

AS/NZS 3500.2:2021
(Incorporating Amendment No. 1)



Australian/New Zealand Standard™

Plumbing and drainage

Part 2: Sanitary plumbing and drainage



AS/NZS 3500.2:2021

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- Association of Hydraulic Services Consultants Australia
- Australian Building Codes Board
- Australian Industry Group
- Australian Stainless Steel Development Association
- Backflow Prevention Association of Australia
- Engineers Australia
- Hydraulic Consultants Association Australasia
- International Copper Association Australia
- Master Plumbers Australia and New Zealand
- Master Plumbers, Gasfitters and Drainlayers New Zealand
- Ministry of Business, Innovation and Employment (NZ)
- Plastics Industry Pipe Association of Australia
- Plastics New Zealand
- Plumbers, Gasfitters and Drainlayers Board (NZ)
- Plumbing Distributors Association of New Zealand
- Plumbing Products Industry Group
- The Institute of Plumbing Australia
- Water New Zealand
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Plumbing and drainage

Part 2: Sanitary plumbing and drainage

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Preface

This Standard was prepared by the joint Standards Australia/Standards New Zealand Committee WS-014, Plumbing and Drainage, to supersede AS/NZS 3500.2:2018.

[A1] This Standard incorporates Amendment No. 1 (October 2021). The start and end of changes introduced by the Amendment are indicated in the text by tags including the amendment number 1. **[A1]**

The objective of this document is to provide installers with deemed to satisfy solutions for compliance with —

- (a) the National Construction Code (NCC) Volume Three, Plumbing Code of Australia (PCA); and
- (b) the New Zealand Building Code (NZBC), Clause G13 Foul Water.

A list of all parts in the AS/NZS 3500 series for plumbing and drainage can be found in the Standards Australia and Standards New Zealand online catalogues.

The major changes in this revision are as follows:

- (i) Conformance to individual product standards has been removed. All products used in plumbing and drainage systems in Australia need to comply with the PCA and, in New Zealand, the NZBC, see [Appendix A](#) for further information. Removal of specific product standard conformance requirements avoids inconsistencies and contradictions between this document and the PCA and NZBC.
- (ii) Definitions have been relocated to AS/NZS 3500.0 for consistency across the series.
- (iii) The range of materials that can be used for wet wells has been expanded to encompass prefabricated wells.
- (iv) Changes to the requirements for the marking of pipes in commercial buildings to assist in the better identification of pipework and avoid cross connections.
- (v) Changes to the connection requirements for drains at grade.
- (vi) The requirement for a commercial dishwashing machine drainage just to connect to a disconnector gully with a 10 m discharge pipe has been removed. This allows the more effective arrangement of commercial kitchens.
- (vii) An appendix has been added providing guidance on the requirements of AS 2870 for flexible connections to be installed in plastics pipe drainage systems. It covers flexible connections, lagging and water ingress under the slab to accommodate a range of differential soil movement for Soil Classes M, M-D, H1, H1-D, H2, H2-D, E and E-D.
- (viii) Changes to the number of pressure attenuators required to allow more flexible installation options.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

Notes or footnotes to tables or figures that are expressed in mandatory terms are deemed to be requirements of this document.

Notes to clauses in this document are informative only and do not include requirements.

This document includes commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by "C" preceding the clause number and is printed in italics in a box. The commentary is for information and guidance and does not form part of the document.

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Contents

Preface	ii
Section 1 Scope and general	1
1.1 Scope	1
1.2 Application	1
1.2.1 Australia	1
1.2.2 New Zealand	1
1.3 Normative references	1
1.4 Terms and definitions	2
1.5 Plastics abbreviations	2
1.6 Measurement of pipe length	2
1.7 Pipe grades	3
1.8 Equivalent pipe sizes	3
Section 2 Materials and products	4
2.1 Scope of section	4
2.2 General	4
2.3 Pipes and fittings — General limitations	4
2.4 Metallic pipes and fittings	4
2.4.1 Sanitary plumbing and drainage systems	4
2.4.2 Limitations	5
2.4.3 Fabricated metallic pipes and fittings	5
2.5 Plastics pipes and fittings	6
2.5.1 Sanitary plumbing and drainage systems	6
2.5.2 Limitations	6
2.6 Pipes and fittings — Other materials	6
2.6.1 Sanitary plumbing and drainage systems	6
2.6.2 Limitations	6
2.6.3 Pipes and fittings for pressure applications	7
2.7 Sheet materials	7
2.7.1 Copper	7
2.7.2 Stainless steel	7
2.8 Joints	7
2.8.1 Flanged joints	7
2.8.2 Elastomeric seals	8
2.8.3 Silver brazing alloy	8
2.8.4 Filler rods for stainless steel joints	8
2.8.5 Solvent cement and priming fluid	8
2.9 Miscellaneous	8
2.9.1 Concrete mix	8
2.9.2 Cement mortar	9
2.9.3 Water for concrete and mortar	9
2.9.4 Timber	9
2.9.5 Epoxy resins	9
2.9.6 Pipe bedding	9
2.9.7 Backfill	9
2.9.8 External protective coatings	9
2.9.9 Fibreglass-reinforced plastics tanks	10
Section 3 Drainage design	11
3.1 Scope of section	11
3.2 Location of drains	11
3.3 Size and length of drains	11
3.3.1 Fixture unit loading	11
3.3.2 Main drain	12
3.3.3 Branch drains	12
3.3.4 Limitations on vented DN 80 branch drains	12

3.3.5	Use of eccentric taper fitting.....	12
3.3.6	Size change.....	12
3.3.7	Downstream of boundary trap.....	12
3.3.8	Oversizing of drains.....	12
3.3.9	Maximum length of fixture discharge pipes.....	13
3.4	Grades of drains.....	13
3.4.1	Minimum grade.....	13
3.4.2	Reduced grades.....	13
3.4.3	Steep grades.....	14
3.4.4	Anchor blocks.....	14
3.5	Laying of drains.....	14
3.5.1	General.....	14
3.5.2	Easements and watercourses.....	15
3.6	Proximity to other services.....	15
3.6.1	General.....	15
3.6.2	Above-ground services.....	15
3.6.3	Separation from underground electrical supply cables or consumer gas pipes.....	15
3.6.4	Separation from underground electrical earthing electrode.....	16
3.6.5	Separation from underground communication cable.....	16
3.6.6	Separation from other underground services.....	16
3.6.7	Crossover of underground services.....	17
3.6.8	Clearance from underground obstructions.....	17
3.7	Depth of cover for buried pipes.....	17
3.7.1	General.....	17
3.7.2	Depth of cover.....	17
3.7.3	Drains installed with less than minimum cover.....	17
3.7.4	Drains under buildings.....	18
3.8	Building over drains.....	18
3.8.1	Alterations and additions to buildings.....	18
3.8.2	Installation near and under buildings.....	18
3.8.3	Fixture connections to vitrified clay drains under buildings.....	19
3.9	Venting of drains.....	19
3.9.1	General.....	19
3.9.2	Location.....	20
3.9.3	Size of drainage vents.....	20
3.10	Unvented branch drains.....	22
3.10.1	General.....	22
3.10.2	Sizing.....	23
3.10.3	Maximum length.....	23
3.10.4	Vertical sections.....	24
3.10.5	Connection of fixture discharge pipes.....	24
3.11	Unvented drains discharging to gullies.....	25
3.11.1	General.....	25
3.11.2	Length of unvented section.....	25
3.12	Inlet pipe to disconnector gully.....	25
3.13	Restriction on connections in proximity to a stack.....	25
3.14	Connection of basement fixtures.....	25
3.15	Connections in flood-prone areas.....	25
3.15.1	Inlet above flood level.....	25
3.15.2	Inlet below flood level.....	25
3.16	Re-use of existing sanitary drains.....	26
3.16.1	Re-use where buildings are demolished or removed.....	26
3.16.2	Re-use in existing buildings.....	26
3.16.3	Renovation techniques.....	26
3.17	Dump points.....	27
3.17.1	Soil waste dump points.....	27
3.17.2	Connection points for short-term sites.....	29
3.18	Drains connected to network utility operator vacuum sewerage systems.....	30

3.19	Common effluent drainage system	31
3.19.1	General	31
3.19.2	Drainage connections	31
3.19.3	Septic tanks	36
3.19.4	Sullage tanks	36
3.20	On-site wastewater treatment units	36
Section 4	Drainage system	37
4.1	Scope of section	37
4.2	Point of connection	37
4.2.1	General	37
4.2.2	Tidal or water-charged locations	37
4.3	Drains	37
4.3.1	Below ground	37
4.3.2	Above ground under buildings	38
4.3.3	Changes of direction	38
4.3.4	Maximum length of fixture discharge pipes	38
4.4	Inspection shafts and boundary traps	38
4.4.1	General	38
4.4.2	Inspection shafts and boundary trap risers	39
4.4.3	Installation of inspection shafts	40
4.4.4	Installation of boundary traps	40
4.5	Reflux valves	41
4.5.1	Location	41
4.5.2	Installation	41
4.5.3	Surcharging sewer	41
4.5.4	Reflux valve chambers	41
4.6	Gullies	41
4.6.1	General	41
4.6.2	Installation	42
4.6.3	Maintenance of water seal	42
4.6.4	Soil fixtures	42
4.6.5	Disconnecter gullies inside buildings	43
4.6.6	Overflow relief gullies	43
4.6.7	Floor waste gullies	46
4.6.8	Charging floor waste gullies	51
4.7	Inspection openings	53
4.7.1	Location	53
4.7.2	Size	54
4.7.3	Types	54
4.7.4	Access to inspection openings	55
4.7.5	Sealing	55
4.8	Inspection chambers	55
4.8.1	General	55
4.8.2	Size	55
4.8.3	Construction	55
4.8.4	Differential settlement	58
4.9	Junctions in drains	59
4.9.1	Drains installed at grade	59
4.9.2	Junctions installed in vertical plane	60
4.9.3	Square junctions	60
4.9.4	Junctions for stacks connected to below-ground drainage	61
4.10	Jump-ups	61
4.11	Disconnection and sealing	62
4.11.1	Disconnection from the sewer	62
4.11.2	Sealing	62
Section 5	Excavation bedding support and backfilling	63
5.1	Scope of section	63

5.2	Excavation of trenches	63
5.2.1	Trench dimensions	63
5.2.2	Over-excavation	63
5.2.3	Water-charged ground	63
5.3	Concrete support for drains	63
5.4	Bedding of drains	64
5.4.1	General	64
5.4.2	Bedding materials	64
5.4.3	Pipe side support and overlay materials	64
5.4.4	Bedding and backfill	64
5.4.5	Minimum cover	65
5.5	Installation of backfill materials	65
5.5.1	General	65
5.5.2	Excavated material	65
5.6	Drains in other than stable ground	65
Section 6	General design requirements for sanitary plumbing systems	67
6.1	Scope of section	67
6.2	Renovation	67
6.3	Fixture unit ratings	67
6.4	Venting for fixtures discharge pipes	69
6.5	Trapping of fixtures and appliances	69
6.5.1	General	69
6.5.2	Water seal	69
6.5.3	Location of traps and self-sealing devices	69
6.5.4	Multiple outlets	69
6.6	Graded discharge pipes	70
6.6.1	Minimum grades	70
6.6.2	Connection methods	70
6.7	Junctions in stacks	72
6.7.1	Types	72
6.7.2	Restrictions for square and ball junctions	72
6.7.3	Opposed connections	72
6.8	Connections near base of stacks	75
6.8.1	Connections to drains or graded pipes	75
6.8.2	Connections above base of stack	76
6.8.3	Connection of stacks to graded pipes or drains above ground	77
6.8.4	Bends at the base of stacks	77
6.9	Vents	78
6.9.1	General	78
6.9.2	Minimum grade	78
6.9.3	Interconnections	78
6.9.4	Termination	78
6.9.5	Connection to graded pipes	79
6.10	Air admittance valves	80
6.10.1	General	80
6.10.2	Requirements for use	80
6.10.3	Location	82
6.10.4	Installation	83
6.11	Pressure attenuators	85
6.11.1	General	85
6.11.2	Installation of pressure attenuators	85
6.11.3	Location of pressure attenuators	86
Section 7	Greywater plumbing and drainage systems	88
7.1	Scope of section	88
7.2	General	88
7.3	Material and products	88
7.4	Installation requirements	88

Section 8 Fully vented systems and fully vented modified systems — Design and installation	90
8.1 Scope of section	90
8.2 System types	90
8.2.1 General	90
8.2.2 Fully vented system	90
8.2.3 Fully vented modified system	91
8.3 Size of discharge pipes	91
8.3.1 General	91
8.3.2 Fixture unit loading	91
8.3.3 Minimum size	91
8.3.4 Limitation on DN 80 pipes	91
8.3.5 Oversizing	92
8.4 Size of stacks	92
8.5 Venting	93
8.5.1 Trap vents	93
8.5.2 Branch vents	97
8.5.3 Relief vents	98
8.5.4 Stack vents	101
8.5.5 Cross-relief vents	101
8.5.6 Header vents	102
8.5.7 Group and common vents	103
8.6 Offsets in stacks	107
8.6.1 Steep offsets	107
8.6.2 Graded offsets	107
Section 9 Single stack systems and single stack modified systems — Design and installation	110
9.1 Scope of section	110
9.2 System design	110
9.2.1 General	110
9.2.2 Single stack system	110
9.2.3 Single stack modified system	112
9.2.4 Design requirements	115
9.2.5 Number of floor levels	116
9.3 Rating of fixtures	117
9.4 Fixtures to be connected	118
9.4.1 Domestic or residential buildings	118
9.4.2 Commercial or industrial buildings	118
9.5 Connection of fixtures without trap vents	119
9.5.1 Separate fixture discharge pipes	119
9.5.2 Acceptable variations	119
9.5.3 Opposed junctions	120
9.5.4 Bends in fixture discharge pipes	120
9.5.5 Vertical dropper on fixture discharge pipes	120
9.5.6 Connection from waste fixtures to stack	120
9.5.7 Connection from waste fixtures to stack below restricted zone	121
9.5.8 Floor waste gullies	121
9.5.9 Traps	121
9.5.10 Connection of ranges of fixtures	121
9.5.11 Ranges of basins	121
9.5.12 Range of water closet pans	123
9.5.13 Range of wall-hung urinals	124
9.6 Venting of stacks	125
9.6.1 General	125
9.6.2 Cross-vents (single stack modified system)	125
9.6.3 Relief vents (single stack modified system)	125
9.7 Sizing of stacks	125
9.7.1 Single stack systems	125

