JOINTS FOR PRESSURE AND NON-PRESSURE APPLICATIONS – DRINKING WATER, NON-DRINKING WATER SUPPLY AND SEWERAGE

WSA PS–320 SLEEVING, POLYETHYLENE (PE) FOR DUCTILE IRON PIPES AND FITTINGS – DRINKING WATER, NON-DRINKING WATER SUPPLY AND SEWERAGE.

Clause 4.5.3

Replace the last paragraph with the following:

The type of cement mortar lining for pipes shall be detailed in the Design Drawings and/or Specification and/or Product Specifications.

Table 4.2

Replace text in Note under Table 4.2 with the following

AS/NZS 2280 requires all DI fittings are coated and lined with a thermal bonded polymeric coating in accordance with AS/NZS 4158.

Insert New Clause 4.5.5

4.5.5 Screw-on flanges for DI pipes

PE sleeving shall be specified on all bituminous coated DI pipes and fittings applied in accordance with AS 3681. Constructors shall be required to repair any damaged sleeving in accordance with the pipe and/or fitting manufacturer's instructions.

Any design incorporating a screw-on flange (Flange class DI pipe) shall ensure that the flange is fully supported in the installed condition. The Design Drawings shall include instructions for preventing loading of the flange during installation (Refer to Clause 16.18 Flanged Joints).

Screw-on flanges depend on thread sealant to maintain leak tightness. Deflection arising from structural loading of the flange during installation or operation may crack the sealant.

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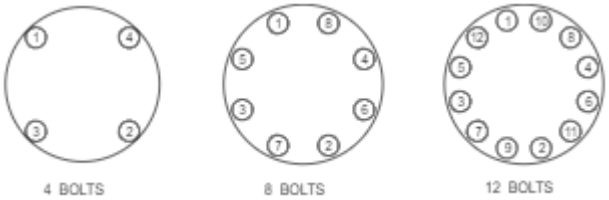
Insert New Clause 4.5.6

4.5.6 Flanged joints

Flanges shall comply with AS/NZS 4087. Select bolting in accordance with Appendix C of AS/NZS 4087. Gaskets shall comply with WSA 109. The Design Drawings shall specify the type of flange gasket and the tightening sequence (see Figure 4.1).

Figure 4.1 FLANGE FASTENER TIGHTENING SEQUENCE



Insert New Clause 4.5.7

4.5.7. Coatings

The majority of Australian Water Agencies have adopted a policy of specifying loose polyethylene sleeving (LPS) for all ductile iron pipes as a corrosion protection measure, unless specialised coatings such as polyurethane or polyethylene, for example, are employed. Properly installed LPS provides a high degree of corrosion protection by creating a passive uniform environment around the pipe and limiting oxygen exposure. LPS should be installed in accordance with AS 3681 and only accredited pipe layers trained in the application of sleeving should be utilised.

The need for LPS depends on the type of soil and the required service life of the pipeline. Ductile iron pipes may be buried without extra external protection in soils that are not aggressive. In soils that are aggressive, and where either the time or the cost of soil assessment is prohibitive, LPS is the recommended solution.

The application of zinc coatings has not historically been utilised on ductile iron pipes in Australia, although they have been used in Europe for more than 60 years. Zinc coatings are now provided in Australia as a standard offering with 200 g/m^2 thickness complete with a finishing layer and are considered to enhance the external corrosion benefits of pipe in buried applications. In some soil applications, it is considered acceptable to install zinc coated pipes without polyethylene sleeving.

Enhancements to zinc coatings are also available where 85/15 Zinc-Aluminium alloy, copper enhanced Zinc-Aluminium alloy and rare earth element enhanced Zinc-Aluminium alloys are offered with 400 g/m^2 thickness complete with a finishing layer. It is reported that these coatings provide improved corrosion protection over standard zinc coating and allows for installation in a wider range of soils, without the need for sleeving.

EN 598 nominates that DI pipes with zinc coating of 200 g/m^2 thickness and min 100μm thick finishing layer or enhanced zinc alloy coating with 400 g/m^2 thickness and min 100μm thick finishing layer can be buried without sleeving except:

For Zinc coatings

a) *soils with a resistivity less than 1500 Ω cm when laid above the water table, or less than 2500 Ω cm when laid below the water table*
b) *mixed soils i.e. comprising two or more soil natures*
c) *soils with a pH below 6 and a high reserve of acidity*
d) *soils containing refuse, cinders, slags or polluted by wastes or industrial effluents*
e) *areas where there are stray currents*

For Zinc-Aluminium or enhanced Zinc-Aluminium alloys

i. *acidic peaty soils*
ii. *soils containing refuse, cinders, slag or polluted by wastes or industrial effluents*
iii. *soils below the marine water table with a resistivity lower than 500 Ω cm,*
iv. *areas where there are stray currents*

EN 598 also advises that evidence of the long-term performance of the above-mentioned solution (e.g. tests and references) should be provided by the manufacturer.

It should be noted however that there has been no proven experience or data to support the extrapolation of European experience to Australian conditions and environments. It is considered imperative that testing be undertaken to ensure that the soil environment meets any necessary pre-conditions.

Manufacturers should be consulted for life expectancy estimates.

Clause 4.6.1

Added the following WSAA Product Specification to the

WSA PS–280 REFLUX VALVES-SEWERAGE

Clause 4.6.1

Removed Gravity from the title of WSA PS–321 as follows

WSA PS–321 MAINTENANCE SHAFTS (MS) – POLYVINYLCHLORIDE, UNPLASTICISED (PVC-U) FOR NON-PRESSURE APPLICATIONS –SEWERAGE.

Clause 4.7

Removed Gravity from the title of WSA PS–322, WSA PS–338, WSA PS–339 and added Non-Pressure to title of WSA PS-339 as follows

WSA PS–322 MAINTENANCE SHAFTS (MS) – POLYETHYLENE (PE) FOR NON-PRESSURE APPLICATIONS – SEWERAGE

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WSA PS–338 MAINTENANCE CHAMBERS (MC) – POLYETHYLENE (PE) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–339 MAINTENANCE HOLES (MH) – POLYETHYLENE (PE) FOR NON-PRESSURE APPLICATIONS – SEWERAGE.

Clause 4.8

Remove gravity from title of WSA PS–337, WSA PS–340, WSA PS–341 and added Non-Pressure to title of WSA PS-340 as follows:

WSA PS–337 MAINTENANCE CHAMBERS (MC) – POLYPROPYLENE (PP) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–340 MAINTENANCE HOLES (MH) – POLYPROPYLENE (PP) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–341 MAINTENANCE SHAFTS (MS) – POLYPROPYLENE (PP) FOR NON-PRESSURE APPLICATIONS –SEWERAGE.

Clause 4.12.5

Replace the first paragraph with the following

Flanges shall comply with AS/NZS 4087.Select bolting in accordance with Appendix C of AS/NZS 4087. Gaskets shall comply with WSA 109. The Design Drawings shall specify the class of flange, the type of flange gasket and the tightening sequence (See Figure 4.1). Gasket types should generally be designated as either full face (FF) or inside bolt circle (IBC).

Gaskets may be single flat sheet or moulded.

Clause 4.13.1

Replace the titles of the WSA PS–290 and WSA PS–291 with the following:

WSA PS–290 DUCTILE IRON ACCESS COVERS AND FRAMES FOR DRINKING WATER, NON-DRINKING WATER SUPPLY AND SEWERAGE TO AS 3996

WSA PS–291 DUCTILE IRON ACCESS COVERS AND FRAMES FOR DRINKING WATER, NON-DRINKING WATER SUPPLY AND SEWERAGE TO EN 124-2

Replace the titles of the WSA PS–314 and WSA PS–315 with the following:

WSA PS–314 STEPS FOR UNDERGROUND MAN ENTRY CHAMBERS - DRINKING WATER, NON-DRINKING WATER SUPPLY AND SEWERAGE

WSA PS–315 FIXED LADDERS FOR MAN ENTRY STRUCTURES - DRINKING WATER, NON-DRINKING WATER SUPPLY AND SEWERAGE

Added a new Product Specification

WSA PS 292 POLYMERIC ACCESS COVERS AND FRAMES FOR DRINKING WATER, NON-DRINKING WATER SUPPLY AND SEWERAGE TO AS 3996

Removed Gravity from title of WSA PS–321, WSA PS–322, WSA PS–323, WSA PS–334 WSA PS–337, WSA PS–338, WSA PS–339, WSA PS–340, WSA PS–341 and WSA PS–342 added Non-Pressure to the title of WSA PS-339 and WSA PS-339 as follows

WSA PS–321 MAINTENANCE SHAFTS (MS) POLYVINYLCHLORIDE, UNPLASTICISED (PVC-U) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–322 MAINTENANCE SHAFTS (MS) POLYETHYLENE (PE) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–323 MAINTENANCE HOLES (MH) PRE-CAST CONCRETE FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–334 VITRIFIED CLAY (VC) MAINTENANCE HOLES (MH), MAINTENANCE CHAMBERS (MC) AND MAINTENANCE SHAFTS (MS) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–337 MAINTENANCE CHAMBERS (MC) – POLYPROPYLENE (PP) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–338 MAINTENANCE CHAMBERS (MC) – POLYETHYLENE (PE) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–339 MAINTENANCE HOLES (MH) – POLYETHYLENE (PE) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–340 MAINTENANCE HOLES (MH) – POLYPROPYLENE (PP) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–341 MAINTENANCE SHAFTS (MS) – POLYPROPYLENE (PP) FOR NON-PRESSURE APPLICATIONS –SEWERAGE

WSA PS–342 MAINTENANCE HOLES (MH) - GLASS REINFORCED PLASTICS (GRP) FOR NON-PRESSURE APPLICATIONS –SEWERAGE.

