MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Please find enclosed Amendment 11, effective 5 November 2020, to Acceptable Solutions E1/AS1 and Verification Method E2/VM1, and a new Acceptable Solution E1/AS2, for Clause E1 Surface Water of the New Zealand Building Code. The previous amendment to the E1 Acceptable Solutions and Verification Methods (Amendment 10) was in January 2017.

Section	Previous amendment	November 2020 Amendment 11
Title page	Remove title page and document status and history pages 1–2B	Replace with new title page and document status and history pages 1–2B
Contents	Remove page 5/6	Replace with new page 5/6
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Definitions	Remove page 9/10	Replace with new page 9/10
E1/VM1	Remove pages 13/14	Replace with new page 13/14
E1/AS1	Remove pages 33–40, 43/44	Replace with new pages 33–40, 43/44
E1/AS1 Appendix 1	Remove page 45/46	Replace with new pages 45–52
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MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Acceptable Solutions and Verification Methods

For New Zealand Building Code Clause **E1 Surface Water**

E1
BUILDING CODE

Status of Verification Methods and Acceptable Solutions

Verification Methods and Acceptable Solutions are prepared by the Ministry of Business, Innovation and Employment in accordance with section 22 of the Building Act 2004. Verification Methods and Acceptable Solutions are for use in establishing compliance with the New Zealand Building Code.

A person who complies with a Verification Method or Acceptable Solution will be treated as having complied with the provisions of the Building Code to which the Verification Method or Acceptable Solution relates. However, using a Verification Method or Acceptable Solution is only one method of complying with the Building Code. There may be alternative ways to comply.

Users should make themselves familiar with the preface to the New Zealand Building Code Handbook, which describes the status of Verification Methods and Acceptable Solutions and explains alternative methods of achieving compliance.

Defined words (italicised in the text) and classified uses are explained in Clauses A1 and A2 of the Building Code and in the Definitions at the start of this document.

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Verification Methods and Acceptable Solutions
are available from www.building.govt.nz

New Zealand Government

Document Status

The most recent version of this document (Amendment 11), as detailed in the Document History, is approved by the Chief Executive of the Ministry of Business, Innovation and Employment. It is effective from 5 November 2020 and supersedes all previous versions of this document.

The previous version of this document (Amendment 10) will cease to have effect on 3 November 2021.

People using this document should check for amendments on a regular basis. The Ministry of Business, Innovation and Employment may amend any part of any Verification Method or Acceptable Solution at any time. Up-to-date versions of Verification Methods and Acceptable Solutions are available from www.building.govt.nz

E1: Document History

	Date	Alterations	
First published	July 1992		
Amendment 1	September 1993	pp. vi and vii, References p. 14, 3.2.1, Figure 3 p. 16, Table 2 p. 18, 3.7.4 p. 20, Figure 13	p. 21, Figure 14 p. 22, Table 4, Table 5, 5.1, 5.1.1, 5.1.2 p. 23, Figure 15, Figure 16 p. 24, 5.1.3, 5.1.4
Amendment 2	19 August 1994	pp. i and ii, Document History p. vi, NZS 3441 replaced NZS 3403	p. 21, 3.9.8 p. 22, Table 4, Table 5 p. 24, 5.1.3, Table 6
Reprinted incorporating Amendments 1 and 2 – October 1994			
Amendment 3	1 December 1995	p. ii, Document History	p. iii, E1.3.1
Reprinted incorporating Amendments 1, 2 and 3 – July 1996			
Amendment 4	1 December 2000	p. ii, Document History p. v, Contents pp. vi and vii, References	p. viii, Definitions pp. 1 – 12K, Revised VM1 pp. 27 and 28, Index
Amendment 5		p. 2, Document History, Status p. 7, References p. 31, 9.0.5	p. 39, 3.8.1 p. 42, 4.3.2
Amendment 6	6 January 2002	p. 3 Code Clause E1	
Reprinted incorporating Amendments 4, 5 and 6 – September 2003			
Amendment 7	Published 30 June 2010 Effective from 30 September 2010	p. 2, Document History, Status pp. 7 and 8, References pp. 9 and 10, Definitions p. 34, E1/AS1 Table 1 p. 37, E1/AS1 Table 3	p. 41, E1/AS1 3.9.8 p. 42, E1/AS1 Table 4 p. 44, E1/AS1 Table 6 p. 47, Index
Reprinted incorporating Amendment 7 – 30 September 2010			
Erratum 1 30 September 2010			p. 43, Figure 16
Amendment 8	Effective from 10 October 2011 until 14 August 2014	p. 2, Document History, Status pp. 7 and 8, References p. 9, Definitions	p. 34, E1/AS1 Table 1 p. 37, E1/AS1 Table 3 p. 42, E1/AS1 Table 4
Amendment 9	14 February 2014 until 30 May 2017	p. 2A Document History, Status p. 7 References p. 9 Definitions	p. 41, E1/AS1 3.9.7 p. 44, E1/AS1 5.5.2