9.7.2	Single stack modified systems.....	126
9.8	Variations to single stack systems.....	126
9.8.1	General.....	126
9.8.2	DN 80 stack.....	127
9.8.3	DN 80 stack with the top section graded and installed in a domestic or residential building.....	128
9.8.4	DN 100 stack up to three floors with the top section graded and installed in a domestic or residential building receiving 30 fixture units.....	129
9.8.5	DN 100 stack of one floor with top section graded.....	130
9.8.6	Connection of multiple fixtures into or below a graded offset (DN 100 stacks).....	131
9.8.7	Waste stack up to DN 100 with either graded or steep offset between the highest and lowest connections.....	132
9.8.8	DN 65 waste stack.....	135
9.8.9	DN 50 vertical section of stack.....	135
9.8.10	Connection at the change of direction in stack with top section graded.....	135
9.9	Offsets in single stack systems only.....	136
9.9.1	General.....	136
9.9.2	Steep offsets.....	136
9.9.3	Connection of laundry troughs to DN 100 stacks.....	138
9.9.4	Steep offsets below the lowest connection.....	138
9.9.5	Graded offsets.....	139
9.9.6	Connections above the offset.....	140
Section 10	General installation of pipework.....	141
10.1	Scope of section.....	141
10.2	Support and fixing of pipework.....	141
10.2.1	Brackets, clips and hangers.....	141
10.2.2	Limitation of pipe supports.....	141
10.2.3	Holes in framework.....	142
10.3	Location.....	142
10.4	Concealment of pipes and fittings.....	142
10.4.1	General.....	142
10.4.2	Extension of inspection openings.....	142
10.4.3	Structural concrete or brickwork.....	142
10.4.4	Drywall construction.....	142
10.4.5	Multiple dwellings.....	142
10.4.6	Walk-in pipe ducts.....	142
10.5	Testing and inspection openings.....	143
10.5.1	General.....	143
10.5.2	Location of testing and inspection openings.....	143
10.5.3	Size of testing and inspection of openings.....	143
10.5.4	Access to inspection openings.....	143
10.6	Installation of copper and copper alloy pipes.....	143
10.6.1	General.....	143
10.6.2	Fixing.....	144
10.6.3	Expansion joints.....	144
10.6.4	Freedom from restraint.....	144
10.7	Installation of other metallic pipes and fittings.....	146
10.8	Installation of plastics pipes and fittings.....	146
10.8.1	PVC-U pipe systems.....	146
10.8.2	ABS pipe systems.....	146
10.8.3	PE pipe systems.....	146
10.8.4	Installation of other plastics pipe systems.....	146
10.9	Disconnection of sanitary plumbing.....	146
10.10	Identification of pipes.....	146
10.11	Installation of above-ground pipework and connection of fixtures using drainage principles.....	147
10.11.1	General.....	147
10.11.2	Maximum length and size.....	147

10.11.3	Applicable installations	147
10.11.4	Installation	147
10.12	Installation of boundary traps, reflux valves and gullies above ground within buildings	148
10.12.1	Boundary traps	148
10.12.2	Reflux valves	148
10.12.3	Gullies	149
10.13	Methods of jointing of pipes	149
10.13.1	General	149
10.13.2	Bolted gland joints (BG)	150
10.13.3	Rubber ring joints (RR)	150
10.13.4	Epoxy resin joints (ER)	150
10.13.5	Cement mortar joints (CM)	151
10.13.6	Silver brazed joints (SB)	151
10.13.7	Solvent cement joints (SC)	151
10.13.8	Threaded joints (TH)	151
10.13.9	Band-clamped sleeve joints (BC)	151
10.13.10	PE joints	151
Section 11	Reduced velocity aerator stack system	152
11.1	Scope of section	152
11.2	General	152
11.3	Size of stacks	152
11.4	Stack vents	152
11.5	Offsets in stacks	153
11.5.1	General	153
11.5.2	Pressure relief bypass for stack offsets	154
11.6	Aerator junction fittings	154
11.6.1	General	154
11.6.2	Opposed connections	154
11.7	Maximum length of discharge pipes	156
11.8	Size of discharge pipes	156
11.9	De-aerators	156
Section 12	Pumped discharge	158
12.1	Scope of section	158
12.2	General	158
12.3	Compressed air ejection	158
12.4	Ejector vent	158
12.5	Wet wells	158
12.5.1	General	158
12.5.2	Construction	158
12.5.3	Base	158
12.5.4	Cover	159
12.5.5	Ladders	159
12.6	Installation of pumps	159
12.6.1	General	159
12.6.2	Inlet to wet well	159
12.6.3	Venting	159
12.6.4	Sealing	159
12.7	Pumped discharges or rising mains	159
12.8	Pump discharge from waste fixtures	160
12.8.1	General	160
12.8.2	Holding tank	160
12.8.3	Provision of valves	160
12.8.4	Inlet	160
12.8.5	Outlet size	160
12.8.6	Venting	160
12.8.7	Pump discharge pipe	160

12.9	Small bore macerator pumps.....	161
Section 13	Fixtures and appliances	162
13.1	Scope of section.....	162
13.2	Installation of sanitary fixtures for people with a disability	162
13.3	General installation requirements	162
13.3.1	Installation of fixtures.....	162
13.3.2	Location of fixture traps or self-sealing devices.....	162
13.3.3	Untrapped fixtures.....	162
13.3.4	Connection of combination fixtures in pairs	162
13.3.5	Connection of soil fixtures.....	162
13.3.6	Fixture grates.....	162
13.3.7	Fixture discharge pipes.....	162
13.4	Plant rooms	163
13.5	Pressurized chambers.....	163
13.6	Autopsy tables.....	163
13.7	Bain-maries and boiling water units	163
13.8	Basins	163
13.9	Baths.....	163
13.10	Bedpan washers and sanitizers.....	164
13.11	Bidets.....	164
13.12	Dental units.....	164
13.12.1	Single	164
13.12.2	Multiple.....	164
13.13	Drinking fountains.....	164
13.14	Food waste disposal units (domestic type).....	164
13.15	Refrigerated air conditioners, heat pumps, refrigerators, deep-freeze cabinets, commercial coffee-making machines and ice-making machines	164
13.15.1	General.....	164
13.15.2	Shower groups.....	164
13.16	Macerating sanitary napkin disposal units.....	164
13.17	Showers.....	165
13.17.1	Individual showers	165
13.17.2	Common channels.....	165
13.18	Sinks	165
13.18.1	Kitchen sinks.....	165
13.18.2	Bar sinks	165
13.18.3	Cleaners' sinks.....	166
13.18.4	Pot, utility and laboratory sinks.....	166
13.19	Slop hoppers	166
13.19.1	Connection.....	166
13.19.2	Installation.....	166
13.20	Instrument sterilizers and autoclaves	166
13.21	Connection of tundishes	166
13.22	Domestic swimming pools.....	166
13.23	Troughs.....	167
13.23.1	Ablution.....	167
13.23.2	Laundry	167
13.24	Urinals.....	167
13.24.1	Slab type	167
13.24.2	Wall-hung.....	167
13.24.3	Conversion to waterless urinals.....	168
13.25	Washing machines.....	168
13.25.1	Clothes-washing machines	168
13.25.2	Domestic dishwashing machines	168
13.25.3	Commercial dishwashing machines	169
13.25.4	Glass-washing machines.....	170
13.26	Untrapped floor drains	170
13.26.1	General.....	170

13.26.2	Restrictions on use	170
13.26.3	Installation	170
13.26.4	Termination of discharge pipe	170
13.27	Water closet pans	170
13.27.1	Connection	170
13.27.2	Installation	171
Section 14	Multi-unit developments	172
14.1	Scope of section	172
14.2	Methods of design	172
14.2.1	General	172
14.2.2	Maintenance shafts	172
14.2.3	Inspection shafts and overflow relief gullies and open upstream vents at each individual residential building	172
Section 15	Testing of sanitary plumbing and sanitary drainage installations	173
15.1	General	173
15.2	Hydrostatic test (water test)	173
15.3	Air pressure test	174
15.3.1	Sealing inlets and outlets	174
15.3.2	Air pressure test procedure	174
15.3.3	Maximum pressure drop	174
15.4	Vacuum test	174
15.4.1	Sealing inlets and outlets	174
15.4.2	Vacuum test procedure	174
15.4.3	Maximum vacuum drop	175
Section 16	Vacuum drainage design and installation	176
16.1	Scope of section	176
16.2	Materials and products for vacuum drainage systems	176
16.3	System design	176
16.3.1	General	176
16.3.2	Design requirements	177
16.3.3	Vacuum recovery	178
16.3.4	Vacuum pipework	178
16.3.5	Vacuum pipe sizing	178
16.3.6	Location of vacuum pipes	179
16.3.7	Eccentric tapered fittings	180
16.3.8	Change in pipe size	180
16.3.9	Grades of vacuum pipes	180
16.4	Inspection openings	180
16.4.1	Location and installation requirements	180
16.4.2	Size	181
16.4.3	Access to inspection openings	181
16.4.4	Sealing	181
16.5	Connections to vacuum system	182
16.6	Connections within a vacuum system	182
16.7	Vacuum automatic interface unit	182
16.8	Buffers	183
16.8.1	General	183
16.8.2	Sizing	183
16.9	Vacuum soil fixtures	183
16.9.1	General	183
16.9.2	Vacuum soil fixture backflow prevention	183
16.10	Vacuum lift pipe	184
16.10.1	Vacuum soil fixture lift pipe	184
16.10.2	Vacuum lift pipe connected to vacuum automatic interface unit	184
16.10.3	Vacuum lift pipe connection to horizontal vacuum pipe	185
16.10.4	Two-stage lift pipe	186
16.11	Vacuum reforming pocket	187

16.11.1	General	187
16.11.2	Open type vacuum reforming pocket	188
16.11.3	Closed type vacuum reforming pocket	188
16.12	Vacuum branch connections	189
16.13	Vacuum pipes installed above ground	190
16.13.1	General	190
16.13.2	Bracketing and supports	190
16.13.3	Brackets and supports	191
16.13.4	Securing of pipes and fittings	191
16.14	Vacuum pipes installed below ground	191
16.14.1	General	191
16.14.2	Anchor blocks	191
16.15	Vacuum test for vacuum drainage systems	191
16.15.1	Sealing inlets	191
16.15.2	Vacuum test pressure	191
16.15.3	Maximum vacuum drop	192
Appendix A (informative) Demonstrating products and materials are fit for purpose		193
Appendix B (normative) Maximum length of fixture discharge pipe without venting		195
Appendix C (informative) Pipe grades conversion		204
Appendix D (informative) Conduct of inspections using closed circuit television		205
Appendix E (normative) Sizing vacuum drainage pipes and buffers		206
Appendix F (normative) Renovation of sanitary plumbing and drainage systems using structural plastics liners		208
Appendix G (informative) Drains in unstable soils		211
Bibliography		217
Amendment control sheet		219

NOTES

Australian/New Zealand Standard

Plumbing and drainage

Part 2: Sanitary plumbing and drainage

Section 1 Scope and general

1.1 Scope

This document specifies requirements for the design and installation of sanitary plumbing and drainage from fixtures to a sewer, common effluent system or an on-site wastewater management system, as appropriate. It applies to new installations as well as alterations, additions or repairs to existing installations.

Illustrations used in this document are diagrammatic only and have been chosen without prejudice.

NOTE 1 The pre-treatment of trade wastes is not specified in this document.

NOTE 2 All sanitary plumbing and sanitary drainage installations for relocatable dwellings on long-term sites should conform to this document.

1.2 Application

1.2.1 Australia

This document shall be read in conjunction with the National Construction Code (NCC), Volume Three, the Plumbing Code of Australia (PCA).

Where alternative Australian or New Zealand Standards are referenced (e.g. AS 1345) the Australian Standard shall be used for Australia.

1.2.2 New Zealand

This document shall be read in conjunction with the New Zealand Building Code. This document may be used to demonstrate compliance with the New Zealand Building Code, Clause G13 Foul Water.

Where alternative New Zealand Standards are referenced (e.g. NZS 5807), the New Zealand Standard shall be used for New Zealand.

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1345, *Identification of the contents of pipes, conduits and ducts*

AS 4809, *Copper pipe and fittings — Installation and commissioning*

AS/NZS 1546.1, *On-site domestic wastewater treatment units, Part 1: Septic tanks*

AS/NZS 1546.2, *On-site domestic wastewater treatment units, Part 2: Waterless composting toilets*

AS 1546.3, *On-site domestic wastewater treatment units, Part 3: Aerated wastewater treatment systems*

AS/NZS 2032, *Installation of PVC pipe systems*

AS/NZS 2033, *Installation of polyethylene pipe systems*

AS/NZS 3500.0, *Plumbing and drainage, Part 0: Glossary of terms*

AS/NZS 3500.1, *Plumbing and drainage, Part 1: Water services*

NZS 7643, *Code of practice for the installation of unplasticized PVC pipe systems*

ISO 7685, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Determination of initial specific ring stiffness*

ISO 9969, *Thermoplastics pipes — Determination of ring stiffness*

WMTS-518, *Rehabilitation of existing Non Pressure Pipelines by the use of Cured In Place Pipe (CIPP)*

1.4 Terms and definitions

For the purposes of this document, the terms and definitions given in AS/NZS 3500.0 apply.

1.5 Plastics abbreviations

The following plastics abbreviations are used in this document.

ABS	Acrylonitrile butadiene styrene
GRP	Glass-filament-reinforced thermosetting plastic
PB	Polybutylene
PE	Polyethylene
PE-X	Cross-linked polyethylene
PP	Polypropylene
PP-R	Polypropylene random copolymer
PVC-M	Modified polyvinyl chloride
PVC-O	Oriented polyvinyl chloride
PVC-U	Unplasticized polyvinyl chloride

1.6 Measurement of pipe length

For the purposes of this document, the length of a branch drain or discharge pipe shall be measured along the centre-line from the weir of the trap to the point of connection to a stack, graded discharge pipe, drain or other drainage trap as shown in [Figure 1.6](#).