Clause 4.13.2

Replaced third paragraph with the following:

MCs have a minimum internal diameter of 600 mm with or without tapering to 300 mm minimum diameter to terminate at FSL with a DN 300 access frame *and cover. MCs incorporate a moulded and channelled or spherical base. Base configurations include in-line,* bend *and junction. MCs are generally available for sewers ≤DN 375 and depths up to 6 m subject to manufacturers certifying their products meet design requirements associated with a water table to full depth.*

Replace the fourth paragraph with the following:

MSs have a minimum internal diameter of 225 mm ranging up to and including 476 mm (DN 450) with or without tapering to terminate at FSL with a sealed cap or access frame *and cover. MSs may incorporate a moulded and channelled or spherical base. Base configurations include in-line,* bend*, junction and terminating. MSs are generally available for sewers ≤DN 300 and depths up to 6 m subject to manufacturers certifying their products meet design requirements associated with a water table to full depth.*

Clause 4.14.1

Add new WSAA Product Specification as follows:

WSA PS–343 TRACER WIRE, DETECTABLE

Clause 4.15.1

Replace the titles of the WSA PS–290, WSA PS–291 and WSA PS–292 with the following

WSA PS–290 DUCTILE IRON ACCESS COVERS AND FRAMES FOR WATER SUPPLY AND SEWERAGE TO AS 3996

WSA PS–291 DUCTILE IRON ACCESS COVERS AND FRAMES FOR WATER SUPPLY AND SEWERAGE TO EN 124-2

WSA PS–292 POLYMERIC ACCESS COVERS AND FRAMES FOR WATER SUPPLY AND SEWERAGE TO AS 3996

Delete Product Specifications WSA PS–293, WSA PS–294

Clause 4.15.3

Delete text (including heading) of Clause 4.15.3 and replace it with the following:

4.15.3 Cast ductile iron access covers and frames

Cast ductile iron access covers and frames conforming to European Standard EN 124-2 together with the additional requirements specified in WSA PS–291 (which includes water and gas tightness), are deemed functionally comparable to those conforming to WSA PS–290 (which is based on AS 3996 but with additional

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requirements). There are significant differences in the cover load classifications between EN 124 and AS 3996 and their equivalence is detailed in WSA PS–291.

Covers and frames are manufactured from ductile cast iron for manual handling (lighter weight) and ductile behaviour (as opposed to brittle behaviour).

> ***Note*** *In-situ structural infill covers are required to meet all the requirements of AS 3996 prior to application of the infill.*

Covers may be solid-top or an infill design.

Bolt-down covers are also used to mitigate flow relief in environmentally sensitive areas and to increase security of sewers from unauthorised access.

Clause 4.15.4

Delete text (including heading) of Clause 4.15.4 and replace it with the following:

The term "Polymeric" replaces the terms "Macro-composite", "Thermoplastic" and "Composite" that were previously used. Polymeric materials are defined in AS 3996 as materials that have a structural polymeric component. Such materials comprise both thermoplastic (e.g. polyethylene, polypropylene, etc.) and thermosetting materials (e.g. epoxy, polyester, etc.), as well as composite materials that contain a polymeric component, such as fibre reinforced plastic (FRP), sheet moulding (SMC) and bulk moulding compounds (BMC) that can contain any reinforcing material (e.g. glass, or plastic fibres).

Polymeric covers are deemed to be functionally the same as cast iron covers. They are typically of lower weight than cast iron covers. This can improve WHS outcomes during cover installation and removal.

Polymeric lightweight covers can currently be economically manufactured for Class B applications.

AS 3996 does not consider fire resistance of polymeric access covers and frames. Polymeric access covers and frames shall not be used in a designated bush fire prone areas.

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Delete text (including heading) of Clause 4.15.5 and replace it with the following:

4.15.5 Not Used

Clause 5.5.5.1

Replace the second paragraph with the following:

> The maximum number of tenements is based on the methodology of the Flow Estimation for Development Areas (Appendix C – FLOW ESTIMATION FOR DEVELOPMENT AREAS)

Clause 5.5.5.1

Table 5.6, in the table header, column 2, Replace $I_{1,2}$ with $I_{1,39.35\%}$

Delete Note 2 and replace Notes 1 under Table 5.6 with the following:

1. For the latest 1 h rainfall intensity at the location, or an Annual Exceedance Probability of 39.35% $I_{1,39.35\%}$ refer to the Bureau of Meteorology at http://www.bom.gov.au/water/designRainfalls/revised-ifd/. Coordinates for particular locations for use in the Bureau of Meteorology's site may be found at http://www.ga.gov.au/placename.

Insert new second last paragraph as follows: (Note the Link to the Sewer Pipe Sizing Calculator has been updated.

> For design assumptions, other than those specified in 5.5.5.2 Design assumptions, refer to Sewer Pipe Sizing Calculator

Last Paragraph replace $I_{1,2}$ with $I_{1,39.35\%}$

Clause 5.5.5.2

Replace the first paragraph and default design assumptions with the following:

> *The default design assumptions tabulated below, together with the 1 hour rainfall intensity at the location, for an average recurrence interval of annual exceedance probability of 39.35%, $I_{1,39.35\%}$ are considered to be reasonably conservative.*

k	*1.50*	*mm*	*Colebrook-White roughness coefficient*
d/D	*1.00*		*A proportional depth ratio of 1.0 provides for pipe full condition at design flow. The air space at PDWF provides sewer ventilation*
EP/ET	*3.50*		*Design ratio of equivalent persons per . Refer to APPENDIX B — ESTIMATION OF EQUIVALENT POPULATION (EP)*
ADWF	*180*	*L/d/EP*	*Refer to APPENDIX C — FLOW ESTIMATION FOR DEVELOPMENT AREAS*
Median lot area	*500*	*m^2*	

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Net/Gross lot area	*70%*		*Refer to APPENDIX B — ESTIMATION OF EQUIVALENT POPULATION (EP)*
Sewer below water table	*70%*	$Portion_{Wet}$	*Refer to APPENDIX C — FLOW ESTIMATION FOR DEVELOPMENT AREAS*
Soil aspect	*0.80*	S_{aspect}	Refer to APPENDIX C — FLOW ESTIMATION FOR DEVELOPMENT AREAS ($0.2 \leq S_{aspect} \leq 0.8$)
Network defects aspect	*0.50*	N_{aspect}	Refer to APPENDIX C — FLOW ESTIMATION FOR DEVELOPMENT AREAS ($0.2 \leq N_{aspect} \leq 0.8$)
Leakage severity, C	*1.30*	$S_{aspect} + N_{aspect}$	APPENDIX C — FLOW ESTIMATION FOR DEVELOPMENT AREAS
AEP	*18.13%*		*The design flow containment standard AEP specified by the Water Agency*

Clause 5.5.8

Insert new Note under second paragraph

> *For further background information about the impact of flow on sulfide generation from biofilms please see the SCORe Project, Sub Project 8 report).*

Clause 7.9.1

Replace Item (b) 3rd paragraph with the following

(b) along waterways subject to flooding where the cover level is below the 1% AEP[1];

Insert the following Note under the list

> (1) A 100 year 1% AEP storm generally refers to an event which has annual exceedance probability of 1%, being the probability of a storm event occurring once in 100 years.

Insert new 2nd last sentence

In designated bush fire prone areas polymeric access covers or frames shall not be used.

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Clause 7.9.1 Table 7.5

Replace Table 7.5 with the following:

Area	Location[5]	Class of cover to AS 3996[1,2,3,4] Sewer DN			Class of cover EN 124-2[1,2,3,4] Sewer DN			Height of MH cover above FSL, mm		
		100 - 225	300 - 600	≥675	100 - 225	300-600	≥675	New sub-divisions	Existing built-up areas	Undeveloped areas
Residential	Private lots	B	D	D	B	C,D	C,D	75	25	100
	Private lots – areas subject to vehicular loading e.g. driveways, parking areas etc	B	D	D	B	C,D	C,D	Flush	Flush	
	Verges & footways	B	D	D	B	C,D	C,D	Flush	Flush	
	Road carriageways	D	D	D	C,D	C,D	C,D	Flush	Flush	
Industrial & commercial	Private lots	D	D	D	C,D	C,D	C,D	75	75	
	Private lots – areas subject to vehicular loading e.g. driveways, parking areas etc	D	D	D	C,D	C,D	C,D	Flush	Flush	
	Verges & footways	D	D	D	C,D	C,D	C,D	Flush	Flush	
	Road carriageways	D	D	D	C,D	C,D	C,D	Flush	Flush	
Public reserves	Reserves in general	B	D	D	B	C,D	C,D	75	75	
	Footpaths & driveways	D	D	D	C,D	C,D	C,D	Flush	Flush	
	Inaccessible public areas	D	D	D	C,D	C,D	C,D	75	25	
Areas subject to flooding	Areas adjacent to waterways	D	D	D	C,D	C,D	C,D	150 mm above the 18.13% AEP flood level	150 mm above the 18.13% AEP flood level	150 mm above the 18.13% AEP flood level
	Coastal areas subject to tidal inundation and storm surges	D	D	D	C,D	C,D	C,D	150 mm above the max predicted level	150 mm above the max predicted level	150 mm above the max predicted flood lev

Clause 7.9.1 Table 7.5

Replace Item (1) in the Notes under Table 7.5 with the following:

1. Access covers and grates shall be designed by Classes B, D, E and F according to load capacity set out in AS 3996 or Classes B,C,D and F according to load capacity set out in EN 124 including variations specified in relevant WSAA Product Specifications.
2. Individual Water Agencies are responsible for determining the acceptability of cover products and the applicability of cover assembly specifications, in accordance with Water Agency asset requirements for particular cover applications.
3. Designers shall assess anticipated live and dead loads imposed on access covers in particular locations prior to cover selection.
4. Designers shall specify watertight and/or gastight covers where necessary in consultation with the Water Agency.
5. AS 3996 does not consider fire resistance. Polymeric access covers and frames shall not be used in designated bush fire prone areas.