E1: Document History (continued)

	Date	Alterations	
Amendment 10	Effective 1 January 2017 until 3 November 2021	pp. 7, 8 Re1erences p. 12 E1/VM1 Table 1	p. 31 E1/VM1 9.0.6
Amendment 11	Effective 5 November 2020	p. 5 Contents pp. 7–8 References p. 9 Definitions p. 13 E1/VM1 2.2.1 p. 34 E1/AS1 3.2.2, Table 1 p. 37 E1/AS1 3.6.1	p. 40 E1/AS1 Figure 13 p. 44 E1/AS1 5.1.5, Table 6 pp. 45– 51 E1/AS1 Appendix A pp. 52–55 New Acceptable Solution E1/AS2 included p. 57 Index

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Amend 1 Sep 1993
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For the purposes of New Zealand Building Code (NZBC) compliance, the Standards and documents referenced in this Verification Method and Acceptable Solutions (primary reference documents) must be the editions, along with their specific amendments, listed below. Where these primary reference documents refer to other Standards or documents (secondary reference documents), which in turn may also refer to other Standards or documents, and so on (lower-order reference documents), then the version in effect at the date of publication of this Verification Method and Acceptable Solutions must be used.

Standards New Zealand

			Where quoted	
	NZS/BS 970:-	Specification for wrought steels for mechanical and allied engineering purposes		
Amend 1 Sep 1993	Part 1: 1991	General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels *Amend: 1*	AS1 Table 4, Table 6	
Amend 9 Feb 2014 Amend 10 Jan 2017	AS/NZS 1254: 2010	PVC pipes and fittings for stormwater and surface water applications *Amend: 1, 2*	AS1 Table 1, Table 3	
Amends 9, 10, 11	AS/NZS 1260: 2017	PVC-U Pipes and fittings for drain, waste and vent application	AS1 Table 1, Table 4	Amend 11 Nov 2020
	AS/NZS 1734: 1997	Aluminium and aluminium alloys – Flat sheets, coiled sheet and plate	AS1 Table 4, Table 6	
Amend 8 Oct 2011	AS/NZS 2032: 2006	Installation of PVC Pipe Systems *Amend: 1*	AS1 Table 3, 3.9.8	
Amend 8 Oct 2011	AS/NZS 2033: 2008	Installation of polyethylene pipe systems *Amend: 1, 2*	AS1 Table 3	
Amends 9, 10, 11	AS/NZS 2280: 2014	Ductile iron pipes and fittings *Amend: 1, 2*	AS1 Table 1, Table 3	
	AS/NZS 2566:-	Buried Flexible pipelines		
Amend 7 Sep 2010	Part 1: 1998	Structural Design	AS1 3.9.8	
Amends 10 and 11	Part 2: 2002	Installation *Amend: 1, 2, 3*	AS1 3.9.8, Table 3	Amend 8 Oct 2011
	AS/NZS 3500:-	Plumbing and drainage		
Amend 11 Nov 2020	Part 3: 2018	Stormwater drainage	AS2 1.0, 1.0.1, 1.0.4	
Amends 1, 4, 7, 8, 9	NZS 3604: 2011	Timber framed buildings	AS1 3.9.7	Amend 5 July 2001
Amend 7 Sep 2010	AS/NZS 4058: 2007	Precast concrete pipes (pressure and non-pressure)	AS1 Table 1	
Amends 8 , 9, 10, 11	AS/NZS 4130: 2018	Polyethylene (PE) pipes for pressure applications	AS1 Table 1	

		Where quoted
NZS 4229: 2013	Concrete masonry buildings not requiring specific design	AS1 3.9.7

Amends 1, 4, 10

NZS 4442: 1988	Welded steel pipes and fittings for water, sewage and medium pressure gas	AS1 Table 1, Table 3

Amend 7 Sep 2010

Amend 8 Oct 2011

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AS/NZS 5065: 2005	Polyethylene and polypropylene pipe and fittings for drainage and sewerage applications *Amend: 1, 2*	AS1 Table 1