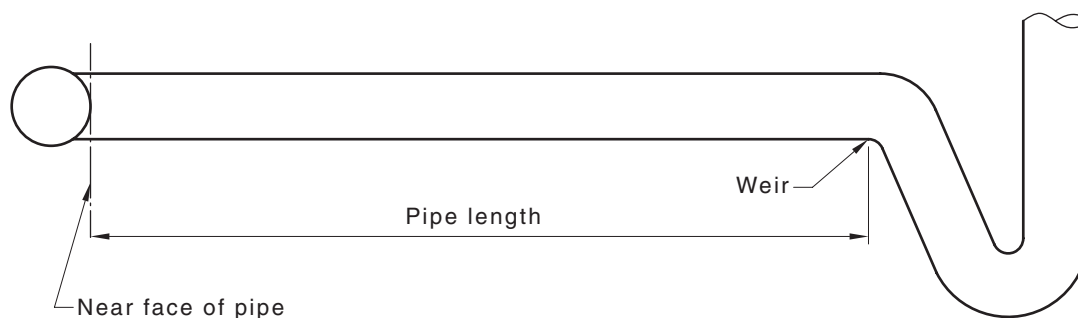


Figure 1.6 — Pipe length — Method of measurement

1.7 Pipe grades

In this document, pipe grades are expressed as a percentage of vertical to horizontal distances.

1.8 Equivalent pipe sizes

Nominal sizes of pipes and fittings specified in this document are applicable to all materials listed in [Appendix A](#), except for polyethylene (PE) and polypropylene (PP). Where the nominal size of a pipe or fitting is specified in this document, an equivalent pipe size, appropriate to polyethylene and polypropylene pipes and fittings, shall be selected from [Table 1.8](#).

Table 1.8 — Equivalent sizes for PE and PP pipes and fittings

Nominal size DN	Equivalent OD for PE and PP
32	32
40	40
50	50
65	63
80	90
100	110
125	125
150	160
225	250
300	315

Section 2 Materials and products

2.1 Scope of section

This section specifies requirements for materials and products to be used in sanitary plumbing and drainage systems.

2.2 General

Materials and products used in a sanitary plumbing and drainage systems shall be selected to ensure they are fit for their intended purpose.

NOTE 1 In New Zealand, the requirements for materials and products are contained in NZBC Clauses B2 Durability and G13 Foul Water.

NOTE 2 See [Appendix A](#) for information on selecting products that are fit for purpose.

NOTE 3 See [Section 16](#) for information on vacuum drainage systems.

2.3 Pipes and fittings — General limitations

The following limitations shall apply to the use of pipes and fittings for plumbing and sanitary drainage installations:

- (a) Bends in pipes shall be free from wrinkling and flattening.
- (b) Pipes and fittings shall be protected from excessive ambient heat.
- (c) When encased in concrete, all pipes and fittings shall be wrapped with an impermeable flexible sheath not less than 6 mm thick.

2.4 Metallic pipes and fittings

2.4.1 Sanitary plumbing and drainage systems

Where metallic pipes and fittings are used in a sanitary plumbing and drainage system, they shall be of the following material types:

- (a) Cast iron fittings (grey cast iron).
- (b) Copper pipes and fittings.
- (c) Copper alloy pipes.
- (d) Copper and copper alloy fittings.
- (e) Ductile iron pipes and fittings.
- (f) Galvanized steel pipes and fittings.
- (g) Stainless steel (SS) pipes and fittings.

NOTE 1 See [Appendix A](#) for information on selecting products that are fit for purpose.

NOTE 2 See [Clause 2.4](#) for information on plastic pipes and fittings.

2.4.2 Limitations

Metallic pipes and fittings shall conform to the following:

- (a) Galvanized steel pipes and fittings shall not be —
 - (i) used for the conveyance of discharge from soil fixtures;
 - (ii) cement-lined;
 - (iii) bent; or
 - (iv) installed in inaccessible locations.
- (b) Copper pipes and fittings shall not be used to convey —
 - (i) undiluted discharges from urinals, trade waste discharges that could have a deleterious effect on the copper (e.g. wastes from photographic equipment or cooling towers); or
 - (ii) the discharge from grease arrestors.
- (c) Copper and copper alloy pipes shall not be bent on site beyond an offset angle of 10°. Type D copper shall not be bent.
- (d) Copper alloy bends and junctions used at the base of stacks greater than 9 m in height shall be cast or hot-pressed.
- (e) Above ground stainless steel pipes and fittings shall have a PREN rating not less than 16.
- (f) Below ground stainless steel pipes and fittings shall have a PREN rating of not less than 22.

NOTE 2 The pitting resistance equivalent number (PREN) may be calculated as follows:

$$\text{PREN} = \% \text{Cr} + (3.3 \times \% \text{Mo}) + (16 \times \% \text{N}).$$

NOTE 3 A PREN of 18 is approximately equivalent to Grade 304, and a PREN of 23 is approximately equivalent to Grade 316.

2.4.3 Fabricated metallic pipes and fittings

Fabricated metallic pipes and fittings shall conform to the following:

- (a) Copper alloy fittings other than junctions shall not be fabricated on site.
- (b) All fabricated copper bends and junctions at the base of stacks up to 9 m in height shall be formed of Type B or heavier gauge copper.
 - NOTE 1 Refer to AS 1432 for additional information on copper types.
 - NOTE 2 Bends and junctions fabricated from copper pipe manufactured in accordance with NZS 3501 are also suitable for use in New Zealand.
- (c) Stainless steel fittings and assemblies, including bending, shall not be fabricated on site.

2.5 Plastics pipes and fittings

2.5.1 Sanitary plumbing and drainage systems

Where plastics pipes and fittings are used in a sanitary plumbing and drainage system, they shall be of the following material types:

- (a) Acrylonitrile butylene styrene (ABS) pipe and fittings.
- (b) High density polyethylene (PE) pipe and fittings.
- (c) Polypropylene (PP) pipe and fittings.
- (d) Unplasticized polyvinyl chloride (PVC-U) pipes and fittings.

NOTE 1 See [Appendix A](#) for information on selecting products that are fit for purpose.

NOTE 2 See [Clause 2.3](#) for information on metallic pipes and fittings.

2.5.2 Limitations

Plastics pipes and fittings of materials other than PVC, black PE or black PP shall be protected from direct sunlight.

NOTE Examples of protection include sleeving with metal or plastics pipe or conduit or lagging.

2.6 Pipes and fittings — Other materials

2.6.1 Sanitary plumbing and drainage systems

Where other than metallic or plastics pipes and fittings are used in a sanitary plumbing and drainage system, they shall be of the following material types:

- (a) Fibre reinforced cement (FRC) pipes and fittings.
- (b) Glass-filament-reinforced thermosetting plastic (GRP) pipe.
- (c) High grade, low thermal expansion, borosilicate glass.
- (d) Vitrified clay pipes and fittings.

NOTE See [Appendix A](#) for information on selecting products that are fit for purpose.

2.6.2 Limitations

Pipes and fittings other than metallic or plastics shall conform to the following:

- (a) Fibre-reinforced concrete (FRC) pipes shall not be used in waste lines receiving trade waste discharges that could have a deleterious effect on the FRC (e.g. wastes from photographic equipment or cooling towers).
- (b) Glass-filament-reinforced thermosetting plastic (GRP) pipes shall have a minimum pipe stiffness of 5 000 N/m deflection per metre length when installed below ground.
- (c) Vitrified clay pipes and fittings shall not be used above ground except where installed as a riser connected to a fixture in accordance with [Clause 3.8.3](#), or as a drain under buildings in accordance with [Clause 4.3.2\(b\)](#).

2.6.3 Pipes and fittings for pressure applications

Pipes and fittings for pressure applications shall conform to the pressure requirements of Section 2 of AS/NZS 3500.1:2021.

2.7 Sheet materials

2.7.1 Copper

Copper sheet shall be alloy C12200.

NOTE Refer to AS 1566 for a list of copper alloys.

2.7.2 Stainless steel

Stainless steel sheet shall have a PREN rating not less than 16. It shall be not less than 1.2 mm thick.

NOTE 1 The pitting resistance equivalent number (PREN) may be calculated as follows:

$PREN = \%Cr + (3.3 \times \%Mo) + (16 \times \%N)$.

NOTE 2 A PREN of 18 is approximately equivalent to Grade 304.

2.8 Joints

2.8.1 Flanged joints

Where flanged joints are used, they shall be of the following material types:

- (a) PVC-U.
- (b) Polyethylene.
- (c) Ductile iron, cast iron and grey cast iron.
- (d) Copper alloy and composite.
- (e) Steel.

NOTE The following Standards contain additional information:

- (a) AS 2129 — flanges for pipes, valves and fittings.
- (b) AS/NZS 4331.1 — steel flanges.
- (c) AS/NZS 4331.2 — cast iron flanges.
- (d) AS/NZS 4331.3 — copper and copper alloy composite flanges.
- (e) AS/NZS 4087 — flanges for waterworks purposes.
- (f) AS/NZS 1477 — PVC pipes and fittings for pressure applications.
- (g) AS/NZS 2280 — ductile iron pipes and fittings.
- (h) AS/NZS 2544 — grey iron pressure fittings.
- (i) AS/NZS 4129 — Polyethylene fittings.

Flanged joints shall be tested in accordance with [Section 15](#).

2.8.2 Elastomeric seals

Where an elastomeric seal gasket is provided in the line or in a fitting, it shall not be replaced with mastic or sealant compounds.

2.8.3 Silver brazing alloy

2.8.3.1 Copper and copper alloys

Silver brazing alloys for capillary jointing of copper and copper alloy pipes and fittings shall conform to the requirements for silver brazing alloys or copper phosphorus alloys and contain a minimum of 1.8 % silver and a maximum of 0.05 % cadmium.

2.8.3.2 Stainless steels

Silver brazing alloys for capillary jointing of stainless-steel pipes and fittings shall contain a minimum of 38 % silver and a maximum of 0.05 % cadmium.

2.8.4 Filler rods for stainless steel joints

Joints in stainless steel pipework larger than DN 25 shall be made using filler rods of low carbon stainless steel not greater than 2 mm in diameter.

2.8.5 Solvent cement and priming fluid

Solvent cement and priming fluid shall be used for the solvent cement jointing of PVC and ABS pipes and fittings.

Solvent cement shall not be used without priming fluid.

NOTE The colour of the priming fluid should be different from the colour of the solvent cement and the pipe to which it is applied. Generally, the priming fluid is pink, and the solvent cement is generally —

- (a) for Type P PVC, green (Australia) or blue or gold (New Zealand);
- (b) for Type N PVC, blue (Australia) or clear (New Zealand);
- (c) for Type P ABS, grey; and
- (d) for Type G, clear.

2.9 Miscellaneous

2.9.1 Concrete mix

Pre-mixed concrete shall have a minimum characteristic compressive strength of 20 MPa.

Site-mixed concrete shall consist of cement, fine aggregate and coarse aggregate, all measured by volume. Site-mixed concrete shall have sufficient water added to make the mix workable. It shall have a minimum characteristic compressive strength of 20 MPa.

NOTE 1 Refer to AS 1379 for information on the specification and supply of concrete.

NOTE 2 The compressive strength of concrete is defined in —

- (a) AS 3600 in Australia; and
- (b) NZS 3109 and NZS 3124 in New Zealand.

NOTE 3 Refer to AS/NZS 4671 for information for steel reinforcing materials.

2.9.2 Cement mortar

Cement mortar shall consist of one part cement and two parts of fine aggregate measured by volume, properly mixed with the minimum amount of water necessary to render the mix workable.

Cement mortar that has been mixed and left standing for more than 1 h shall not be used.

NOTE Refer to AS 1478.1 for information on chemical admixtures for concrete, mortar and grout.

2.9.3 Water for concrete and mortar

Water used for mixing concrete and cement mortar shall be free from amounts of matter that are harmful to the mixture, the reinforcement or any other items embedded within the concrete or mortar.

2.9.4 Timber

Timber exposed to the weather shall be of durability Class 2 conforming with AS/NZS 2878 or be treated in accordance with AS 1604.1. In New Zealand, exposed timber shall be treated to H3 (CCA) in accordance with NZS 3640.

Timber in contact with the ground shall be durability Class 1 for Australia and H4 (CCA) for New Zealand.

2.9.4.1 Timber in Australia

In Australia, timber exposed to the weather shall be of durability Class 2 or treated with an appropriate preservative. Timber in contact with the ground shall be durability Class 1.

NOTE 1 Refer to AS/NZS 2878 for information on timber classification into strength groups.

NOTE 2 Refer to AS/NZS 1604 for information on preservative treatment of sawn and round timber.

2.9.4.2 Timber in New Zealand

In New Zealand, timber exposed to the weather shall be treated to H3 (CCA). Timber in contact with the ground shall be treated to H4 (CCA).

NOTE 1 Refer to NZS 3631 for information on timber grading rules.

NOTE 2 Refer to NZS 3640 for information on chemical preservation of round and sawn timber.

2.9.5 Epoxy resins

Epoxy resins shall be compatible with the materials being joined.

2.9.6 Pipe bedding

Pipe bedding materials shall conform to [Clause 5.4](#).

2.9.7 Backfill

Backfill material shall conform to [Clause 5.5](#).

2.9.8 External protective coatings

External coatings used for the protection of drains installed in corrosive areas shall —

- (a) be impervious to the passage of moisture;
- (b) be resistant to the external corrosive environment;

- (c) be resistant to abrasion by the surrounding fill; and
- (d) not contain any material that could cause corrosion to the underlying pipes or fittings.

NOTE Polyethylene sleeving used to protect underground drains may require additional protection if installed in rock or in stony ground.

2.9.9 Fibreglass-reinforced plastics tanks

Fibreglass-reinforced plastics tanks shall be manufactured in accordance with AS/NZS 1546.1.

Section 3 Drainage design

3.1 Scope of section

This section specifies requirements for the design of sanitary drainage systems.

NOTE See [Section 16](#) for information on vacuum drainage.

3.2 Location of drains

Any drain located under or inside a building shall only serve fixtures within that building.

NOTE 1 Drains should be located external to the building wherever practicable.

NOTE 2 The sanitary drainage system should accommodate the range of differential soil movement in accordance with the soil movement classified on each individual site.