Clause 8.4.2

Insert new second paragraph

The SCORe project also undertook research on ventilation and developed an equation to help design forced ventilation.

Clause 8.8.1

Replace second paragraph with

Most flow devices require minimum flows of greater than 5 L/sec in order to register meaningful results within acceptable error tolerances (Refer to APPENDIX C – FLOW ESTIMATION FOR DEVELOPMENT AREAS.)

Clause 9.3.1

Delete (iii)

(iii) POP015 Design Guidance for Polypropylene Structured Wall Pipes.

Clause 9.4.2.

Added date to Standards designation when referencing Table 3.2 as follows:

Table 3.2 of AS/NZS 2566.1:1998.

Clause 9.4.5

Replace Item (v) 3rd paragraph with the following

(vii) the groundwater level shall be assumed to be at the FSL, unless information is available that a lower groundwater level exists, in which case the groundwater level with an AEP of 1% shall be used and the buoyant upthrust force factored by 1.5.

Clause 9.5.1

Corrected the date of Standards designation from 2002 to 1998 as follows.

Refer to Appendix I of AS/NZS 2566.1:1998.

Clause 14.4

Amended designation of AS 2187 to AS 2187.2 Appendix A as follows:

Where approval is granted, prepare a blasting plan that includes management of the blasting and means to be used to satisfy the requirements of AS 2187.2 Appendix A and the approving parties.

Clause 16.17.3

Replace first paragraph with the following:

Make connections to PVC/ABS/DI/steel pipelines using PE flange adaptors and backing rings with AS/NZS 4087 Figure B2 mating dimensions.

Clause 17.2.6

Replace with the following:

Protect concrete MH's as required in Clause 7.6.2. Coat MHs in accordance with the manufacturer's instructions and as specified in accordance with WSA 201 Manual for the Selection and Application of Protective Coating Systems.

Where protection is required, all exposed concrete surfaces (walls, tapers and the underside of converter slab) except for the benching and flow channel shall be protected. The cover and frame does not require protection.

Clause 21.4.2 Table 21.3

Replace Table 21.3 with the following Table.

TABLE 21.3

PRESSURE AND VACUUM AIR TESTING
ACCEPTANCE TIMES FOR 7 KPA PRESSURE CHANGE

Pipe size DN	Test length m					
	50	100	150	200	250	300
	Minimum test duration minutes					
100	2	2	2	2	3	3
150	3	3	3	5	6	7
225	4	5	8	10	13	15
300	6	9	14	18	23	28
375	7	14	22	29	36	43
450	10	21	31	41	52	62
525	14	28	42	56	70	84
600	18	37	55	73	92	110
675	23	46	70	93	116	139
750	29	57	86	115	143	172
900	41	83	124	165	207	248
1000	51	102	153	204	255	306
1050	56	112	169	225	281	337
1200	73	147	220	294	367	441
1500	115	230	344	459	574	689

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NOTES:

1. Timing of the test duration to commence after the 3 minutes initial period
2. Test duration times for other combinations of pipe size and test length to be interpolated.

Clause 21.6.3

Replace the first paragraph with the following:

Test all flexible gravity sewers ≤DN 300 except where single size granular embedment (Type 3 of Figure 9.4) has been used or where a pre-qualified embedment compaction method was used in accordance with 19.3.2 Compaction trials / Pre-qualification of embedment compaction method.

Clause 21.6.4.1

Replace Table 21.6 with the following

TABLE 21.6

MAXIMUM ALLOWABLE SHORT-TERM PIPE DEFLECTIONS

Pipe material	Maximum allowable short term vertical pipe deflection %					
	3 d*	7 d*	14 d	30 d	3 months	1 yr
Plastics						
ABS, PE, PP, PVC	3.8	4.3	4.8	5.0	5.5	6
GRP	3.1	3.5	3.9	4.1	4.5	4.9
Metallic						
Ductile iron	2.4	2.7	3.0	3.2	3.5	3.8
Steel Welded joint with:						
—No cement mortar lining	3.0	3.4	3.8	4.0	4.4	4.8
—Cement mortar lining	2.4	2.7	3.0	3.2	3.5	3.8
Elastometric joint	2.4	2.7	3.0	3.2	3.5	3.8

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Appendix C

Amended Title of Appendix C to APPENDIX C FLOW ESTIMATE FOR DEVELOPMENT AREAS and replace with the following:

APPENDIX C FLOW ESTIMATION FOR DEVELOPMENT AREAS

C1 GENERAL

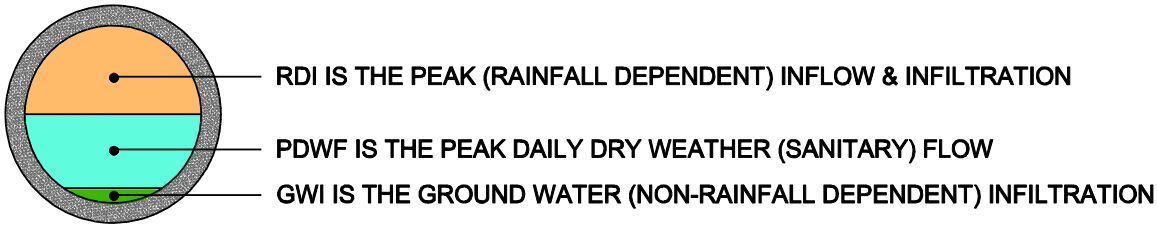
The use of this Appendix requires Water Agency approval.

Design flow estimates are required for designing pipe networks and input to pump station designs. Design flow is the peak flow to be contained within the sewer system.

Design flow is the sum of the three components of flow, illustrated in Figure C.1 (reproduced below).

Design flow = PDWF + GWI + RDI

FIGURE C.1 FLOW COMPONENTS IN A GRAVITY SYSTEM



NOTES

1. *Components are indicative only and will differ due to location, rainfall, strata, pipe material and jointing methods and other factors.*
2. *The component shown as RDI is also the air space / ventilation allowance during dry weather flows.*

C2 PEAK DRY WEATHER (SANITARY) FLOW

The Peak Dry Weather Flow (PDWF) is defined as the most likely peak sanitary flow in the pipe during a normal day. It exhibits a regular pattern of usage with morning and evening peaks related to water usage for toilets, showers, baths, washing and other household activities.

Peak dry weather flow is related to the average dry weather flow (AWDF) by a "peaking factor", d:

PDWF = d * ADWF

where:

ADWF is the combined average daily sanitary flow into a sewer from domestic, commercial and industrial sources. Based on empirical evidence, ADWF is deemed to be 180 L/d/EP or 0.0021 L/s/EP.

The dry weather peaking factor, d, is a function of the EP and gross development area in hectares. Values of d are given in Figures C.1 and C.2.

The average dry weather flow in (L/s) is:

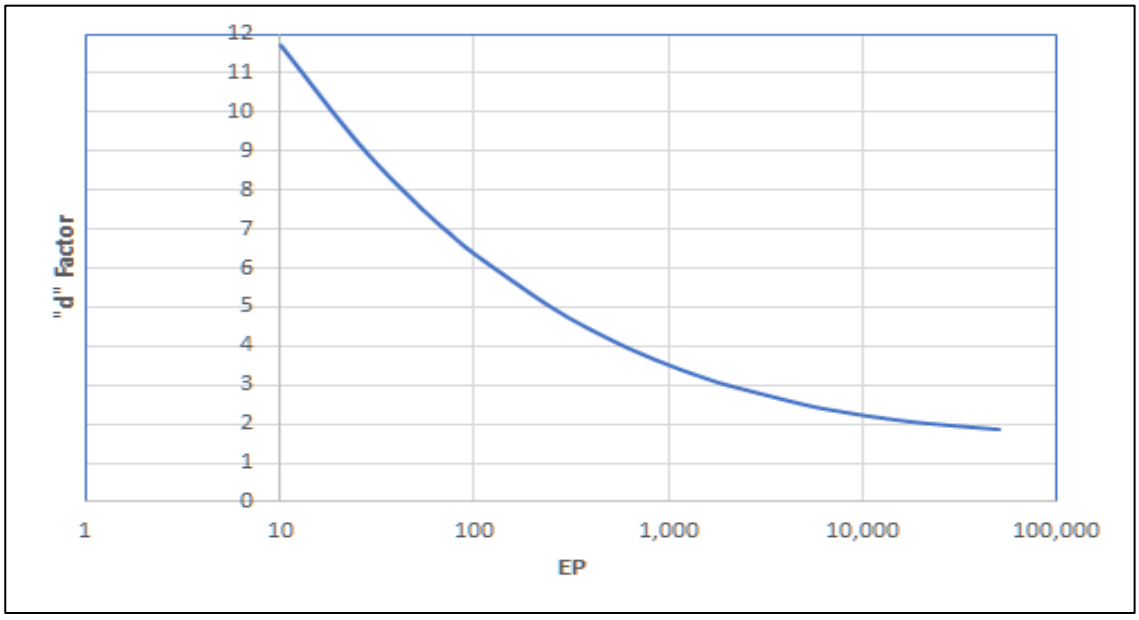
ADWF = 0.0021 * EP

Where:

***EP** is based on combined residential, commercial and industrial equivalent populations and is known or otherwise calculated in accordance with **APPENDIX B ESTIMATION OF EQUIVALENT POPULATION (EP)**.*

PDWF = d * 0.0021 * EP

FIGURE C.2 "d" FACTOR VERSUS EP – EP <50000

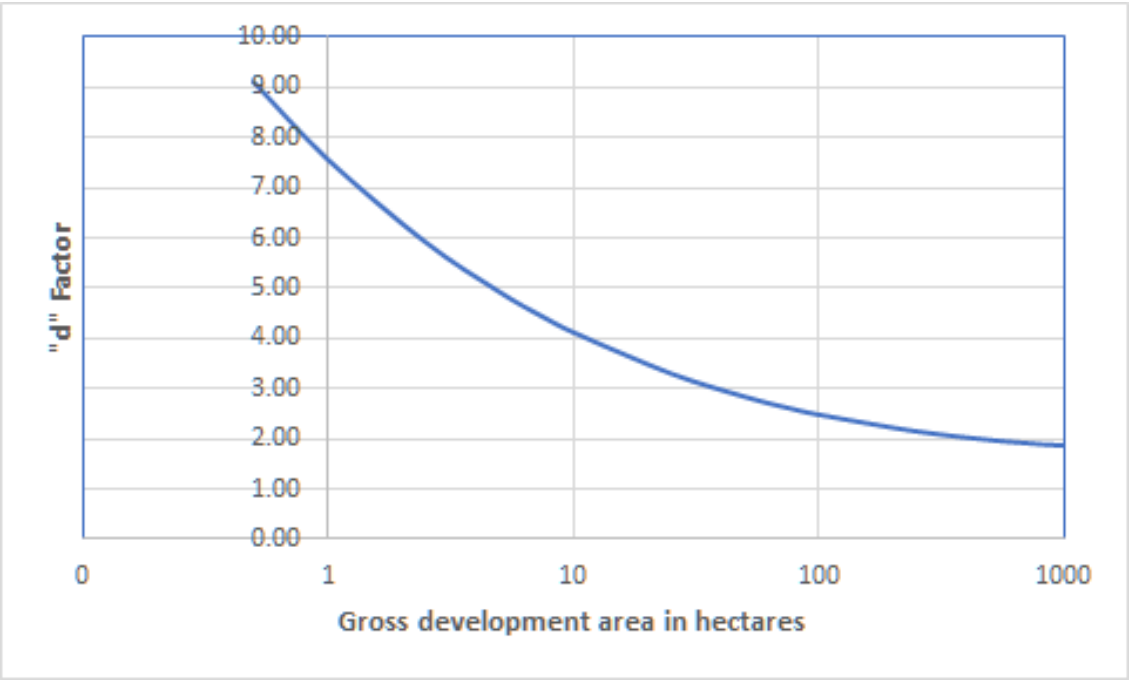


The curve in Figure C.2 may be approximated by the following correlation and applied up to an equivalent population of 50,000.

$d = 0.01(\log_{10} EP)^4 – 0.259(\log_{10} EP)^3 + 2.56(\log_{10} EP)^2 – 11.37\log_{10} EP + 20.78$

Alternatively:

FIGURE C.3 "d" FACTOR VERSUS AREA – AERA <1000 Ha



For land development with 70% of the gross development area containing single occupancy lots at a gross development density of 15 lots/Ha and having 3.5 EP/lot, the curve in Figure C.3 may be approximated by the following correlation and applied up to gross development areas of 1000 hectares.

$d = 0.01(\log_{10} A)^4 – 0.19(\log_{10} A)^3 + 1.4(\log_{10} A)^2 – 4.66\log_{10} A + 7.57$

where:

A *is gross plan area of the development's catchment, in hectares*

C3 GWI CALCULATION

Groundwater infiltration (GWI) is caused where the long-term non-rainfall dependent groundwater table or seawater level exceeds pipe inverts and enters the sewer network through pipe wall permeation and defects such as cracks, porosity, corroded and/or eroded areas, ineffective and/or tree root penetrated joints at pipes, fittings and maintenance structures and their displacement.

Where a map of groundwater table levels is not available, areas with fine clays and sandstones should be classified as high groundwater table portions of the catchment, or as otherwise advised by the responsible local agency or technical specialist.

The allowance for GWI assumes that good quality materials and workmanship have been used for sewer system construction and that ongoing condition assessment, inspection and maintenance is performed. The allowance for GWI should be taken to be:

$GWI = 0.025 * A * Portion_{Wet}$

where:

GWI *is groundwater ingress in L/s.*

A *is gross plan area of the development's catchment, in hectares.*

$\boldsymbol{Portion_{Wet}}$ *is the portion of the planned pipe network estimated to have groundwater table levels in excess of pipe inverts. For example, if 70% of the sewer system is below groundwater table levels, then* $Portion_{Wet} = 0.7$

C4 RDI CALCULATION

RDI is the peak (rainfall dependent) inflow and infiltration that may enter the sewer network as inflow via localised flooding of yard gully traps, illegal stormwater connections and as rainfall infiltration through pipe and maintenance structure defects. RDI is affected by factors such as soil type, the condition of pipes, fittings, joints (including customer sanitary drains), maintenance structures, surface covers and community awareness and attitudes regarding the impact of sanitary drains and illegal stormwater connections. Control of RDI requires the Water Agency to deploy programmed monitoring, condition assessment, inspection, testing and maintenance of the sewer network and to cultivate community awareness to improve the level of compliance of customer sanitary drains.

RDI is calculated in L/s by using a model similar to the National "Rational Method" for stormwater flow calculation using the formula:

$RDI = 0.028 * A_{Eff} * C * I$

where:

A_{Eff} *is the effective area capable of contributing rainfall dependent infiltration. Calculation of* A_{Eff} *depends on the type e.g. residential or industrial, gross planned area and density i.e. EP per hectare of development.*

For residential developments:

A_{Eff} *is a function of the development density, as follows:*

A_{Eff} ***= A x (Density/150)$^{0.5}$*** *for Density <150 EP/Ha*

A_{Eff} = *A* *for Density >150 EP/Ha*

where:

A *is gross plan area of the development's catchment, in hectares.*

Density *is the development's EP density per gross hectare.*

For commercial and industrial developments:

A_{Eff} *is a function of the expected portion of the catchment to be covered with impervious structures, such as building roofs, sealed roads and car parks, which will discharge rain-runoff to stormwater drains.*

$A_{Eff} = A \times (1 - 0.75\ Portion_{Impervious})$

where:

A *is gross plan area of the development's catchment, in hectares.*

$Portion_{Impervious}$ *is the portion of the gross plan area likely to be covered by impervious structures that drain directly to the stormwater system e.g. if a development has 20% coverage by such structures, then* $Portion_{Impervious}$ *= 0.2.*

C *is the IIF leakage severity coefficient (similar to the stormwater "run-off coefficient"). It defines the contribution of rainfall run-off to sewer flows via IIF. C comprises the sum of the contributions from a "soil movement" aspect e.g. highest contribution for expansive clays and a "defects aspect" including the effectiveness of the Water Agency's long-term strategy for maintenance and managing the impact of sanitary sewers. With reference to Table C1, C will lie in the range from 0.4 to 1.6.*

The Water Agency should nominate values of C to be adopted for design, taking account of the likely impact of factors outlined above.

TABLE C.1

LEAKAGE SEVERITY COEFFICIENT (C)

Influencing aspect	Low impact	High impact
Soil aspect, S_{aspect}	0.2	0.8
Network defects and inflow aspect, N_{aspect}	0.2	0.8
$C = S_{aspect} + N_{aspect}$	Minimum = 0.4	Maximum = 1.6

I *is a function of rainfall intensity at the development's geographic location, catchment area size and required sewer system containment standard. These influencing factors are related by:*

$I = I_{1,39.35\%} \times Factor_{Size} \times Factor_{Containment}$

where:

$I_{1,39.35\%}$ is the 1 hour duration rainfall intensity at the location, for an annual exceedance probability (AEP) of 39.35%, which corresponds to an average recurrence interval of 2 years.

Rainfall intensities for particular locations may be determined from the Bureau of Meteorology at http://www.bom.gov.au/water/designRainfalls/revised-ifd/.

Coordinates for particular locations for use in the Bureau of Meteorology's site may be found at http://www.ga.gov.au/placename.

> *The new IFDs have been released for use with ARR2016.*
>
> *Access to the ARR87 IFDs through the Bureau of Meteorology's website ceased in June 2019.*

Approximate values for a selection of Australian cities are presented in Table C.2

The Water Agency should nominate values of $I_{1,39.35\%}$ to be used.