British Standards Institution

Amend 7 Sep 2010

Amend 8 Oct 2011

BS EN 1172: 1997	Copper and copper alloys – sheet and strip for building	AS1 Table 4, Table 6
BS EN 1759	Flanges and their joints.	
Part 1: 2004	Circular flanges for pipes, valves, fittings and accessories, class-designated. Steel flanges, NPS 1/2 to 24.	AS1 Table 3

Amend 7 Sep 2010

Amend 8 Oct 2011

Amend 7 Sep 2010

Standards Association of Australia

Amend 7 Sep 2010

AS 1273: 1991	Unplasticised PVC (UPVC) downpipes and fittings for rainwater	AS1 Table 4, Table 6
AS 1397: 2011	Continuous hot-dip metallic coated steel sheet and strip – Coatings of zinz and zinc alloyed with aluminium and magnesium *Amend: 1*	AS1 Table 4, Table 6
AS 1579: 2001	Arc welded steel pipes and fittings for water and waste water	AS1 Table 1
AS 1646: 2007	Elastomeric seals for waterworks purposes	AS1 Table 3
AS 1741: 1991	Vitrified clay pipes and fittings with flexible joints – sewerage quality	AS1 Table 1

Amend 11 Nov 2020

Amend 7 Sep 2010

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Amends 7 and 11

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AS 3706:-	Geotextiles – Methods of test	
Part 1: 2012	General requirements, sampling, conditioning, basic physical properties and statistical analysis	VM1 9.0.4

New Zealand Legislation

Resource Management Act 1991		VM1 2.1.2

Definitions

Amend 7 Sep 2010

This is an abbreviated list of definitions for words or terms particularly relevant to this Verification Method and Acceptable Solutions. The definitions for any other italicised words may be found in the New Zealand Building Code Handbook.

Amends 9 and 11

Access chamber A chamber with working space at *drain* level through which the *drain* passes either as an open channel or as a pipe incorporating an inspection point.

Amend 11 Nov 2020

Annual Exceedance Probability (AEP) The probability that a given rainfall intensity will be exceeded in any one year, expressed as a percentage.

Amend 7 Sep 2010

Building has the meaning given to it by sections 8 and 9 of the *Building Act 2004*.

Construct in relation to a *building*, includes to build, erect, prefabricate, and relocate; and *construction* has a corresponding meaning.

Drain A pipe normally laid below ground level including fittings and equipment and intended to convey *foul water* or *surface water* to an *outfall*.

Inspection chamber A chamber with working space at ground level through which the *drain* passes either as an open channel or as a pipe incorporating an *inspection point.*

Inspection point A removable cap at *drain* level through which access may be made for cleaning and inspecting the drainage system.

Network utility operator means a *person* who:

(a) undertakes or proposes to undertake the distribution or transmission by pipeline of natural or manufactured gas, petroleum, biofuel, or geothermal energy; or

Amend 8 Oct 2011

(b) operates or proposes to operate a network for the purpose of

(i) telecommunication as defined in section 5 of the Telecommunications Act 2001; or

(ii) radiocommunications as defined in section 2(1) of the Radiocommunications Act 1989; or

(c) is an electricity operator or electricity distributor as defined in section 2 of the Electricity Act 1992 for the purpose of line function services as defined in that section; or

Amend 7 Sep 2010

(d) undertakes or proposes to undertake the distribution of water for supply (including irrigation); or

(e) undertakes or proposes to undertake a drainage or sewerage system.

Amend 7 Sep 2010

Other property means any land or *buildings* or part thereof which are:

a) Not held under the same *allotment*; or

b) Not held under the same ownership – and includes any road.

Outfall That part of the disposal system receiving *surface water* or *foul water* from the drainage system. For *foul water*, the *outfall* may include a *foul water sewer* or a septic tank. For *surface water*, the *outfall* may include a natural water course, kerb and channel, or a soakage system.

Rodding point A removable cap at ground level through which access may be made for cleaning and inspecting the drainage system.

Secondary flow path The path over which *surface water* will follow if the drainage system becomes overloaded or inoperative.

Sewer A *drain* that is under the control of, or maintained by, a *network utility operator*.

Sitework means work on a *building* site, including earthworks, preparatory to or associated with the *construction, alteration,* demolition or removal of a *building.*

Sump A chamber which is installed in the *drain* and incorporates features to intercept and retain silt, gravel and other debris.