3.3 Size and length of drains

3.3.1 Fixture unit loading

The size of a drain shall be determined by the number of fixture units and type of fixtures discharging into it. The fixture unit loading for each pipe size and grade shall not exceed the maximum specified in [Table 3.3.1](#).

NOTE Fixture unit ratings are given in [Tables 6.3\(A\)](#) and [6.3\(B\)](#).

Table 3.3.1 — Maximum fixture unit loading for vented drains

Grade %	Nominal size of drain, DN						
	65 ^a	80	100	125	150	225	300
5.00	60	215	515	1 450	2 920	11 900	26 900
3.35	36	140	345	1 040	2 200	9 490	21 800
2.50	25	100	255	815	1 790	8 060	18 700
2.00	×	76	205	665	1 510	7 090	16 600
1.65	×	61	165	560	1 310	6 370	15 000
1.45	×	(50)	(140)	485	1 160	5 810	13 900
1.25	×	(42)	(120)	425	1 040	5 360	12 900
1.10	×	×	×	(380)	935	4 970	12 100
1.00	×	×	×	(340)	855	4 500	11 400
0.85	×	×	×	×	(725)	3 850	10 300
0.65	×	×	×	×	(595)	3 250	9 090
0.50	×	×	×	×	×	×	7 720
0.40	×	×	×	×	×	×	6 780

^a DN 65 drains may be used as branch drains only, provided no soil fixtures (except urinals) are connected thereto.

NOTE 1 “×” indicates that the combination of nominal size and grade is not acceptable.

NOTE 2 Values in parentheses are the maximum fixture unit loadings for drains laid at reduced grades in accordance with [Clause 3.4.2](#).

NOTE 3 The regulatory authority may prescribe or approve the sizing and grading of any drain on the basis of observed peak flows for buildings of similar occupancy in lieu of the size determined as prescribed in this document.

NOTE 4 See [Table C.1](#) for conversion of percentage to ratio.

3.3.2 Main drain

The minimum size of a main drain shall be DN 100.

3.3.3 Branch drains

The minimum size of a branch drain shall be DN 65.

3.3.4 Limitations on vented DN 80 branch drains

Not more than two water closet pans shall be connected to a vented DN 80 branch drain. Any discharge pipe from a bath or laundry trough connected to a DN 80 vented branch drain shall be DN 40.

3.3.5 Use of eccentric taper fitting

Where any fixture with a P-trap of DN 40 or DN 50 is connected to a DN 65 branch drain, the eccentric taper fitting used to make the connection shall be fitted immediately downstream of the fixture trap, as shown in [Figure 3.3.5](#). The soffit of the fitting shall be in common alignment with the soffit of the pipe to which it is connected.

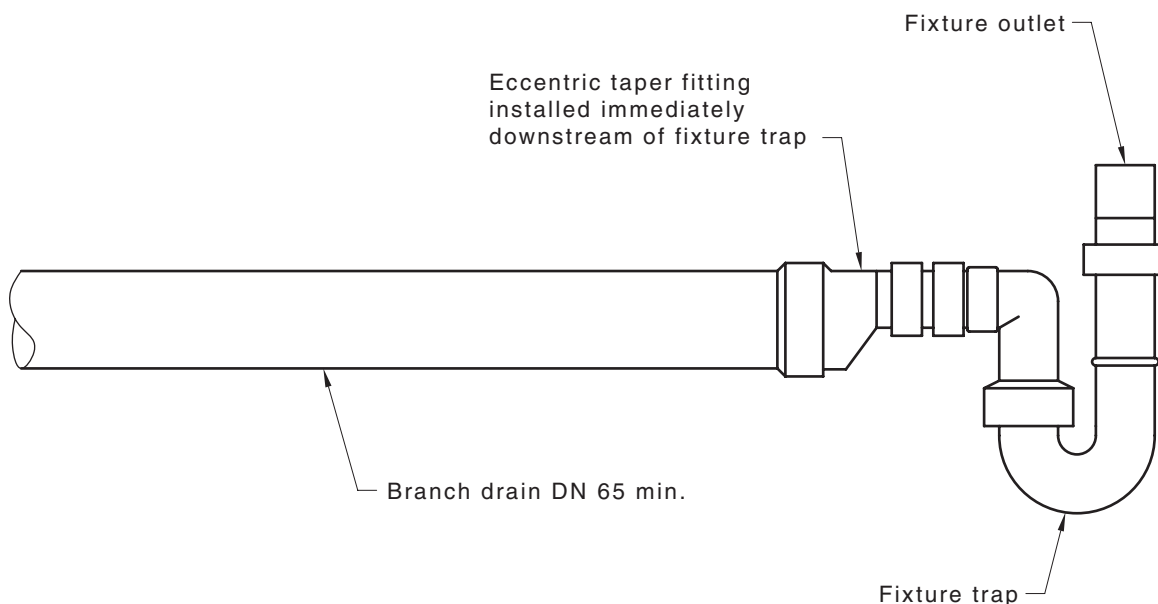


Figure 3.3.5 — Connection of fixture traps (DN 40 or DN 50) on grade to branch drains

3.3.6 Size change

A drain shall not diminish in size in the direction of flow.

3.3.7 Downstream of boundary trap

Drains downstream of a boundary trap shall be not smaller than DN 100.

3.3.8 Oversizing of drains

A drain shall not be increased in size unless the fixture unit loading is in excess of the maximum allowable for that size drain at a particular grade, as specified in [Table 3.3.1](#).

3.3.9 Maximum length of fixture discharge pipes

The maximum length of fixture discharge pipe without venting shall be in accordance with [Appendix B](#).

3.4 Grades of drains

3.4.1 Minimum grade

The nominal minimum grade of vented and unvented drains shall be as given in [Table 3.4.1](#).

Table 3.4.1 — Minimum grade of drains

Nominal size DN	Minimum grade %
65	2.50
80	1.65
100	1.65 ^a
125	1.25
150	1.00
225	0.65
300	0.40

^a Except for drains from septic tanks, sewage treatment plants and unvented discharge pipes from tundishes, which may have a minimum grade of 1.00 %.

NOTE [Table C.1](#) provides a table for conversion of grades as a percentage to grades as a ratio.

3.4.2 Reduced grades

Where the minimum gradient required by [Clause 3.4.1](#) cannot be obtained, drains may be laid at the reduced grades given in [Table 3.4.2](#).

Where soil fixtures are connected, the fixture unit loading on the drain shall be not less than the appropriate value given in [Table 3.4.2](#). If this loading cannot be achieved, provision shall be made for flushing the drain.

Table 3.4.2 — Minimum fixture unit loadings for reduced grade drains

Reduced grade %	Nominal size of drain, DN			
	80	100	125	150
1.45	9	10	—	—
1.25	10	18	—	—
1.10	x	x	27	—
1.00	x	x	38	—
0.85	x	x	x	75
0.65	x	x	x	160

NOTE 1 “x” indicates that the combination of nominal size and grade is not acceptable.

NOTE 2 “—” indicates that the grade is acceptable by [Table 3.4.1](#) for this size (i.e. not reduced grade).

NOTE 3 [Appendix C](#) provides a table for conversion of grades as a percentage to grades as a ratio.

3.4.3 Steep grades

Where it is necessary to install a drain on a grade between 20 % and vertical, anchor blocks shall be installed —

- (a) at the bend or junction at the top and bottom of the inclined drain; and
- (b) at intervals not exceeding 3 m.

3.4.4 Anchor blocks

Anchor blocks for drains up to DN 150 shall be of reinforced concrete having two reinforcing rods of not less than 9 mm diameter. The reinforcing rods shall be bent to a radius that is 100 mm greater than the outside diameter of the pipe, as shown in [Figure 3.4.4](#). Anchor blocks shall —

- (a) be not less than 150 mm in thickness;
- (b) extend across the full width and be firmly keyed into the sides of the trench;
- (c) extend above the top of the pipe to a minimum height of 150 mm;
- (d) extend below the base of the trench for a minimum depth of 150 mm; and
- (e) not cover any flexible joint.

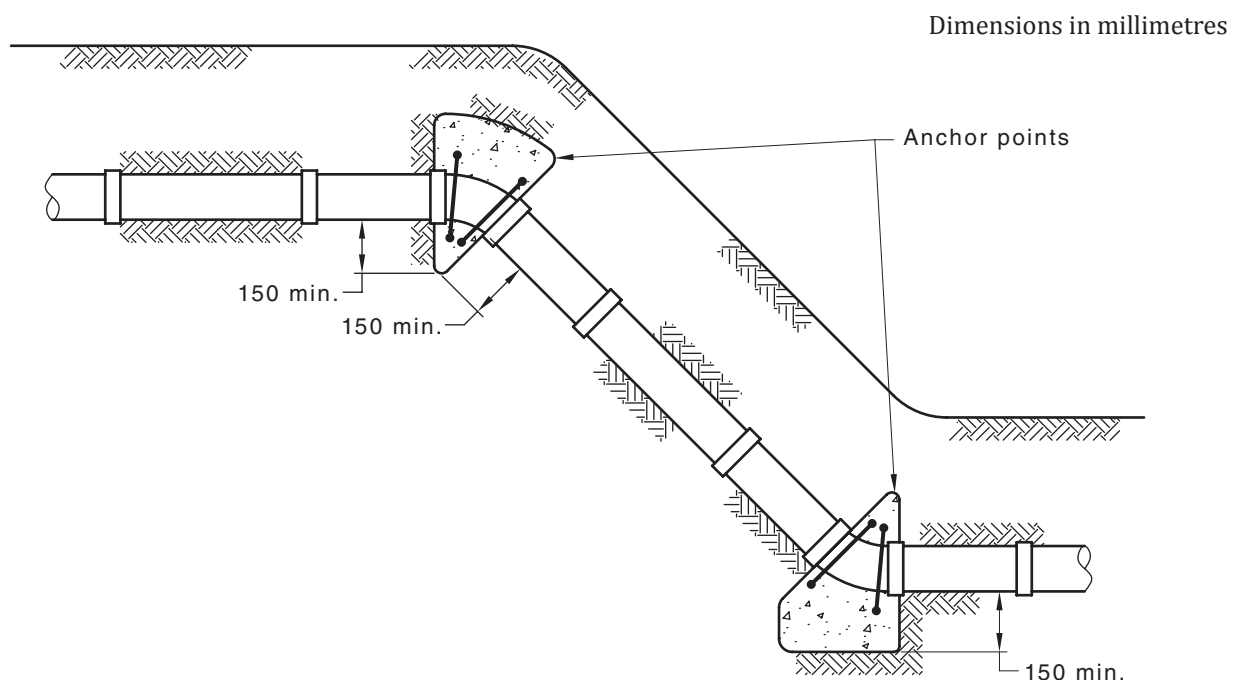


Figure 3.4.4 — Anchoring of drains

3.5 Laying of drains

3.5.1 General

Where a drain is to be located in an open cut trench that is in a road, easement, public place or the like, it shall be installed in accordance with the following:

- (a) Where the full depth at the point of connection is not required to drain the property, a jump-up shall be installed either at the point of connection or within the property boundary.

- (b) Where the presence of any obstacle prevents the drain from being laid at an even grade and with the required cover, the drain shall pass beneath the obstacle at an even grade with a jump-up only at the point of connection. Alternatively, a minimum clearance of 25 mm shall be provided between the obstacle and the drain, or an inclined section may be installed adjacent to the obstacle in the form of a graded jump-up with changes of direction not greater than 60°.
- (c) The minimum cover of the drain shall be as specified in [Table 3.7.2](#).

3.5.2 Easements and watercourses

Drains crossing an easement or watercourse shall be installed in accordance with the following:

- (a) The drain shall pass under or over any pipeline or closed conduit in the easement or under any open channel or watercourse.
- (b) In an easement, a minimum clearance of 100 mm shall be maintained between an open channel, pipeline or conduit and the drain.
- (c) No drain shall be laid through any such obstacle as outlined in Item (a).
- (d) Where the drain is to pass over any obstacle as set out in Item (a), the drain shall have the minimum depth of cover specified in [Clause 3.7.2](#).

3.6 Proximity to other services

3.6.1 General

Where electrical conduit, wire, cable or consumer gas pipes, drains and other services are in existence, pipes shall be installed in accordance with the requirements of [Clauses 3.6.2](#) to [3.6.8](#).

3.6.2 Above-ground services

Separation of at least 25 mm shall be maintained between any above-ground sanitary plumbing and drainage and any of the following services:

- (a) Electrical or telecommunications conduits.
- (b) Electrical or telecommunications wires or cables.
- (c) Consumer gas pipes.
- (d) Other sanitary plumbing and drainage.
- (e) Storm water drainage.
- (f) Above-ground water services.
- (g) Any other services.

Where a pipe is insulated, the measurement shall be from the outer edge of any insulation or wrapped material applied to the pipework.

3.6.3 Separation from underground electrical supply cables or consumer gas pipes

The separation between any underground drain and an electrical supply cable shall be at least —

- (a) 100 mm, provided the electrical supply cable is indicated along its length with orange marker tape and is mechanically protected; or
- (b) 600 mm, where the electrical supply cable is neither indicated nor protected.

The separation between any underground drain and consumer gas pipes shall be at least —

- (i) 100 mm, provided the consumer gas pipe is indicated along its length with marker tape laid 150 mm above the installed pipe and is mechanically protected; or
- (ii) 600 mm, where the consumer gas pipe is neither indicated nor mechanically protected.

NOTE 1 Mechanical protection may be provided by concrete slabs, continuous concrete pour, polymeric cover strips, or bricks designed for protecting electrical supply cables and may include a suitable conduit.

NOTE 2 See [Clause 3.6.5](#) for separation from a communication cable.

NOTE 3 Refer to AS/NZS 2648.1 for information on non-detectable tape.

3.6.4 Separation from underground electrical earthing electrode

For an electrical supply not exceeding 1 000 V, the separation between any underground drainpipe and an electrical earthing electrode shall be at least 500 mm.

NOTE For an electrical supply exceeding 1 000 V, the relevant regulatory authorities should be contacted for a ruling.

3.6.5 Separation from underground communication cable

The separation between any underground drain and a communication cable shall be at least 100 mm.

3.6.6 Separation from other underground services

The separation between any underground drain and any other service other than electrical supply cables, consumer gas piping, communication service or water service shall be at least 100 mm or 300 mm from a stormwater drain exceeding DN 100.