TABLE C.2

APPROXIMATE VALUES OF $I_{(1,39.35\%)}$ FOR VARIOUS LOCATIONS

City		***Approx. Value of $I_{(1,39.35\%)}$***
Adelaide		16.5
Alice Springs		20.9
Ballarat		19.1
Brisbane		47.0
Broome		46.7
Cairns		59.5
Canberra		21.4
Darwin		60.2
Dubbo		25.9
Geelong		17.4
Gold Coast		50.6
Gosford		37.3
Hobart		13.9
Melbourne		18.4
Newcastle		34.5
Perth		20.5
Port Headland		35.3
Sydney		40.5
Whyalla		14.5

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Factor$_{Size}$ *accounts for the fact that II flow concentration times are faster for smaller catchments, calculated as:*

$$Factor_{Size} = (40/A)^{0.12}$$

where:

A *is gross plan area of the development's catchment, in hectares.*

Factor$_{Containment}$ *reflects local environmental aspects and regulations on wet weather sewage containment (overflow frequency). The design should incorporate the AEP of sewage overflows, specified by the Water Agency. Given the specified AEP, Factor$_{Containment}$ may be either taken from Table C.3, or calculated from:*

$$Factor_{Containment} = 0.77 \times \frac{10^{0.43X}}{10^{0.14X^2}}$$

where:

$$X = \mathrm{Log}_{10}\left(\frac{1}{-\mathrm{Ln}(1-\mathrm{AEP})}\right)$$

and AEP is the specified containment annual exceedance probability (decimal).

$$\mathrm{AEP} = 1 - \frac{1}{e^{\frac{1}{\mathrm{ARI}}}}$$

or

$$\mathrm{ARI} = \frac{1}{-\mathrm{Ln}(1-\mathrm{AEP})}$$

TABLE C.3

CONTAINMENT FACTOR VERSUS AEP

AEP	100%	98.17%	86.47%	63.21%	39.35%	18.13%	9.52%
(ARI)	(1 month)	(3 months)	(6 months)	(1 year)	(2 years)	(5 years)	(10 years)
$Factor_{Containment}$	0.2	0.4	0.6	0.8	1.0	1.3	1.5

C5 WORKED EXAMPLE FOR A RESIDENTIAL DEVELOPMENT

C5.1 Description

A low density development on a greenfields site with gross area of 50 hectares and an average lot size of 500 m^2 is proposed for North Adelaide.

C5.2 Peak dry weather flow (PDWF)

From Table B.1, the EP per gross hectare for 500 m^2 single occupancy lots is 50.

Calculate the design EP: = 50 x 50 (Ha) = 2500 EP

Estimate design ADWF: = 0.0021 x EP = 0.0021 x 2500 = 5.25 L/s

Determine the "d" factor: From the formula under Figure C.1, d has been calculated = 2.85

Determine PDWF: = d x ADWF = 2.85 x 5.25 = 15.0 L/s

C5.3 Ground water infiltration (GWI)

It is known that the local "perennial" groundwater table levels are such that half of the proposed sewer routes will be subject to high groundwater table levels. The GWI flow allowance is then calculated as:

$GWI = 0.025 \times A \times Portion_{Wet}$

For $Portion_{Wet} = 0.5$, $GWI = 0.025 \times 50 \times 0.5 = 0.625$, say 0.6 L/s

C5.4 Rainwater dependent inflow and infiltration (RDI)

RDI calculation is as noted in C4:

$RDI = 0.028 \times C \times I \times A_{Eff}$

To determine C:

Sandy loam soils (low soil movement and good drainage) are prevalent in the route of the sewer. Assuming that the Water Agency has a program to reduce illegal stormwater connections and has a reasonable condition assessment, inspection and maintenance program in place, with reference to *Table C.1*, a "C" value of 0.6 is adopted i.e. assume $S_{aspect} = 0.2$ and $N_{aspect} = 0.4$)

To determine $I_{1,39.35\%}$):

Determining North Adelaide's co-ordinates from http://www.ga.gov.au/placename to be Lat. -34.9°, Long. 138.6° enables the 1 hour rainfall intensity to be determined as 14.3 for 50% AEP and 20.4 for 20% AEP from http://www.bom.gov.au/water/designRainfalls/revised-ifd/. The 1 hour duration rainfall intensity ($I_{1,39.35\%}$) at the location, for an AEP of 39.35% is then calculated to be 16.5.

To determine $Factor_{Size}$:

$= (40/A)^{0.12} = (40/50)^{0.12} = 0.97$

To determine $Factor_{Containment}$:

Regional environmental regulations for sewage spill frequency permit a 39.35% AEP containment standard. Using *Table C.3* this gives $Factor_{Containment} = 1.0$.

To determine I:

$I = I_{1,39.35\%} \times Factor_{Size} \times Factor_{Containment} = 16.5 \times 0.97 \times 1.00 = 16$

To Determine A_{Eff}:

$A_{Eff} = A \times (Density / 150)^{0.5}$

$A_{Eff} = 50 \times (50 / 150)^{0.5} = 28.9$ Ha

To Determine RDI:

$RDI = 0.028 \times C \times I \times A_{Eff} = 0.028 \times 0.6 \times 16 \times 28.9 = 7.8$ L/s

C5.5 Design flow

Design flow calculation is as follows:

Design flow = PDWF + GWI + RDI = 14.9 + 0.6 + 7.8 = 23.3 L/s, which, for this example, is equivalent to 1.5*PDWF.

Note: For a given development, the ratio of Design flow:PDWF may significantly vary with variables such as C, $I_{1,39.35\%}$ and $Factor_{Containment}$.

APPENDIX D PROTECTION AGAINST DEGRADATION

D2

Amend 1st paragraph as follows.

Septic sewage gives rise to production of hydrogen sulphide (H2S) which, through turbulence, is released from the sewage flow as hydrogen sulphide gas. H2S may be further converted into sulphuric acid on walls of the sewer by thiobactillus bacteria, leading to attack of cementitious and metallic products. For means of controlling the production of hydrogen sulphide (through ventilation, reduction of turbulence, chemical oxidation, etc.) refer to WSAA publication 'Hydrogen Sulphide Control Manual' Volumes 1 and 2 and the material from the SCORe project.

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APPENDIX E GUIDELINES FOR VENTILATION OF RETICULATION SEWERS

E1

Delete the following from the first paragraph last sentence.

> or Section 4 of AS/NZS 3500.5 as appropriate.

Insert the following after the seventh paragraph

> *The SCORe project also undertook research on ventilation and developed an equation to help design forced ventilation.*

APPENDIX I

Clause I3

Replace the fifth paragraph with the following

Where CLSM embedment is used, the trench width may be reduced by:

75 mm for DN 150 to < DN 300

100 mm for DN 300 to DN 450

150 mm for > DN 450 to DN 900

175 mm for > DN 900 to DN 1500

Clause I6

Delete Note 9 from the following list

The following notes apply to Tables I1 to I8 inclusive:

1. The embedment modulus is derived from Table 3.2 of AS/NZS 2566.1 with reference to WSA 02 Table 21.2.
2. Applicable to plain wall (solid and sandwich) excluding profile wall pipes.
3. Minimum trench widths are derived from Figure 3.1 of AS/NZS 2566.1 or Table 4.2 of AS/NZS 2566.2.
4. Trench width to be measured at the spring line.
5. A Support Type 3 or 4 as shown in Figures 9.4 and 9.5.
6. Pipeline vertical deflects ≥ 5%.
7. Buckling factor of safety of 2.5.
8. Assuming AUSTROADs W7 and T44 highway loadings.
9. For Tables I3 and I4 Polypropylene PP-E material is based on Table 2.1 in AS/NZS 2566.1.
10. For Tables I5 and I6 DN is based on Australian sized outside diameter, not ISO sized outside diameter.

Table I5

Changes 2nd Colum heading to Pipe Stiffness N/m.m and remove SN in front of values

Table I6

Changed 2nd Colum heading to Pipe Stiffness N/m.m and remove SN in front of values

Table I7

Changed the Colum Heading 2 from Pipe SN to Pipe SDR

Table I 8

Changed the Colum Heading 2 from Pipe SN to Pipe SDR

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Appendix J

J2

1st paragraph, last sentence delete "*document*." and replace with "*Appendix*"

Insert new 2nd Paragraph.

> *Talus material consists of a mixture of soils and rock fragments, which range in size from pebble to large boulder, and often forms steep slopes as a result of the collapse of cliffs. The presence of talus usually indicates a potentially unstable environment, where a number of factors including construction activity could trigger ground movement.*

Insert New Figure heading for Figure J1 titled "Example of Typical Talus Slopes"

Deleted 2nd paragraph and replace with the following:

> *Talus is typically associated with areas that contain interbedded sequences of resistant sandstone and less resistant shales and siltstones, which leads to differential weathering, undercutting, cliff retreat and collapse, with the formation of potentially unstable talus. A typical "talus" slope is shown in Figure J.1*

Amended the 3rd Paragraph as follows:

> *Other potentially unstable areas in the Sydney and Hunter Region lie within colluvial landscapes associated with the clayey soils of the weathered rocks. Colluvium (which includes talus) is generally defined as unconsolidated soil and rock material moved*

largely by gravity (i.e. mass movement), deposited on a lower slope and/or at the base of a slope. Soil creep, earthflow, slumping and tension cracking occur in these areas.

J3

3rd paragraph Replace

The Office of Environment and Heritage (OEH) website (www.environment.nsw.gov.au) lists a series of published Soil Landscape maps available at a scale of 1:100,000 and 1:250,000.

with

*The NSW Governme*nt on its Natural *Resources website (www.environment.nsw.gov.au) lists a series of published Soil Landscape maps available at a scale of 1:100,000 and 1:250,000.*

4th paragraph replace

Geotechnical input to the design of a gravity sewer or sewer rising main system shall be obtained for development in the following Soil Landscape areas (as defined by OEH), and to any area where, for any reason, ground stability is considered suspect.

with

Geotechnical input to the design of gravity sewer pipelines or sewer pressure mains shall be obtained for development in any area where, for any reason, ground stability is considered suspect.