Surface water All naturally occurring water, other than sub-surface water, which results from rainfall on the site or water flowing onto the site, including that flowing from a *drain*, stream, river, lake or sea.

Territorial authority (TA) means a city council or district council named in Part 2 of Schedule 2 of the Local Government Act 2002; and—

a) in relation to land within the district of a *territorial authority,* or a *building* on or proposed to be built on any such land, means that *territorial authority*; and

b) in relation to any part of a coastal marine area (within the meaning of the Resource Management Act 1991) that is not within the district of a *territorial authority,* or a *building* on or proposed to be built on any such part, means the *territorial authority* whose district is adjacent to that part.

Amend 7
Sep 2010

Trap A chamber which is installed in the *drain* and incorporates features to intercept and retain floatable debris.

duration information produced by NIWA shall be used to determine the rainfall intensity.

COMMENT:

Rainfall intensity curves are available for most areas. These have been developed from meteorological data. Rainfall frequency-duration tables for each official rain gauge throughout New Zealand are also available.

Rainfall intensity data is also available online in digital form from the National Institute for Water and Atmospheric Research (NIWA) High Intensity Rainfall Design System (HIRDS).

HIRDS provides rainfall intensity estimates for any location in New Zealand based on historical rain gauge data and also projections of future rainfall intensities for various climate change scenarios.

Where differing design rainfall intensities are provided for a particular location, the most conservative rainfall intensity should be used for design calculations.

Amend 11 Nov 2020

Table 2: Slope Correction for Run-off Coefficients
Paragraph 2.1.3

Ground slope	Adjust C by:	
0-5%	subtracting	0.05
5-10%	no adjustment	
10-20%	adding	0.05
20% or steeper	adding	0.10

2.3 Time of concentration

2.3.1 The time of concentration used to determine rainfall intensity is the time taken for *surface water* run-off from the furthest point (in time) of the catchment to reach the design point. Flow time calculations shall take account of catchment run-off coefficients and slopes.

Time of concentration for the catchment t_c (minutes) shall be calculated from the formula:

$t_c = t_e + t_f$

but shall be no less than 10 minutes.

Where

t_e = time of entry (minutes) which is the run-off time for overland travel (i.e. via ground, roofs, downpipes, carriageways or road channels) to the point of entry to a *drain* or open channel.

t_f = time (minutes) of network flow, (comprising flow in pipes and open channels), to the design point.

COMMENT:

In some catchments due to shape, *surface water* network and varying permeabilities within the catchment, part of the catchment under consideration may produce a higher peak flow than the whole of the catchment. Although the area for the part catchment is smaller, this may be more than offset by the higher intensity storm associated with a shorter time of concentration and storm duration. This situation will generally arise where the lower reaches of a catchment are densely developed.

2.3.2 Time of entry t_e

The time of entry t_e:

a) Where the catchment area has a well defined and regularly repeated pattern for directing the *surface water* to the *drain* or open channel, the time of entry may be taken as:

t_e = 5 minutes for commercial or industrial areas where greater than 50% of the surface of the catchment area feeding the *drain* or open channel consists of roofed, asphalt, concrete, paved or metalled surfaces.

t_e = 7 minutes for residential areas where the impervious area exceeds 50% of gross area.

t_e = 10 minutes for low density residential areas where the impervious area is 36% to 50% of gross area.

b) Where the catchment does not have a well defined and regularly repeated pattern or where the catchment is longer than 1.0 km, the time of entry t_e shall be the sum of the time of overland flow and, if applicable, the time of road channel flow as given in i) and ii) below:

i) the time of overland flow shall be determined by the formula:

$t = 100\ nL^{0.33}/s^{0.2}$

where

t = time (minutes).

L = length of overland flow (m).

s = slope (%).

n = Manning's 'n' (roughness coeffiecient).

The results from this formula, for normal surface types, are shown in Figure 1.

ii) The time of road channel flow, which is the time taken for water to flow from the point of entering the road channel, to the point of discharge to a *sump*, catchpit, *drain* or other outlet, shall be determined from Figure 2.