NOTE See [Figure 3.6.6](#) for a typical shared trench.

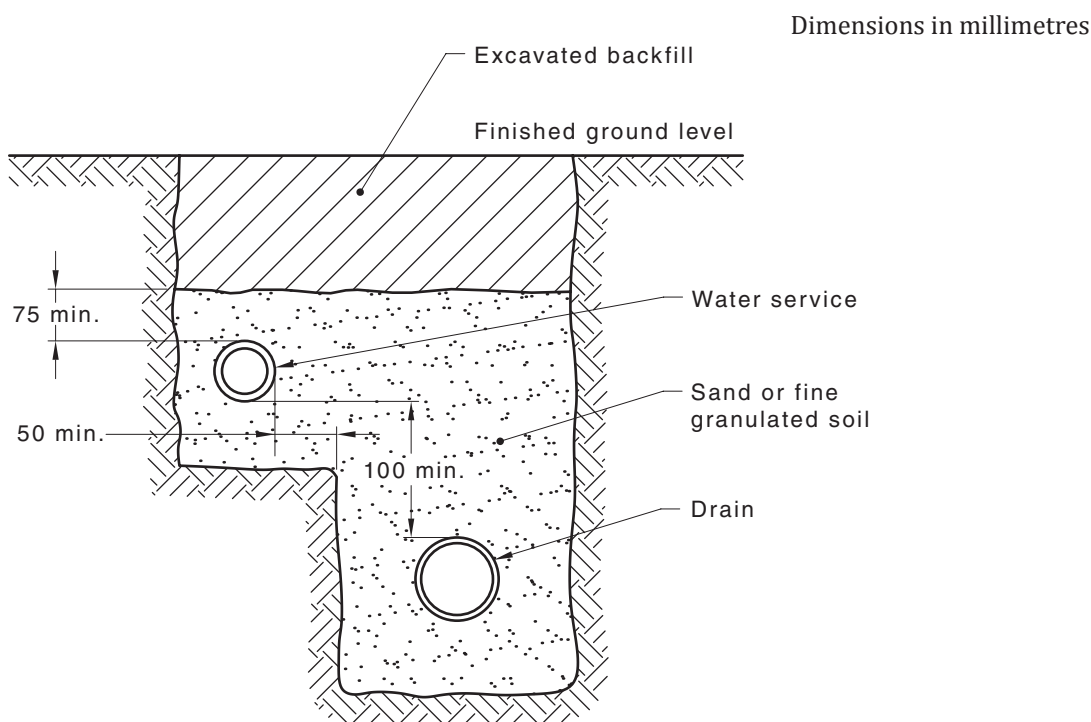


Figure 3.6.6 — Typical shared trench

3.6.7 Crossover of underground services

Any underground drain crossing a service or any underground service crossing a drain shall —

- (a) cross at an angle of not less than 45°;
- (b) have a vertical separation of not less than 100 mm; and
- (c) be marked along its length for 1 m either side of the centre-line of the service with marker tape laid 150 mm above the installed service.

NOTE Refer to AS/NZS 2648.1 for information on non-detectable marking tape.

3.6.8 Clearance from underground obstructions

Drains shall be installed with sufficient clearance to any underground obstruction to protect the drain from physical damage and to permit repairs. The clearance shall be at least 100 mm.

NOTE See [Clause 3.8](#) for drains in proximity to footings and foundations.

3.7 Depth of cover for buried pipes

3.7.1 General

Drains shall be laid in a manner that provides protection against mechanical damage and deformation due to vehicular loadings.

3.7.2 Depth of cover

Drains shall be installed with a minimum depth of cover, measured from the top of the pipe socket or inspection opening to the finished surface level, as specified in [Table 3.7.2](#).

Table 3.7.2 — Minimum cover for buried pipes

Location	Minimum depth of cover mm	
	Cast iron and ductile iron	Other materials
Subject to vehicular traffic	300	500
All other locations	Nil	300 ^a

^a Except as provided in [Clauses 3.7.3](#) and [3.7.4](#).

3.7.3 Drains installed with less than minimum cover

Drains constructed of materials having less than the minimum cover specified in [Table 3.7.2](#) shall be covered by at least 50 mm of overlay and then paved with —

- (a) 100 mm minimum thickness of reinforced concrete, where subject to heavy vehicular loading;
- (b) 75 mm minimum thickness of brick or concrete paving, where subject to light vehicular traffic; or
- (c) 50 mm minimum thickness of brick or concrete paving, where not subject to vehicular traffic.

The paving shall extend the full width of the trench. If it does not extend the full width of the trench, the drain shall be protected from mechanical damage.

3.7.4 Drains under buildings

Drains below ground and under buildings may be laid with less than the minimum cover specified in [Table 3.7.2](#), provided —

- (a) 25 mm of overlay separates the drain from a reinforced concrete slab; or
- (b) the drain is adequately protected from mechanical damage and superimposed loads.

3.8 Building over drains

3.8.1 Alterations and additions to buildings

The footings for alterations or additions to buildings shall not be placed over or adjacent to existing drains until the clearances specified in [Clause 3.8.2](#) have been provided. Alternatively, such drains shall be relocated.

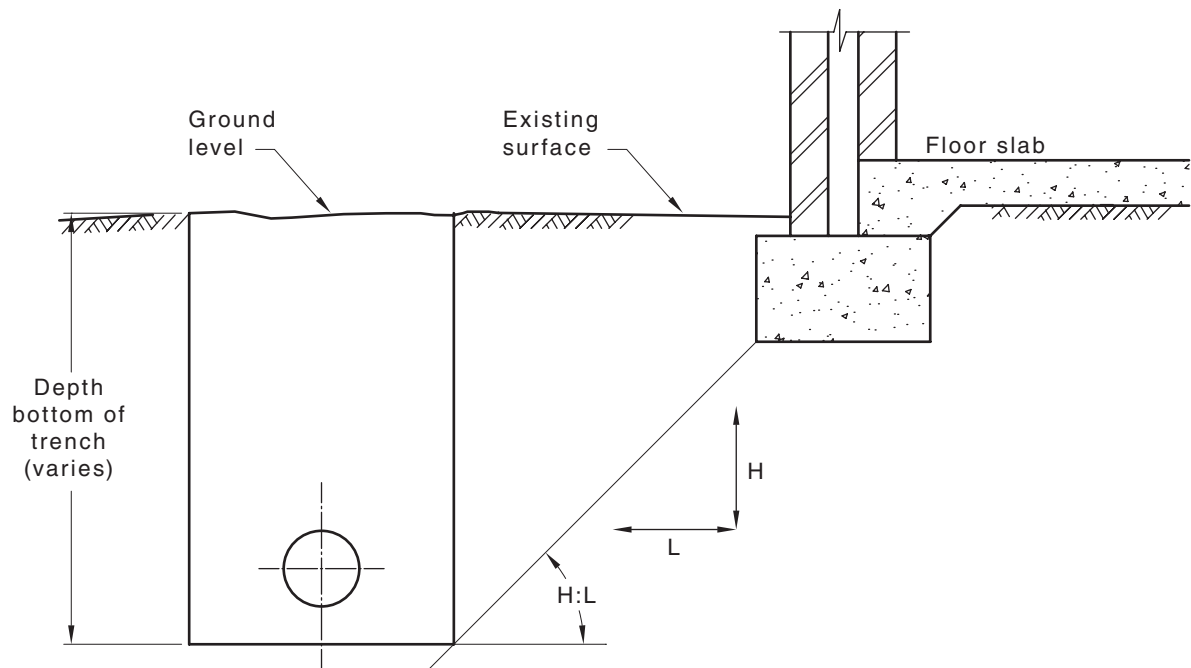
Any existing gully, inspection shaft, or boundary trap riser shall not remain under any such alterations or additions other than where specified in accordance with [Clauses 4.4.2.3](#), [4.6.5](#) and [4.6.6.5](#).

3.8.2 Installation near and under buildings

The following applies to drains in close proximity to footings or foundations:

- (a) Where a drain passes under a strip footing, its angle of intersection with the footing in the horizontal plane shall be not less than 45°. The minimum clearance between the top of the drain to the underside of the footing shall be 25 mm.
- (b) Drains laid through footings or walls, other than below-ground external walls, shall be installed with an annular space of not less than 25 mm filled with a liner of flexible material.
- (c) Pipes may be laid through below-ground external walls, provided —
 - (i) two flexible joints are provided externally within 800 mm of the external face of the wall, and such joints are not less than 600 mm apart; and
 - (ii) the penetration of the wall is made watertight.
- (d) Where a drain is installed parallel to a footing, the trench shall be located as follows:
 - (i) In Australia (for single dwellings), as shown in [Figure 3.8.2](#).
 - (ii) In New Zealand, in accordance with NZBC Acceptable Solution G13/AS2 for light timber framed and concrete masonry buildings.

NOTE For all other buildings or where the requirements of Item (d) cannot be achieved, an engineered design should be used.



Soil type	Slope H:L	
	Compacted fill	Undisturbed ground
Stable rock ^a	2:3	8:1
Sand ^a	1:2	1:2
Silt ^b	1:4	1:4
Firm clay	1:2	1:1
Soft clay	Not suitable	2:3
Soft soils ^b	Not suitable	Not suitable

^a Most sand and rock sites with little or no ground movement from moisture changes.

^b Sites include soft soils such as soft clay or silt or loose sands, landslip, mine subsidence, collapsing soils, soils subject to erosion, reactive sites subject to abnormal moisture conditions or sites that cannot be classified otherwise.

Figure 3.8.2 — Excavation near footings

3.8.3 Fixture connections to vitrified clay drains under buildings

Where a riser of vitrified clay material is installed for the purpose of connecting a fixture, it may be extended up to 1 m above ground surface, provided —

- (a) the spigot end of the riser is below ground;
- (b) only the socket of the exposed pipe extends above floor level; and
- (c) the exposed pipe is protected from damage.

3.9 Venting of drains

3.9.1 General

Vents in drains shall be provided —

- (a) at both ends of any drain that incorporates a boundary trap;

- (b) at the upstream end on any drain not incorporating a boundary trap;
- (c) at the upstream end of any branch drain to which a fixture trap or floor waste gully is connected, if the distance from the weir of the trap to the vented drain exceeds 10 m;
- (d) at the upstream end of a branch drain to which a gully is connected, or a sullage dump point located in a caravan park is connected, if the distance from the weir of the trap to the vented drain exceeds 10 m;
- (e) at the upstream end of any DN 100 branch drain to which three or more water closet pans are connected;
- (f) along the line of a DN 100 vented drain where 10 or more water closet pans are installed in a toilet block and are each individually connected in accordance with [Clause 3.9.3.4](#); and
- (g) in accordance with [Clause 3.9.3.1](#) for drains connected to vacuum sewerage systems.

NOTE See [Clause 6.10](#) for information on where air admittance valves are used.

3.9.2 Location

3.9.2.1 Upstream vent

The upstream vent on any drain shall be connected —

- (a) to the drain downstream of any fixture or drainage trap connection, provided any unvented section of drain upstream of the vent branch connection conforms with [Clause 3.10.3](#); or
- (b) at the vent extension of a stack located at or near the upstream end of the drain, provided any unvented section of drain upstream of the stack branch connection conforms with [Clause 3.10.3](#).

3.9.2.2 Downstream vent

Where required by [Clause 3.9.1\(a\)](#), the downstream vent on any drain shall be connected within 10 m of the boundary trap riser, provided no other fixture is connected between the boundary trap riser and the vent connection.

3.9.2.3 Low level vent (ground vent)

Where a low-level vent is provided in accordance with [Clause 3.9.2.2](#), it shall be located so that —

- (a) the inlet of the vent is not less than 150 mm above ground level;
- (b) it terminates not less than 3 m from any opening into a building or 5 m from any air duct intake; and
- (c) it is not liable to be damaged or cause injury or obstruction.

3.9.3 Size of drainage vents

3.9.3.1 Minimum size

Drainage vents shall be sized in accordance with [Table 3.9.3.1](#) and —

- (a) the upstream vent on any main drain shall be not less than DN 50;
- (b) the upstream vent on any branch drain shall be not less than DN 40;
- (c) the section of drain acting as a vent shall be not less than DN 65, as shown in [Figure 3.9.3.1](#);

- (d) notwithstanding the number of fixture units discharging to the drain, the minimum size of any ground vent pipe shall be DN 50; and
- (e) if an air admittance valve is used to terminate an upstream vent, [Table 6.10.2\(A\)](#) shall apply.

NOTE 1 Branches connected into a positive pressure area, such as near boundary traps in multistorey buildings, may need additional venting.

NOTE 2 Where a branch vent has an AAV suitable for the fixture unit loading of that branch, the AAV can be taken into account to achieve a rating equal to or greater than the rating for the single vent.

Table 3.9.3.1 — Size and rating of vents

Size of vent pipe DN	Fixture units discharging to drain		Vent rating
40	> 1	≤ 10	0.5
50	> 10	≤ 30	1
65	> 30	≤ 175	2
80	> 175	≤ 400	3
100	> 400	≤ 600	6

NOTE See [Clause 6.10](#) for the use of air admittance valves (AAV).