Delete table in J.3 IDENTIFICATION OF POTENTIALLY UNSTABLE AREAS

J4

Create new H3 for J4.1.1 Gravity Sewers

2nd paragraph, 2nd sentence

Amend Figure J.1 to Figure J.2

Create new H3 for J4.1.2 and changed Rising Mains to Pressure Mains

1st, 2nd and 3rd paragraphs

Replaced rising mains with pressure mains

3rd paragraph, 1st sentence

Amend Figure J.2 to Figure J.3

Figure J.3 Notes

Note 3

Replace ‘this figure’ with Figure J.3

Note 4

Delete (see Layout sketch)

Note 6,7 and 8

Delete text and replace with not used.

J4.3

2nd paragraph

Amend (see photographs below) to (Refer to Figure J.4)

J4.5

1st Paragraph

Added labels and titles to existing figures (Figures J.5 and J.6)

Appendix L

Changed the Heading to SPECIFICATION FOR INTERNAL INSPECTION OF NEWLY CONSTRUCTED SEWERS AND CRITERIA FOR ACCEPTANCE

L1

Amended first paragraph as follows:

> This Specification provides guidance for the internal inspection and reporting requirements for newly constructed rigid and flexible sewers and maintenance structures to enable acceptance by the Water Agency.

Inserted new second, third and fourth paragraph as follows:

> It is not intended to override specifications for acceptance of new assets issued by water agencies, councils or other organisations. In the absence of such specifications, it provides a resource that can be applied by the owner of the new assets before acceptance.
>
> This guide is not applicable for acceptance inspection of rehabilitated conduits or maintenance structures. It is applicable to conduits/pipes that have been lined during manufacture e.g. plastiline.
>
> This guide should be applied in conjunction with design, specifications and construction drawings for the assets being inspected and the relevant codes and standards for those

assets as well as other acceptance testing techniques such as low pressure air testing, vacuum testing, backfill compaction testing etc.

Amend Note as follows

All new sewer conduits warrant inspection and assessment of structural and operational integrity before the intended owner accepts the responsibility for these assets.

L3

Changed the Heading as follows:

QUALIFICATIONS OF INSPECTORS AND ACCEPTANCE ASSESSORS

First paragraph amended as follows

Inspectors shall hold a Statement of Attainment in Unit NWPNET016 – Inspect sewer or stormwater line, (or equivalent credential) awarded by a Registered Training Organisation is required for all CCTV operators.

Insert new second paragraph

In addition, operators shall also hold appropriate credentials and recognised qualifications in:

Insert new last paragraph

Different technologies and software are available for deformation measurement by laser profiling and there is currently no recognised training for operators of this service. As such, those contractors seeking to provide laser profiling of new assets must demonstrate to the owner's satisfaction that they have undergone training in the use of the laser profiler and are competent in its use.

L 4

First paragraph. Last sentence

Change reference to WSA 05:2012-3.1 to WSA 05:2020-4.1

New second paragraph

Inspection should confirm the size, material and class of sewer where this can be determined. In addition, any variations to the design should be drawn to the attention of the asset owner for their determination of acceptance.

L 5

Delete all and replace with the following

The summary report shall be prepared by the Consultant/Project Manager/Acceptance Assessor, with the purpose of providing an overview of all features or defects identified in the internal inspection that do not meet the criteria

defined in the Tables J2 – J4 for sewers or Tables J5 – J7 for stormwater conduits (refer to J14 ACCEPTANCE PARAMETERS for tables).

The summary report shall be provided in PDF format with a filename of the following convention:

Project File Number_Internal_Inspection_Summary_Report.pdf

e.g. 13PD1234_Internal_Inspection_Summary_Report.pdf

The summary report shall be included on the submitted digital media of project conduit inspections and also submitted with other applicable documentation.

Where previous acceptance inspections in the project have resulted in rework or rectification of defects this shall be noted in the final inspection report of that asset length and in the summary report.

Information to be included in the summary report shall be as shown in the format below, which is best presented in landscape format.

FIGURE J.1 Summary Report Template (blue text is example only)

CCTV Acceptance Inspection Summary Report

Project Description: Riverview Estate Stage 4

Project File Number: 13PD1234

Project Consultant: Smith Group

Acceptance Assessor: Pipe View

Construction Contractor: John Constructions

Dates of inspections: 26-27 August 2018

Defect ID	Inspection Report Section No.	Inspection Video Ref	Photo Ref	Construction Date	Design Line No.	DN	Material	Start Node	End Node	Distance	Defect/ Feature Code	Description and Quantifications	Threshold Quantification	Acceptance Determination	Comments
1	1	1_26082018_13PD1234	10_1_26082018_13PD1234	July 2017	1	375	PVC	CMP1-2	CMP1-3	3.86	JDR	Joint displaced radially, 15-20mm	> 10 mm	Not acceptable	Repair coupling used to join pipe
2	1	1_26082018_13PD1234	15_1_26082018_13PD1234	July 2017	1	375	PVC	CMP1-2	CMP1-3	42.55	DV	Deformation 10%	> 6% @ 12 months	Not acceptable	Confirmed by laser profile
3	2	2_26082018_13PD1234	5_2_26082018_13PD1234	July 2017	1	300	PVC	CMP1-3	CMP1-4	9.19	DJSN	Seal visibly displaced		Not acceptable	Pinched ring

L 6

Replace with the following

L.6 ACCEPTANCE INSPECTION REPORTS

The CCTV contractor shall produce inspection reports for each sewer in the project in accordance with the reporting format specified in this code. The following fields shall be completed accurately:

a. Project File Number;
b. Project name;

c. Code version being applied;
d. CCTV contractor's name and operator's name;
e. Date and time of inspection;
f. Suburb and closest street;
g. Section description;
h. Names of upstream and downstream nodes (maintenance structures or other features specified in the design);
i. Depth to inverts of maintenance structures;
j. Direction of inspection (upstream or downstream);
k. Longitudinal reference point;
l. Purpose of inspection (new construction);
m. Use of sewer ;
n. Type of sewer ;
o. Conduit shape, diameter and material; and
p. Each observation, with its code and position set out in sequential order in the direction of the CCTV inspection.

In addition, the following information shall be recorded and incorporated into the inspection report:

i. Photographs of each defect or feature considered to have failed acceptance criteria;
ii. Photographs of any internal markings that identify the size, class, material, origin etc; and
iii. Video clips of any feature or defect that cannot be adequately shown with a still photograph.

.

The preliminary grading of the structural and service condition of the sewer , as set out in this code, is not intended to be used for the purpose of acceptance of new assets and is not required to be included in the assessment reports

A separate file shall be provided for each sewer line inspected, in PDF format, with a filename of the following convention:

Project File Number_YYYYMMDD_HHMM_Section number_Start Node_End Node.pdf

e.g. 13PD1234_20180828_1430_Section02_CMP1-2_CMP1-3.pdf

For those agencies and contractors using Wincan software it is recommended that Wincan Viewer be used to package digital inspection reports and video record. This provides a format that is very user friendly and allows access to all inspection reports and videos and other information on one platform. The ultimate asset owner may specify that all digital data is provided in Wincan Viewer format.

All results and reports from the CCTV inspection are to be submitted to the Asset Owner in digital form on single or multiple DVDs (as necessary), or a portable hard drive. The digital media shall be accompanied with a transmittal form outlining their contents as follows:

(A) Project File Number;
(B) Project Name;
(C) Consultant's name;
(D) Construction Contractor's name;
(E) Acceptance Assessor's name;
(F) Date or period of CCTV inspection(s);
(G) Line or part line numbers included in the data package; and
(H) Line or part line numbers in the project that are not included in the data package.

Delete Table L.1, L.2 and L.3

L7

Change L6 to L7 Materials

Add additional sentences to the end of the second paragraph

However, it is critical that the operator/acceptance assessor considers all the indicators of sewer pipeline material and class such as internal markings, characteristic features and pipe unit length in identifying the sewer pipeline material. Any variation of sewer material and or class from the design shall be noted on the acceptance report.

Add new clause ,L 8,L 9,L 10,L 11 and L 12

L8 STEEL REINFORCED CONCRETE PIPE

Steel reinforced concrete pipe presents some difficulties in determining the acceptability of cracking in new assets

In essence the permitted cracking will depend on:

a) crack width;

b) pattern of cracking;

c) size of asset;

d) cover to the reinforcement; and

e) operational conditions – conveying sewage, low pH water from acid sulphate soil catchments, in a marine environment or rainwater.

Surface cracks <0.15 mm are not generally classified as defects. Where there is doubt, the existence of such cracking should be reported for assessment by the asset owner or engaging agency.

Various agencies, such as the Concrete Pipe Association of Australia, concrete pipe manufacturer Humes Pipeline Systems, Standards Australia, Brisbane City Council, ACT Government - Territory and Municipal Services and others have provided guidelines on cracking acceptability relating to

the criteria above. Reference to those guidelines may be helpful in ensuring that the new asset will give the optimum service life for the conditions under which the asset will operate.

The values given in this appendix are indicative of the cracking thresholds for acceptance advised in those resources.

L 9 DEFORMATION OF FLEXIBLE SEWERS

Deformation measurement provides a valuable method of detecting that the specified embedment placement and compaction for flexible sewer has been correctly or poorly implemented. Deformation measurement using lasers should be conducted in accordance with Clause 1.10 Laser Profiling of Conduits, WSA 05:2020-4.1.

Deformation measurement may be undertaken using:

a) *Physical measurement in large diameter sewer;*

b) *Laser measurement technologies; and*

c) *An ovality proving tool.*

This code does not advocate proving tools which may damage the sewer if not correctly sized.