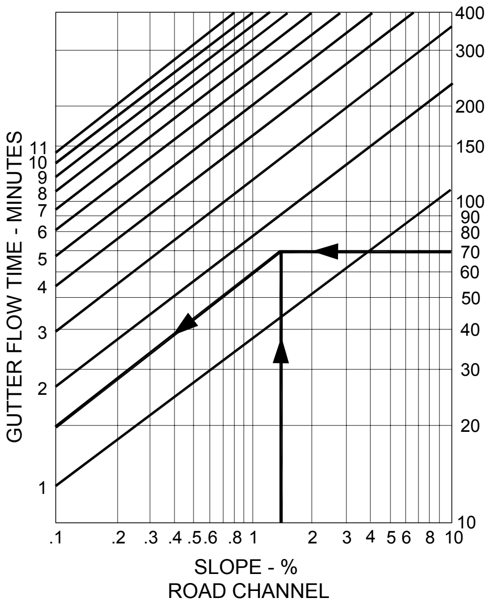
2.3.3 Time of network flow

The time of network flow t_f shall be determined from the sum of the travel times within pipes and open channels.

2.3.4 Time of pipe flow

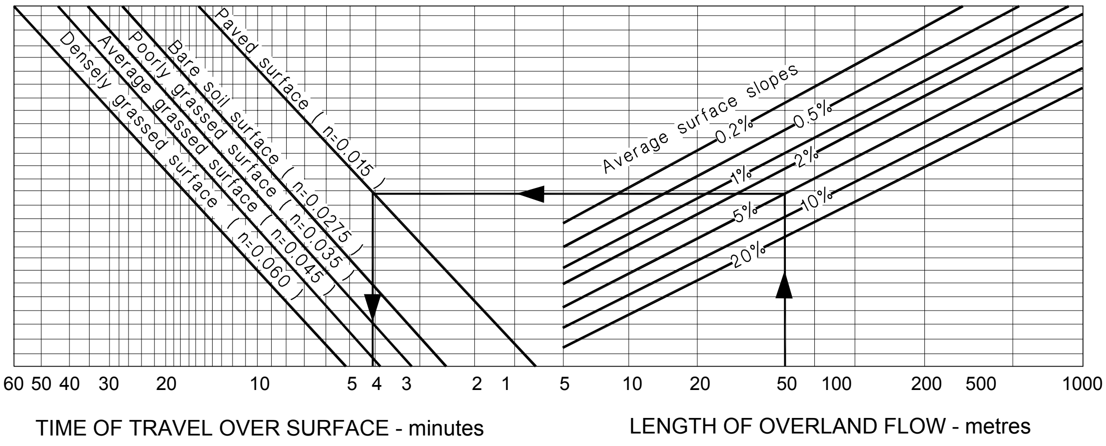
The time of pipe flow shall be calculated from the velocity as determined from Figure 3. Where the pipe changes in material, diameter or gradient the time taken in each section of the pipe shall be calculated and the component times summed. For pipes with Manning's 'n' other than 0.013 the velocity determined from Figure 3 shall be multiplied by the ratio of 0.013/n. Other values of Manning's 'n' for different pipe materials are given in Table 3.

Figure 2: **Road Channel Flow Time**
Paragraph 2.3.2 b) ii)



Example: For a slope of 1.4% and a road channel length of 70 metres the time of road channel flow is 1.7 minutes

Figure 1: **Times for Overland Flow**
Paragraph 2.3.2 b) i)



Example: For surface water flowing 50 m over a paved surface at a slope of 5 % the time of travel is 4.1 minutes

Acceptable Solution E1/AS1

1.0 Limitations of the Solution

1.0.1 This Acceptable Solution is limited to *buildings* and *sitework* having a catchment area of no more than 0.25 hectares and which are:

a) Free from a history of flooding,

b) Not adjacent to a watercourse,

c) Not located in low lying area, and

d) Not located in a *secondary flow path.*

COMMENT:
Boundary fences and other site development must not significantly hamper the flow of *surface water* from the site.

2.0 Minimum Acceptable Floor Level

2.0.1 Suspended floors and slabs on ground shall be at least 150 mm above the finished level of the surrounding ground immediately adjacent to the *building*, and:

a) For sites level with or above the road, no less than 150 mm above the road crown on at least one cross-section through the *building* and roadway (see Figure 1).

b) For sites below the road, no less than 150 mm above the lowest point on the site boundary (see Figure 2).