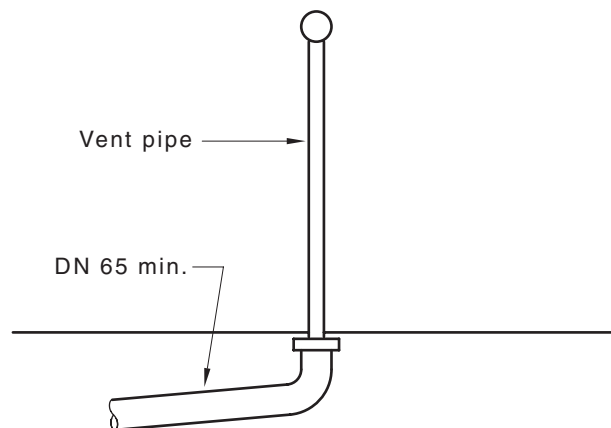
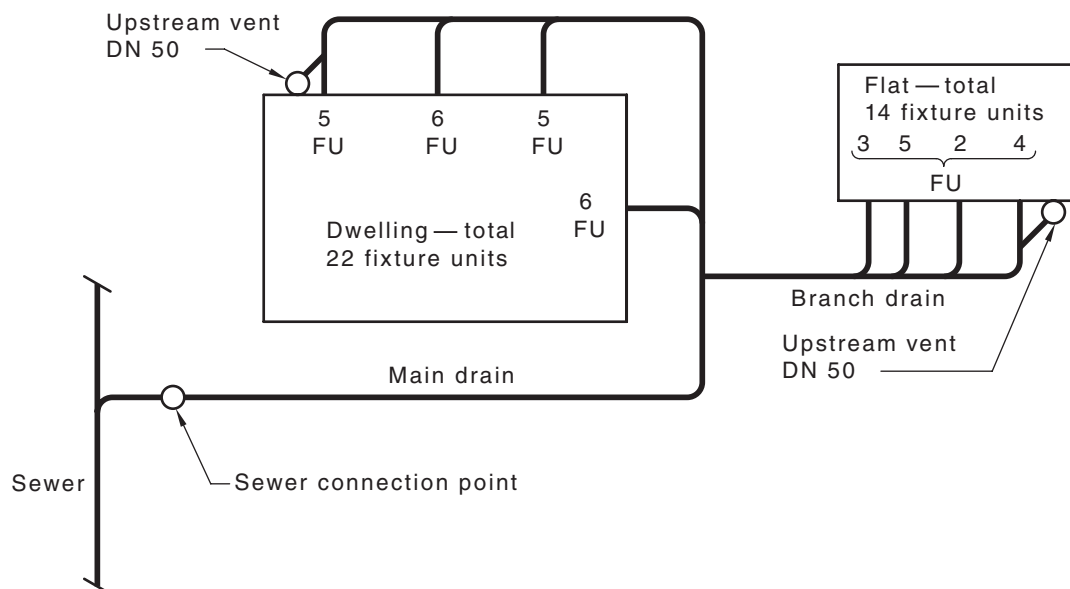


Figure 3.9.3.1 — Connection of vent to drain

3.9.3.2 Rating of vents

Where two or more vents are directly connected to a drain, these vents may take the place of the single vent required by [Table 3.9.3.1](#), provided the sum of the ratings is equal to or greater than the vent rating for the single vent as shown in [Figure 3.9.3.2](#).



NOTE The section of drains to be vented shall not be reduced below the rating of venting required.

Figure 3.9.3.2 — Vent sizing

EXAMPLE Total loading units discharging to drain = 36 FU.

Required size of drainage vent = DN 65 — (Rating of 2), see [Table 3.9.3.1](#).

The two other stack or drainage vents (assuming the branch drain is over 10 m) in combination may take the place of a single DN 65 or DN 50 vent.

3.9.3.3 Connection of vent to drain

Where the minimum size of DN 65 for a drain line exists, a minimum DN 50 vent pipe may be connected as shown in [Figure 3.9.3.1](#).

3.9.3.4 Water closet pans in toilet blocks

Water closet pans connected to a DN 100 drain in toilet blocks shall be vented in accordance with the following:

- The vents shall be positioned to divide the water closet pans into approximately equal groups.
- Where 10 or more water closet pans in any ground-floor toilet block are each separately connected to a vented drain and the spacing of respective branch drain connections to the vented drain are such that they are 2 m apart or less, one DN 50 vent, located between the last and second last pan, shall be provided for the first 10 pans. An additional DN 50 vent shall be provided for each additional 10 pans or part thereof.
- Each vent shall branch from the vented drain, or from a water closet pan branch.

3.10 Unvented branch drains

3.10.1 General

The requirements of this clause shall apply to —

- ground-floor connections to a vented drain installed on grade, located below or above the ground, see [Clause 10.10](#); or

- (b) connections to a disconnect or overflow relief gully.

3.10.2 Sizing

The size of an unvented branch drain shall be such that the sum of the fixture unit ratings, as given in [Table 6.3\(A\)](#), do not exceed the maximum loading specified in [Table 3.10.2](#).

Table 3.10.2 — Size of unvented branch drains

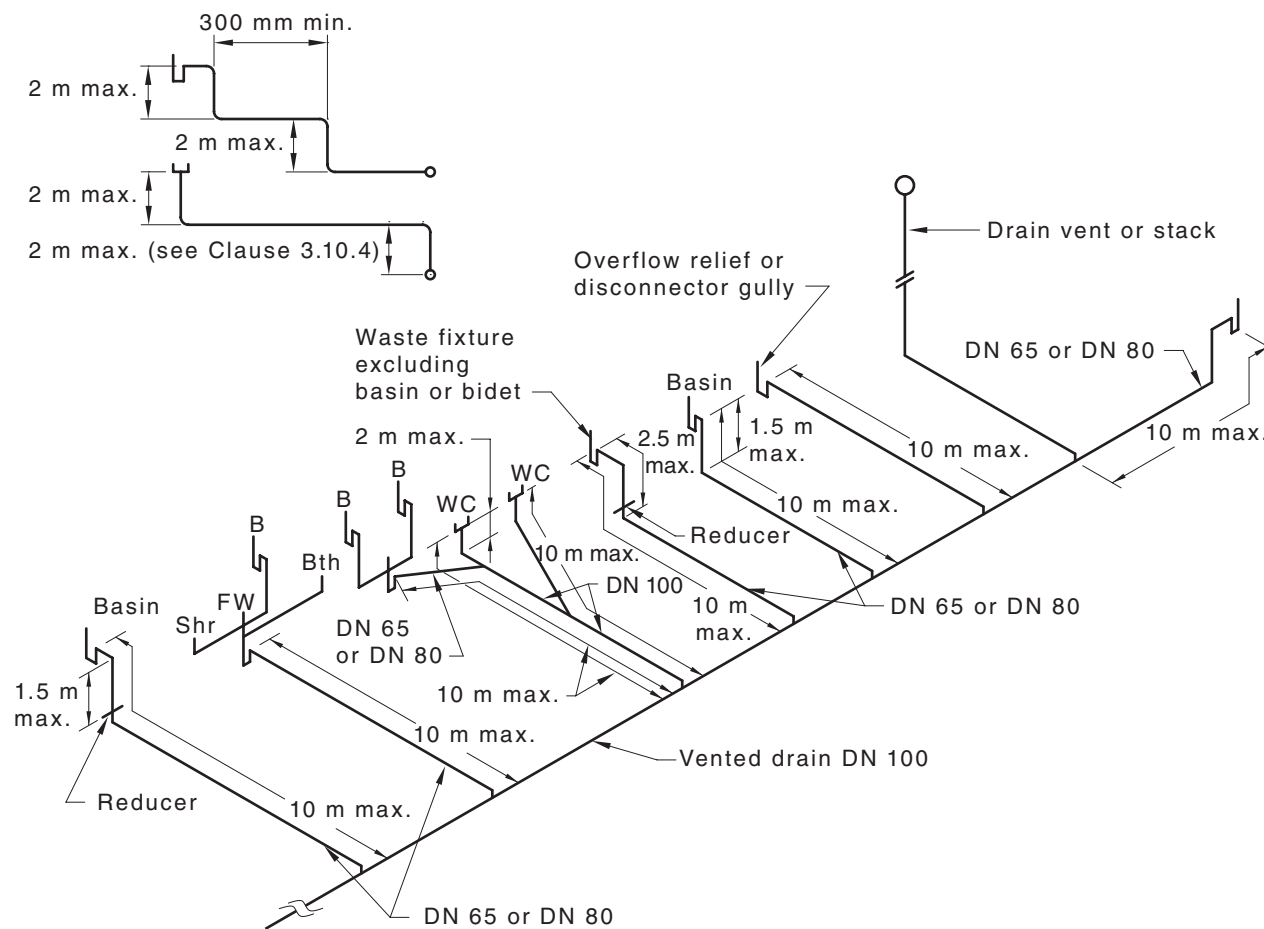
Size of pipe DN	Maximum fixture unit loading
65	5 fixture units (excluding a water closet pan or slop hopper); or 10 fixture units from one floor waste gully
80	12 fixture units (including not more than one water closet pan or slop hopper)
100	30 fixture units (including not more than two water closet pans or slop hoppers)

3.10.3 Maximum length

The total length of an unvented branch drain, including the length of the fixture discharge pipe, shall be not greater than the following:

- (a) 10 m from the vented drain to the weir of the trap, provided the length of the discharge pipe does not include a vertical drop, between the crown of the trap and the invert of the branch drain, exceeds —
 - (i) 2 m for water closet pans with DN 80 discharge pipes;
 - (ii) 1.5 m for basins and bidets fitted with “S” traps; and
 - (iii) 2.5 m for all other fixtures.
- (b) 10 m from the weir of a disconnect gully.
- (c) 10 m from a sullage dump point.

NOTE See [Figure 3.10.3](#) for a typical example of the above.



Key

B	=	basin
Bth	=	bath
FW	=	floor waste
SHR	=	shower
WC	=	water closet

NOTE Total length of branch connections to fixtures to not exceed 10 m.

Figure 3.10.3 — Typical connections of ground-floor fixtures to unvented branch drains

3.10.4 Vertical sections

Where the fixture discharge pipe is the same size as the unvented branch drain to which it connects, the drain to the trap shall have a maximum of two vertical jump-ups, each not exceeding 2 m in height, and separated by not less than 300 mm of graded pipe.

3.10.5 Connection of fixture discharge pipes

Where fixtures are connected to unvented branch drains, the requirements for the fixture discharge pipes shall be the same configuration as for the connection of fixtures to group vented branches and conform to the following:

- [Clause 8.5.7.5.4](#) for connections of basins and bidets.
- [Clause 8.5.7.5.5](#) for connection of all other fixtures.

- (c) [Clause 3.10.3](#) for maximum length of unvented drains.

3.11 Unvented drains discharging to gullies

3.11.1 General

A drain that receives the discharge from waste fixtures only may be connected to a gully.

The maximum fixture unit loading and size of unvented branch drain shall conform to [Table 3.10.2](#).

3.11.2 Length of unvented section

The combined length of an unvented drain and fixture discharge pipe shall not exceed 10 m. The fixture discharge pipe shall conform to [Clauses 3.10.3](#) and [3.10.5](#). If the combined length of the unvented drain and fixture discharge pipe exceeds 10 m, the branch line shall be vented in accordance with [Clause 3.9.2](#) or [Clause 6.9](#).

3.12 Inlet pipe to disconnecter gully

Where the inlet pipe to a disconnecter gully is DN 65 or larger, multiple branches may be connected to such inlet pipe, provided all fixture traps are within 10 m of the disconnecter gully and within the fixture unit loading for pipe size and the disconnecter gully.

3.13 Restriction on connections in proximity to a stack

Discharge pipes from fixtures shall only connect to a drain in proximity to a stack in accordance with [Clause 6.8](#) and [Figure 6.8.1](#).

3.14 Connection of basement fixtures

Fixtures installed in basements or other locations where surcharge could occur shall be connected to the sewerage system by means of a pumping installation conforming to [Section 12](#).

3.15 Connections in flood-prone areas

3.15.1 Inlet above flood level

In areas subject to known flooding, the inlet to a sanitary plumbing and drainage system shall be positioned at least 150 mm above the declared flood level.

3.15.2 Inlet below flood level

Where inlets to fixtures, fittings or appliances cannot be installed at a height of 150 mm above the declared flood level, they shall be connected as follows:

- (a) The discharge of the fittings, fixtures and appliances shall be raised by ejector or pump conforming with [Section 12](#) to a height required by the regulatory authority and discharged into the sewer as and where directed.
- (b) An automatic, float-controlled device or similar device shall be installed to ensure that the ejector or pump ceases to operate during periods of flooding.

3.16 Re-use of existing sanitary drains

3.16.1 Re-use where buildings are demolished or removed

When a building containing sanitary plumbing and drainage is demolished or removed from site and a new building constructed, the following requirements shall apply to the use of existing sanitary drains up to the point of connection:

- (a) Mortar-jointed vitrified clay, mortar-jointed concrete, asbestos cement and fibre-reinforced cement pipes shall not be re-used unless they have been renovated using a structural plastics liner in accordance with [Clause 3.16.3](#).
- (b) Drains constructed of other materials shall not be re-used unless they have been verified for conformance in accordance with the relevant clauses of this document and tested in accordance with [Section 15](#) and found to be satisfactory.

Drains that do not conform to the requirements listed above shall be replaced or repaired and retested.

3.16.2 Re-use in existing buildings

For an existing building, including alterations or additions that will involve additional fixtures being connected to the existing drain, if that section of the existing drain is found to be defective it shall be renovated in accordance with [Clause 3.16.3](#) or a new section of drain installed.

3.16.3 Renovation techniques

3.16.3.1 Cured in place pipe

The renovation of a drain by the cured in place pipe (CIPP) technique shall be in accordance with [Appendix F](#) with the exception of [Clause F.3\(g\)](#) which does not apply.

NOTE CIPP renovation is the lining of a drain with a flexible tube impregnated with a thermosetting resin. This produces a rigid pipe after the resin has cured.

3.16.3.2 Other renovation techniques

Other renovation techniques shall be as follows:

- (a) *Lining with discrete pipes* — Lining with short lengths of pipe that are jointed to form a continuous pipe one by one during insertion, the cross-section of the lining pipe remaining unchanged.
- (b) *Lining with continuous pipes* — Lining with a pipe made continuous prior to insertion, where the diameter of the lining pipe remains unchanged.
- (c) *Lining with close-fit pipes* — Lining with a continuous pipe for which the cross-section is reduced to facilitate installation and expanded after installation to provide a close fit to the existing pipe.
- (d) *Lining with spirally wound pipes* — Lining with a profile strip, spirally wound to form a continuous pipe after installation.

[Appendix F](#) shall apply to the above renovation techniques with the exception of [Clauses F.3\(c\)](#) and [F.3\(f\)](#) which do not apply.