To ensure a valid measure of deformation do not conduct measurement/inspection until at least 14 days after completion of placement and compaction of trench and embankment fill material.

Refer to Table 21.6 for the limiting deformation thresholds for acceptance or sewers pipes.

L 10 LATERAL INSPECTION

This specification is also applicable to the acceptance inspection of laterals (property connection sewers) from junctions or connections where that is part of the new asset to be taken over. Inspection may be effected using push rod camera from a property access point or from the main sewer using satellite inspection technology.

However, some defects requiring measurement may not be able to be quantified accurately.

L 11 INSPECTION AT THE END OF DEFECTS LIABILITY PERIOD

It is recommended that final visual and deformation inspections of new assets are undertaken at the end of the defects liability period to ensure that latent conditions, not affecting the conduit immediately after construction, have not contributed to defects that would be unacceptable. Such inspections will also detect any damage from the installation of other utilities and enable repairs to be undertaken.

L 12 MANUFACTURING DEFECTS

Some new conduits may exhibit manufacturing and/or handling defects. Use an appropriate code to report the defect(s) where possible and add in remarks 'Possible Manufacturing Defect'. If a defect code does not appear to describe the observed defect record details using code GC (refer to 2.7.9.3 General comment—GC).

L 13 RISK ASSESSMENT AND RECTIFICATION

The final decision to accept a new asset lies with the ultimate asset owner. Reports based on this specification will provide significant data and evidence on which the asset owner can make

decisions regarding the life of the new asset, potential operational performance issues as well as the risks associated with premature structural or operational failure.

Rectification of defects needs to take into account many factors:

a) Can the defect/s be repaired without compromising the service life of the asset?

b) Does the repair introduce an acceptable loss of operational performance?

c) What are the consequences and likelihood of failure associated with accepting a defect or repairing?

d) Was there a problem in the design in regard to pipe class, soil type, embedment selection etc?

e) Was there a problem with installation that may manifest in other defects at a later date?

Any section of new asset that is repaired, re-laid or rehabilitated must also be inspected again with a supplementary report submitted.

L 14 ACCEPTANCE PARAMETERS

The configuration of elements in a new sewer is usually defined in design drawings, standard drawings and specifications. Compliance with some of these requirements may be determined by inspection.

The inspector/operator and acceptance assessor shall have a copy of design drawings, standard drawings and specifications applicable to the works being inspected for reference in determining the acceptance of nominated and other features.

The following tables describe nominated features that are to be reported to the engaging agency.

TABLE L.2 ACCEPTANCE PARAMETERS FOR RIGID SEWERS – VITRIFIED CLAY, STEEL REINFORCED CONCRETE

Defect	Ch1	Ch2	Q1/2	Remarks
Cracking (Vitrified Clay)	L, C, S, M			Not acceptable - all of these cracking patterns are generally indicative of poor handling, unsatisfactory installation and or overloading. Any cracking is likely to lead to crack propagation and ultimate failure. In identifying cracking it is critical that occasional minor manufacturing irregularities or superficial marks are not reported as cracking.
Cracking (Concrete)	C, S, M		>0.5 mm	Not acceptable – these cracking patterns are likely to be associated with mishandling or poor installation. Water Agency should review all cracking and crack dimensions. In identifying cracking it is critical that occasional minor manufacturing irregularities such as cracking of limited extent or superficial marks are not reported as cracking.
Cracking (Concrete)	L (most commonly appearing at 12 o'clock and 6 o'clock, and smaller possibly insignificant cracking at 3 o'clock and 9 o'clock)		>0.5 mm	Not acceptable – this cracking pattern may be associated with proof loading, overloading, poor installation or inadequate pipe class. Water agency should review all cracking and crack dimensions. In identifying cracking it is critical that occasional minor manufacturing irregularities such as cracking of limited extent or superficial marks are not reported as cracking.

Defect	Ch1	Ch2	Q1/2	Remarks
Breaking	D, M, E			Not acceptable
Deformation	V, H, M			Not acceptable
Collapsed				Not acceptable
Porous conduit				Not acceptable
Surface damage concrete	S		Significant spalling >20 mm loss fabric	Not acceptable – asset owner to review for determination based on reinforcement cover and wall thickness of asset.
	AP, AM, RC, CP, H, JR			Not acceptable – unlikely to be observed in new construction
	RV, RVP, RS, and evidence of reinforcement close to the surface (shadowing)			Not acceptable – cover to reinforcement is clearly less than specified in the relevant standard. Indicative of a manufacturing defect, damage or evident in spalling. Note: Reinforcement that is close to the surface but covered by a thin layer of concrete, sometimes referred to as shadowing where the circumferential and longitudinal reinforcement is clearly visible just under the surface, is generally not reportable using the defect codes. This feature should be reported using the General Comment code with the remark of 'possible manufacturing defect'.
	Z			Refer to asset owner for determination
Surface damage other	S		Significant spalling >20 mm loss of fabric	Not acceptable – asset owner to review for determination based on wall thickness of asset
	H			Not acceptable
	Z			Refer to asset owner for determination
Lining defective (plastic lined concrete pipes only)	B, BU, H, WD			Not acceptable
	Z			Identify defect, report in remarks for asset owner's determination
Deposits on wall or invert	E, S, R, C, W, Z			Not acceptable – can disguise defects and should not occur in a new sewer. Asset owner to consider need for cleaning and reinspection
	W, Z			Not acceptable – identify material and report in remarks
Exfiltration	J, D			Not acceptable
Infiltration	S, D, R, G			Not acceptable
Ingress of soil	S, F, G, Z			Not acceptable
Roots	T, F, M, RT, RF, RB			Not acceptable
Joint displacement	L		>15 mm	Refer to asset owner for determination based on pipe and joint seal characteristics
	R		>5 mm for pipe sizes ≤DN 250 >10 mm for pipe sizes >DN 250 to ≤DN 500 >20 mm for pipe sizes >DN 500	Not acceptable – for some pipe systems with separate collars incorporating two rubber seals, such as Hepworth Superseal, achieving these tolerances may be difficult. For those pipe systems the integrity of the seal may be sound despite apparent radial displacements exceeding the given acceptance thresholds.

Defect	Ch1	Ch2	Q1/2	Remarks
	A			Angular deflection cannot be readily measured by the operator. It can be estimated by the assessor if the camera operator sets the camera in a position to view consecutive joints from a straight ahead camera view and then the offset measured at the furthest joint. Applying some trigonometry allows an approximate angle to be calculated. (For pipe unit lengths greater than 2 metres this technique may not be applicable.) Alternatively the maximum gap at the joint Q2 >30 mm may be used. The capacity of the pipe joint to facilitate angular deflection should be determined by the asset owner and applied to acceptance criteria.
Defective joint seal	R	N, HH, HL, B		Not acceptable
	Z			Report and refer to asset owner for determination
Point repair	H, I, IS, L, R, RE, S			Identify all repairs observed and refer to asset owner for determination. (Some techniques may not be acceptable in new sewers.)
	Z			Identify repair technique, report in remarks. Refer to asset owner.
Point repair (defects)		B, D, G, P		Not acceptable – determine extent of 'bellies' and refer to asset owner for determination
		Z		Identify defect and refer to asset owner for determination
Obstruction	B, C, I, J, M, P, S			Not acceptable
	Z			Not acceptable – identify obstruction and refer to asset owner
Water level	F	C, T		Should not occur in new sewer but may be operational or indicates failure in part of the system. Investigate and refer to asset owner.
	P	C, T	>5%	Not acceptable – report on extent of ponding due to vertical misalignment (sag) in line
Defective junction	B, D, JC, JD, P, SE, SR			Not acceptable if lateral is part of new construction and the responsibility of the asset owner. Otherwise refer to asset owner to determine.
	Z			As above
Connection				Should not occur in new sewer. Report unexpected or poorly constructed connections in remarks and refer to the Water Agency for acceptance determination.
Intruding connection				As above
Lifting hole	M, B	U, S		Not acceptable – lifting holes, plugged or otherwise are not acceptable in sewerage pipes

TABLE L.3 ACCEPTANCE PARAMETERS FOR FLEXIBLE SEWER PIPES – PLASTICS (PVC, PE, PP, GRP), DUCTILE IRON AND STEEL

Defect	Ch1	Ch2	Q1/2	Remarks
Cracking	L, C, S, M		Any value	Not acceptable
Breaking	D, M, E			Not acceptable
Deformation	V			Refer to Table J1 for acceptance parameters for different materials