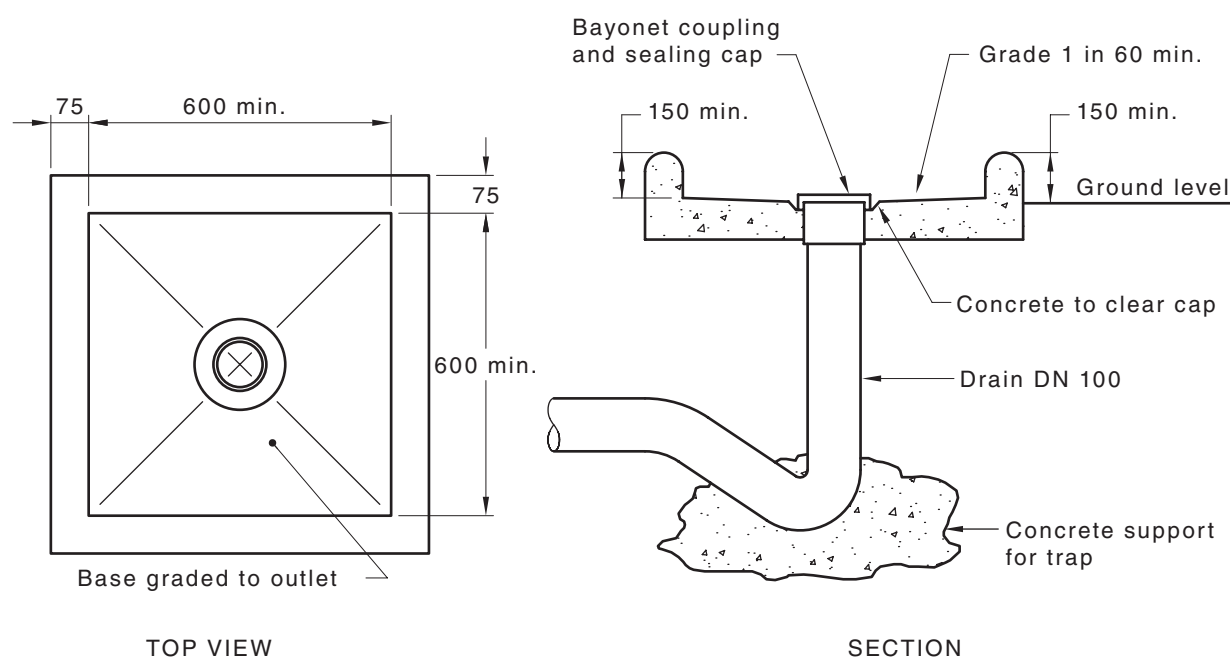
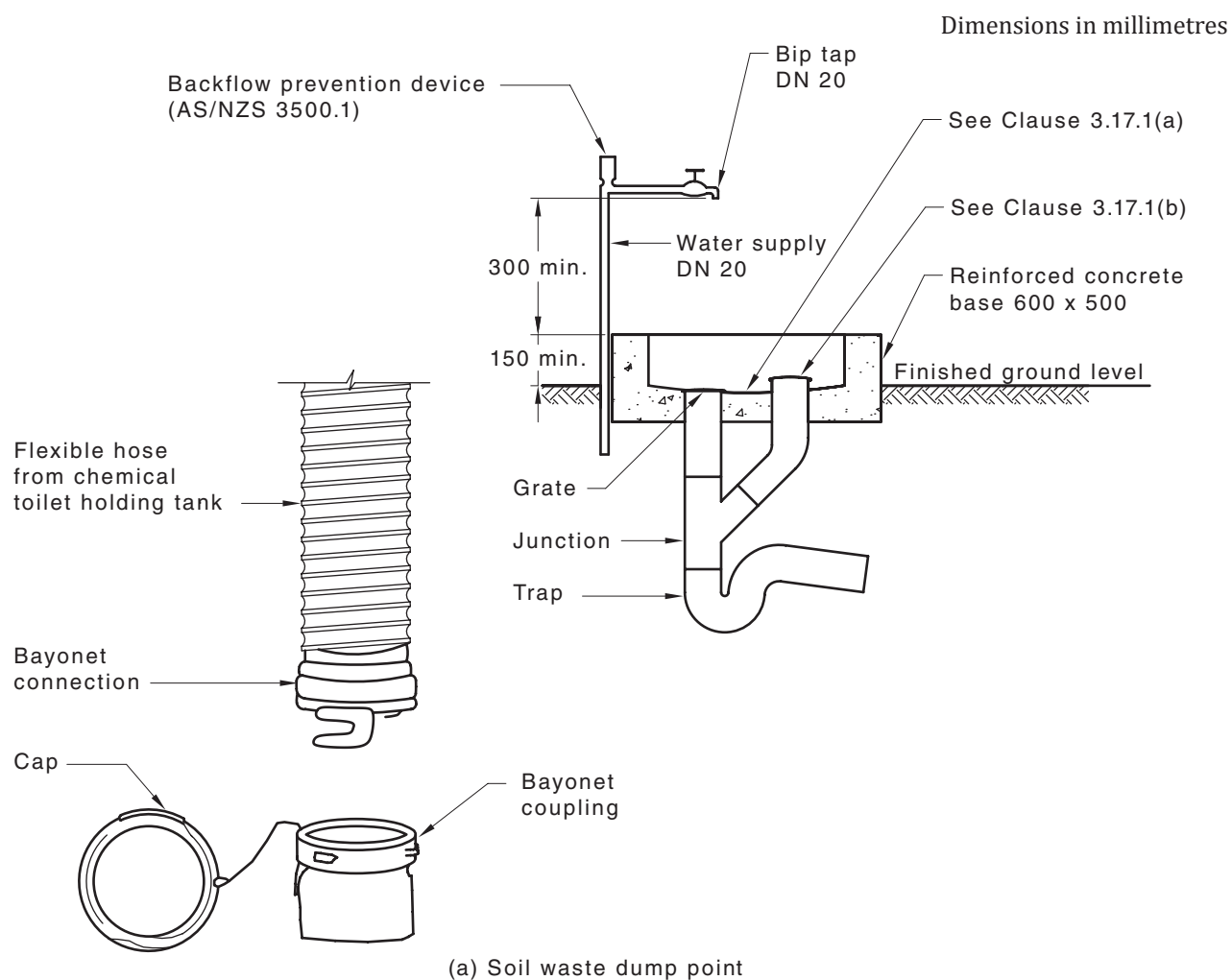
NOTE Refer to ISO 11295, ISO 11296-1 and ISO 11296-2 for further information on renovation techniques for these pipes.

3.17 Dump points

3.17.1 Soil waste dump points

Dump points for discharging the contents of holding tank type toilets within caravans and relocatable dwellings shall be in accordance with [Figure 3.17.1](#) and the following:

- (a) The concrete base shall be graded to the outlet at a grade of not less than 1 in 60.
- (b) The outlet pipework shall be DN 80 or DN 100.
- (c) The bayonet connection shall include a sealing cap and hose coupling. The connection shall be at least 25 mm clear of any obstruction.



NOTE Bib tap and backflow prevention device to be provided.

Figure 3.17.1 — Soil dump points

3.17.2 Connection points for short-term sites

Where sullage connection points are provided to serve individual caravans or mobile home sites, they shall be constructed in accordance with [Figures 3.17.2\(A\)](#) or [3.17.2\(B\)](#), as applicable.

Sullage points shall be positioned to obtain the shortest connection to the caravan. They shall be not more than 10 m from the vented drain.

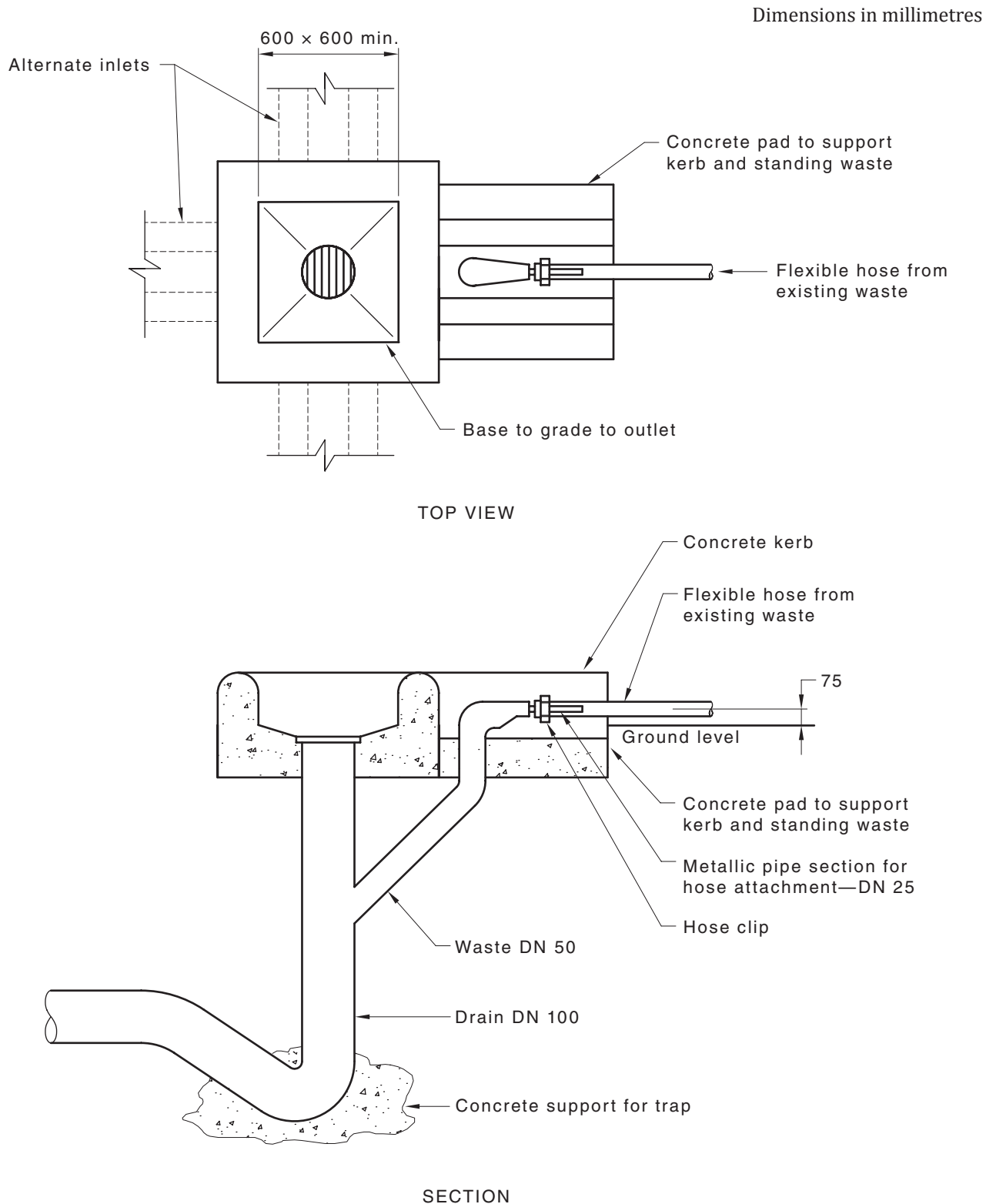


Figure 3.17.2(A) — Sullage dump point

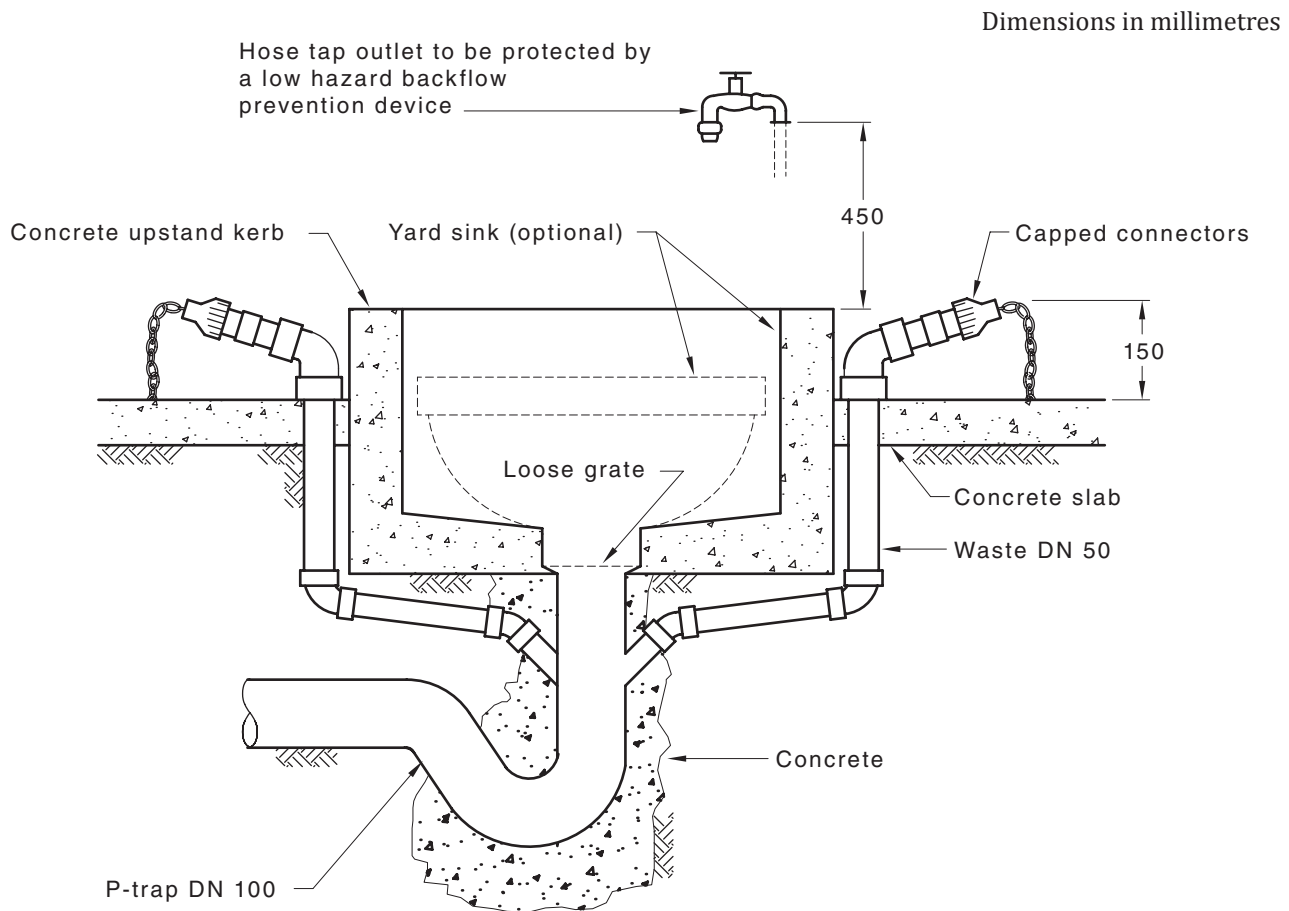


Figure 3.17.2(B) — Sullage dump point with multiple inlets

3.18 Drains connected to network utility operator vacuum sewerage systems

Drains connected to network utility operator vacuum sewerage systems shall be installed in accordance with the following:

- (a) An inspection shaft connected to the drain with a junction shall be placed as close as practicable to, and upstream of, the collection tank.
- (b) The junction inlet to the inspection shaft shall be against the grade of the drain so that any rodding of the line is in the direction away from the collection tank.
- (c) Where more than one drain is connected to a collection tank, the spill level of both overflow gullies of the drains shall be installed level with each other wherever practicable.
- (d) A DN 100 open vent pipe shall be provided at the upstream end of each drain connected to the collection tank. A DN 100 downstream vent shall be located within 10 m of the collection tank. No fixtures shall be connected between the collection tank and the downstream vent connection.

NOTE 1 In addition to the open vents, air admittance valves, installed in accordance with [Clause 6.10](#) may be used to provide additional venting of drains connected to a collection tank.

NOTE 2 Jump-ups should be avoided.

NOTE 3 Vacuum drainage systems are covered in [Section 16](#).

3.19 Common effluent drainage system

3.19.1 General

All sanitary plumbing and sanitary drainage in common effluent drainage systems shall conform to the relevant sections of this document.

3.19.2 Drainage connections

Drains connected to common effluent drainage systems shall be installed in accordance with the following:

- (a) Discharge from fixtures shall pass through a septic tank.

NOTE 1 Where this is impracticable due to location and available fall, discharge from waste fixtures may pass through a sullage tank.
- (b) Drains from septic or sullage tanks to the common effluent drain shall be not less than DN 80 and not more than DN 100. They shall be laid at a grade of not less than 1 % (1 in 100).
- (c) Induct vents shall not be installed on septic tanks. Where induct vents are installed on an existing septic tank, they shall be removed before connecting the septic tank to a common effluent drainage system.
- (d) Inspection openings shall be provided in accordance with [Clause 4.7](#) and included on —
 - (i) the inlet to an on-site wastewater treatment unit; and
 - (ii) the outlet of the on-site wastewater treatment unit, within 2.5 m of the tank, where the connecting drain is greater than 10 m in length.
- (e) Existing and new drains shall be tested in accordance with [Section 15](#).
- (f) Soakage trenches, and stormwater, roof water and subsoil water drainage shall not be connected to a common effluent drainage system.

NOTE 2 Typical connections are shown in [Figures 3.19.2\(A\), 3.19.2\(B\), 3.19.2\(C\)](#) and [3.19.2\(D\)](#).

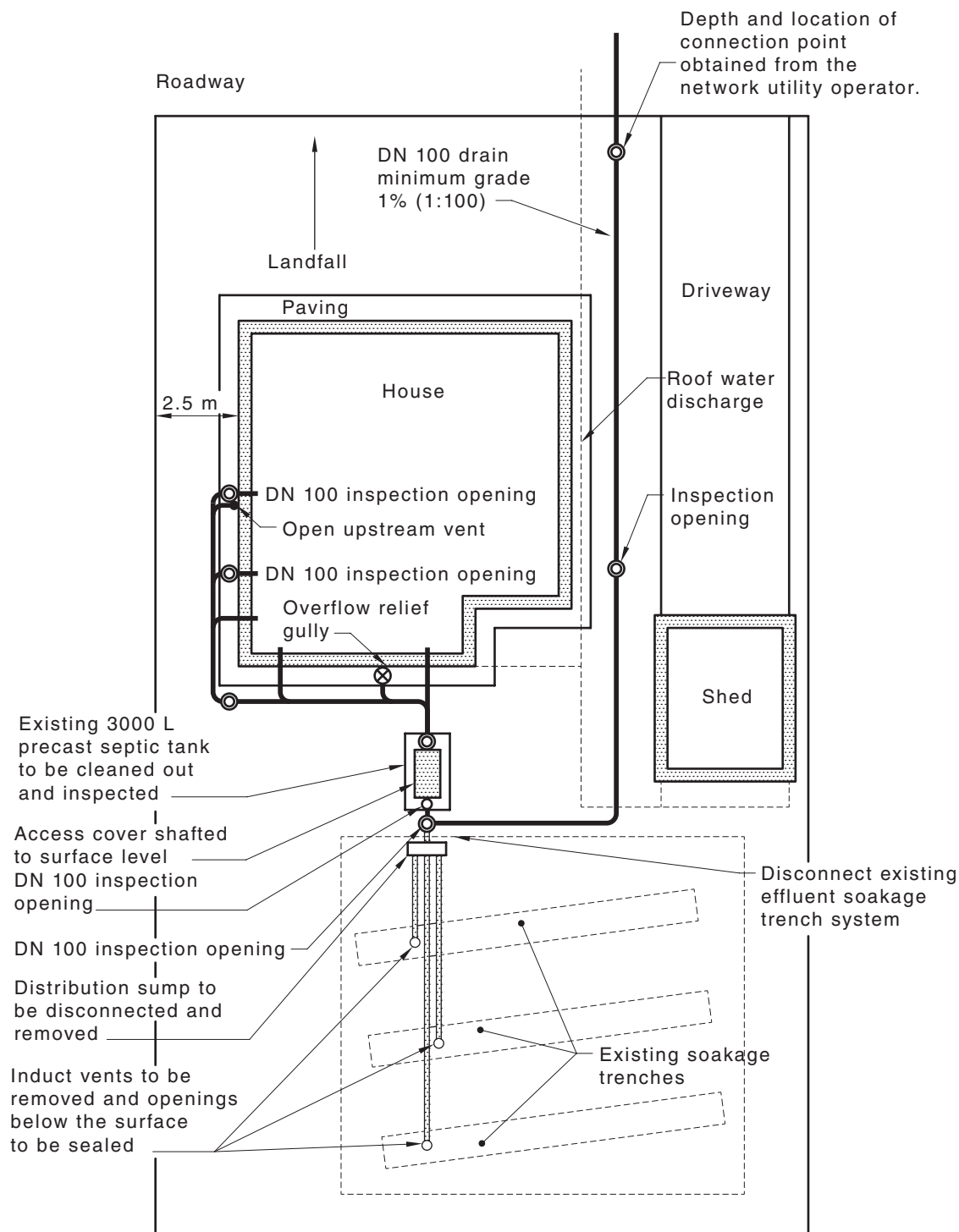


Figure 3.19.2(A) — Typical site layout plan showing connection details for an all-waste septic tank system

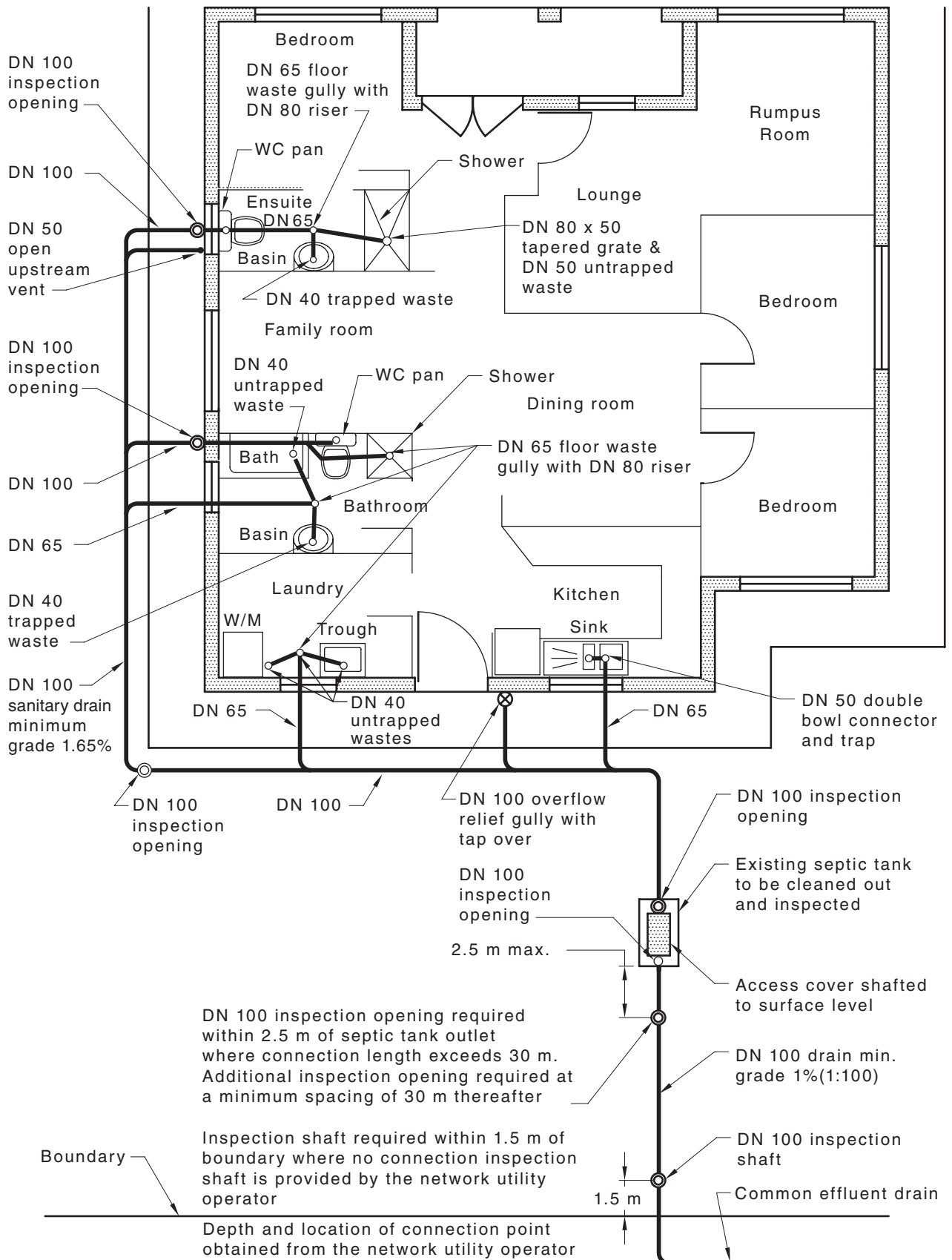


Figure 3.19.2(B) — Typical connection of septic tank to common effluent drain (existing all-waste septic tank installation only)

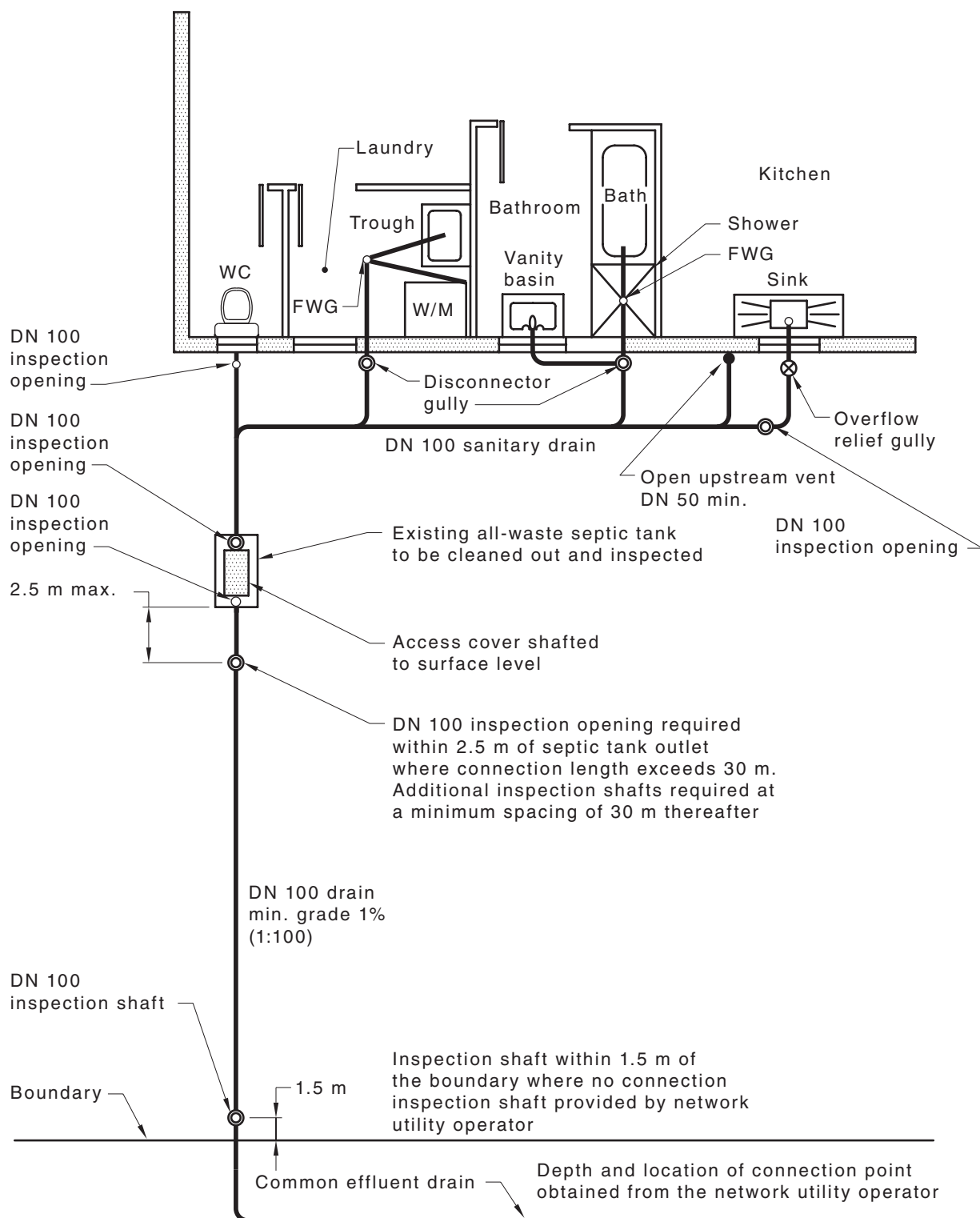


Figure 3.19.2(C) — Typical connection details for an all-waste septic tank system