Defect	Ch1	Ch2	Q1/2	Remarks
	H, M			As above – in addition, investigate and report on the likely cause for the deformation in other than vertical direction
Deformation Local or point deformation	V, H, M			Not acceptable - an unusual but not uncommon feature mostly occurring in plastics pipes. Usually associated with poor backfill control with rocks or other objects deposited adjacent to the pipe. The deformations appear some time after backfill and increases with time.
Collapsed				Not acceptable
Porous conduit				Not acceptable – not likely to be a feature of these pipes
Surface damage other	H, MD, S, T			Not acceptable – not likely defects in new flexible pipe but any surface damage defect identified should be referred to the asset owner for determination
	Z			Identify defect, report in remarks for asset owner's determination
Lining defective	H, E, M, RM, RMCP, B			Not acceptable – one or more of the defects could be associated with cement mortar lined ductile iron or steel pipes; polyethylene, thermal bonded polymeric, fusion bonded epoxy or other internal coating of ductile iron and steel pipes; or defects of internal corrosion barrier in GRP pipes
	Z			Identify defect, report in remarks for asset owner's determination
Deposits on wall or in invert	E, S, R, C, W, Z			Not acceptable – can disguise defects and should not occur in new sewer. Asset owner to consider need for cleaning and reinspection.
Exfiltration	J, D			Not acceptable
Infiltration	S, D, R, G			Not acceptable
Ingress of soil	S, F, G, Z			Not acceptable
Roots	T, F, M, RT, RF, RB			Not acceptable
Joint displacement	L		>15 mm	Refer to asset owner for determination based on pipe and joint seal characteristics
	R		>5 mm for pipe sizes ≤DN 250 >10 mm for pipe sizes >DN 250 to ≤DN 500 >20 mm for pipe sizes >DN 500	Not acceptable – the pipe types described as flexible do not have jointing systems that would permit any significant radial displacements. Any radial displacement would most likely be associated with a joint effected with a repair coupling.
	A			Angular deflection cannot be readily measured by the operator. It can be estimated by the assessor if the camera operator sets the camera in a position to view consecutive joints from a straight ahead camera view and then the offset measured at the furthest joint. Applying some trigonometry allows an approximate angle to be calculated. (For pipe unit lengths greater than 2 metres this technique may not be applicable.) Alternatively the maximum gap at the joint Q2 >30 mm may be used. Most joint types in plastics pipes have limited capacity for angular deflection. Any angular deflection of these pipes should be identified and referred to the asset owner for acceptance determination. The capacity of the pipe joint to facilitate angular deflection should be determined by the asset owner and applied to acceptance criteria.
Defective joint seal	R	N, HH, HL, B		Not acceptable
	Z			Report and refer to asset owner for determination

Defect	Ch1	Ch2	Q1/2	Remarks
Point repair	H, I, IS, L, R, RE, S			Identify all repairs observed and refer to asset owner for determination. (Some techniques may not be acceptable in new sewers.)
	Z			Identify repair technique and report in remarks. Refer to asset owner.
Point repair (defects)		B, D, G, P		Not acceptable – determine extent of line deviation and refer to asset owner for determination
		Z		Identify defect and refer to asset owner for determination
Obstruction	B, C, I, J, M, P, S			Not acceptable
	Z			Not acceptable – identify obstruction and refer to asset owner
Flow (water) level	F	C, T		Should not occur in new sewer but may be operational or indicates failure in part of the system. Investigate and refer to asset owner.
	P	C, T	>5%	Not acceptable – report on extent of ponding due to vertical misalignment (sag) in line
Defective junction	B, D, JC, JD, P, SE, SR			Not acceptable if lateral is part of new construction and the responsibility of the asset owner. Otherwise refer to asset owner to determine action.
	Z			As above
Connection				Should not occur in a new sewer. Report unexpected or poorly constructed connections in remarks and refer to the Water Agency for acceptance determination.
Intruding connection				As above

L4 ACCEPTANCE CRITERIA - CONFIGURATION OF PIPEWORK AND FITTINGS – ALL SEWERS

Feature	Description	Remarks
Rocker pipes	These are shorter pipes than the normal unit pipe length and are required, by some Water Agencies, adjacent to structures such as maintenance holes, other structures and concrete encasement. The purpose is to allow for differential settlement between the structure and the pipeline without cracking or distortion of the pipe adjacent to the structure.	The required length of rocker pipe and the configuration of pipes at the structure are specified in design drawings, standard drawings and or specifications for particular pipe materials. The inspector should record the distance at each joint adjacent to the structure to determine the length of the rocker pipe and report it in remarks.
Bends (line deviations) LR, LL, LU, LD or compound bends	Bends occur in some sewers at changes of direction and or grade. In some cases compound bends (vertical and horizontal) may be encountered. Long radius bends in polyethylene may extend for several metres and accommodate significant changes in horizontal direction and level. In small diameters up to DN 225 bends are likely to be moulded or post-formed long radius. For DN 225 it is likely that bends will be fabricated in a 'lobster back' with a series of mitre cuts and the pipes joined with epoxy, hot air welding or some other technique.	The distance at the start and finish of bends shall be recorded in the inspection report along with a description of the form of the bend i.e. lobster back, moulded.
JDA continuous	Long radius curves in sewers may be constructed by successive angular deflections at joints (within the tolerance of the joint). Such a requirement will be clearly indicated in design drawings with possibly the offset required for each pipe to align with the designed curve.	Report the start and finish of continuous angular deflections.
Junction	A junction is a prefabricated fitting installed as part of the original construction or post construction by inserting the junction fitting in the pipeline.	All junctions for direct customer connection should be provided with a PVC plain wall solvent weld socket with screwed cap or for VC, a plugged VC to PVC plain wall

Feature	Description	Remarks
	Junctions are provided to allow customers to connect house drains directly to the sewer or allow a property connection sewer to be extended to the customer's property. Acceptable configurations of junctions with associated fittings should be specified by the Water Agency.	adaptor. Inspect each junction lateral and report compliance with regard to configuration of fittings in accordance specifications and standard drawings.
Maintenance shafts and chambers	Provide access to the sewer for maintenance equipment but not person entry. May have an integral bend or may have an adjoining (generally upstream) long radius bend. Can have up to three inlets.	Report if the inspection equipment and/or transportation unit cannot traverse through the maintenance shaft. The transition to maintenance shaft from bend or straight line must not exceed the angular deflection for the joint system used. Record joint deflection if observable.
Orientation of concrete pipes	Steel reinforced concrete pipes DN 600 and above typically have 'elliptical' circumferential reinforcement to resist vertical loads. These pipes have a designated top which is stamped on the inside of the pipe.	The location of the 'TOP' mark is to be checked on each pipe unit. Where the 'TOP' mark is not within 100 of vertical, report 'Not acceptable' and refer to asset owner.

The configuration of elements in new stormwater drainage assets is usually defined in design drawings, standard drawings and specifications. Compliance with some of these requirements may be determined by inspection

The inspector/operator and acceptance assessor shall have a copy of design drawings, standard drawings and specifications applicable to the works being inspected for reference in determining the acceptance of nominated and other features.

The following tables describe nominated features that are to be reported to the asset owner/engaging agency.

ISBN TBA

Explanatory Note - Minimum Air Space

Changes to Figure 3.1 and Figure C1 Appendix C of WSA 02:2014 Gravity Sewerage Code Version 3.2

Environmental Regulations may nominate a sewage spill containment standard. For example, in Victoria, the State Environment Protection Policy (Waters) requires a water corporation responsible for sewerage management to, inter alia, ensure that sewerage infrastructure is designed and maintained to contain flows associated with at least an 18.1% Annual Exceedance Probability (AEP), which corresponds to an average recurrence interval (ARI) of 5 years.
The Gravity Sewerage Code of Australia WSA 02:2014Version 3.1, defines the Design Flow as the estimated maximum flow into a sewer comprising the sum of peak dry weather flow (PDWF), ground water infiltration (GWI) and peak rainfall dependent inflow and infiltration (RDI).

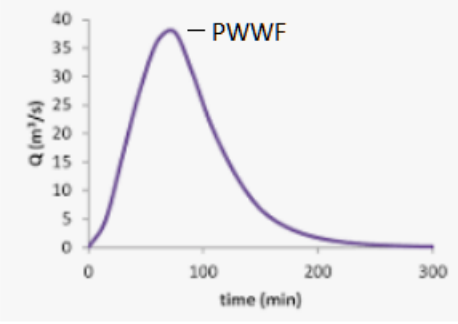
The Code does not define peak wet weather flow (PWWF), however the design flow, as defined, coincides with the PWWF.

The Code states:

> 5.5.3 Minimum air space
> *Containment is satisfied if pipe is full at design flow. There will be a gap at PDWF. The magnitude of gap at PDWF is dependent on the allowance for GWI and RDI. Note that provision for growth should be specified at the planning stage, to enable provision within the design flow.*
> At PDWF the depth of flow shall not be more than 60% of the pipe internal diameter, i.e. minimum air space equivalent to 40% of the pipe internal diameter at PDWF.

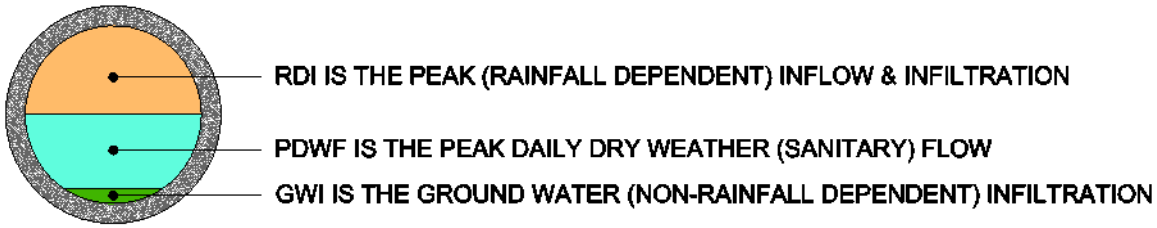
Note the first paragraph is in informative text for which it is noted and emphasized in Part 0 of the Code, that the exact approach taken to all aspects of a particular sewerage or reticulation project is the decision of the Water Agency and its authorised Planners, Designers and Constructors.

The minimum air gap at PDWF was considered to adequately meet the ventilation requirements of a reticulation sewer. The pipe full condition coinciding with the PWWF was considered to be of low duration, being the instantaneous duration of the design peak of the inflow hydrograph.



With the provision for growth included in the design flow, there is no necessity to provide for additional capacity above PWWF.

The depiction of the flow constituents as shown below correctly shows no air gap at design flow (PWWF), being pipe full condition.



The component shown as RDI is also the air space / ventilation allowance during dry weather flows .

ISBN TBA