Figure 1: **Minimum Floor Level for Site Above Road**
Paragraph 2.0.1 a)

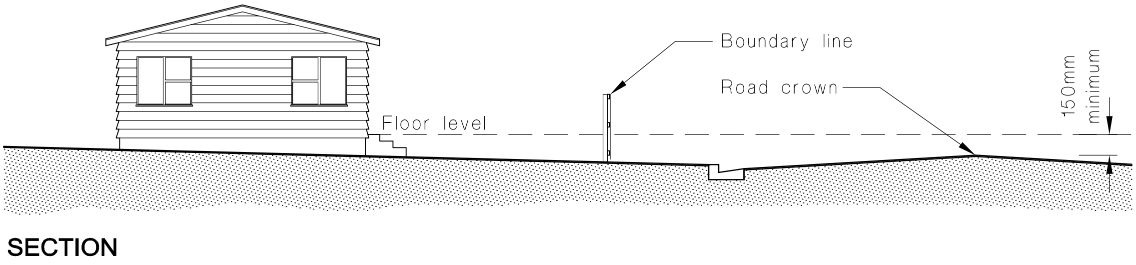
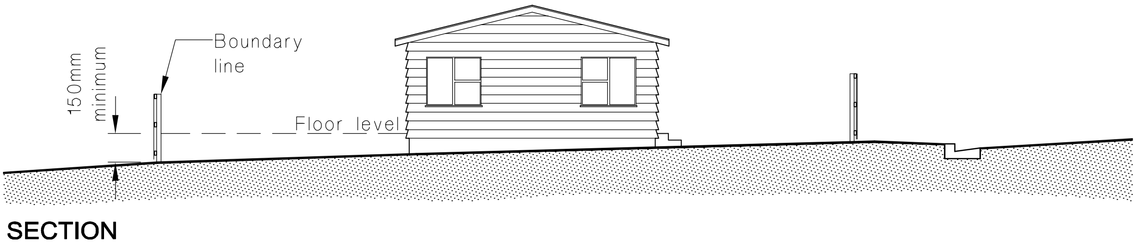


Figure 2: **Minimum Floor Level for Site Below Road**
Paragraph 2.0.1 b)



3.0 Drainage System Materials and Construction

3.1 Materials

3.1.1 Pipe materials shall comply with the standards given in Table 1.

Table 1: Acceptable Pipe Materials
Paragraphs 3.1.1 and 3.9.2

Concrete	AS/NZS 4058
Vitrified clay	AS 1741
Steel	NZS 4442 or AS 1579
Ductile iron	AS/NZS 2280
PVC-U	AS/NZS 1260 or AS/NZS 1254
Polyethylene	AS/NZS 4130 or AS/NZS 5065
Polypropylene	AS/NZS 5065

Amend 7 Sep 2010

Amends 8 and 11

3.2 Sizing of drains

3.2.1 *Drains* shall be of sufficient size and gradient to transport *surface water* from the site, and be capable of handling the rainfall calculated to fall on roof and paved areas of the site during a storm with a 10% probability of occurring annually. No *drain* shall have an internal diameter of less than 85 mm.

Amend 1 Sep 1993

3.2.2 Figure 3 provides a method for selecting the correct pipe size for a calculated modified catchment area, given as:

Modified catchment area = 0.01 AI,

where

A = area being drained comprising plan roof area (m^2) plus paved area (m^2). Paved area includes paving blocks, concrete, asphalt or metalled surfaces.

I = rainfall intensity for a storm with a 10% probability of occurring annually and a 10 minute duration (mm/hr).

The rainfall intensity (I) shall be obtained from the *territorial authority* or from the Table in Appendix A.

COMMENT:
Where there are differences between the design rainfall intensities obtained from the above sources for a particular location, the most conservative rainfall intensity should be used for design calculations.

Territorial Authorities may refer to any available Regional Council rainfall data to establish design rainfall intensities for their city or district.

Amend 11 Nov 2020

3.2.3 The modified catchment area method is only suitable for the combination of pipe sizes, gradients and areas indicated in Figure 3. For other combinations specific design is required.

3.3 Alignment and gradient of drains

3.3.1 *Drains* shall be laid on a uniform line and gradient between points of access (see Paragraph 3.7). The change in direction of a *drain* shall not exceed 90° at any point, and where practical should be kept to less than 45° as illustrated in Figure 4.

3.3.2 Where two *drains* intersect, the directions of flow as shown in Figure 5 shall be at an angle of 60° or less.

3.4 Minimum gradients

3.4.1 Minimum acceptable gradients for *surface water drains* are given in Table 2.

Table 2: Minimum Gradients
Paragraph 3.4.1

Drain internal diameter	Minimum gradient
85 mm	1 in 90
100 mm	1 in 120
150 mm	1 in 200
225 mm	1 in 350

Amend 1 Sep 1993

3.4.2 Restricted fall to outlet

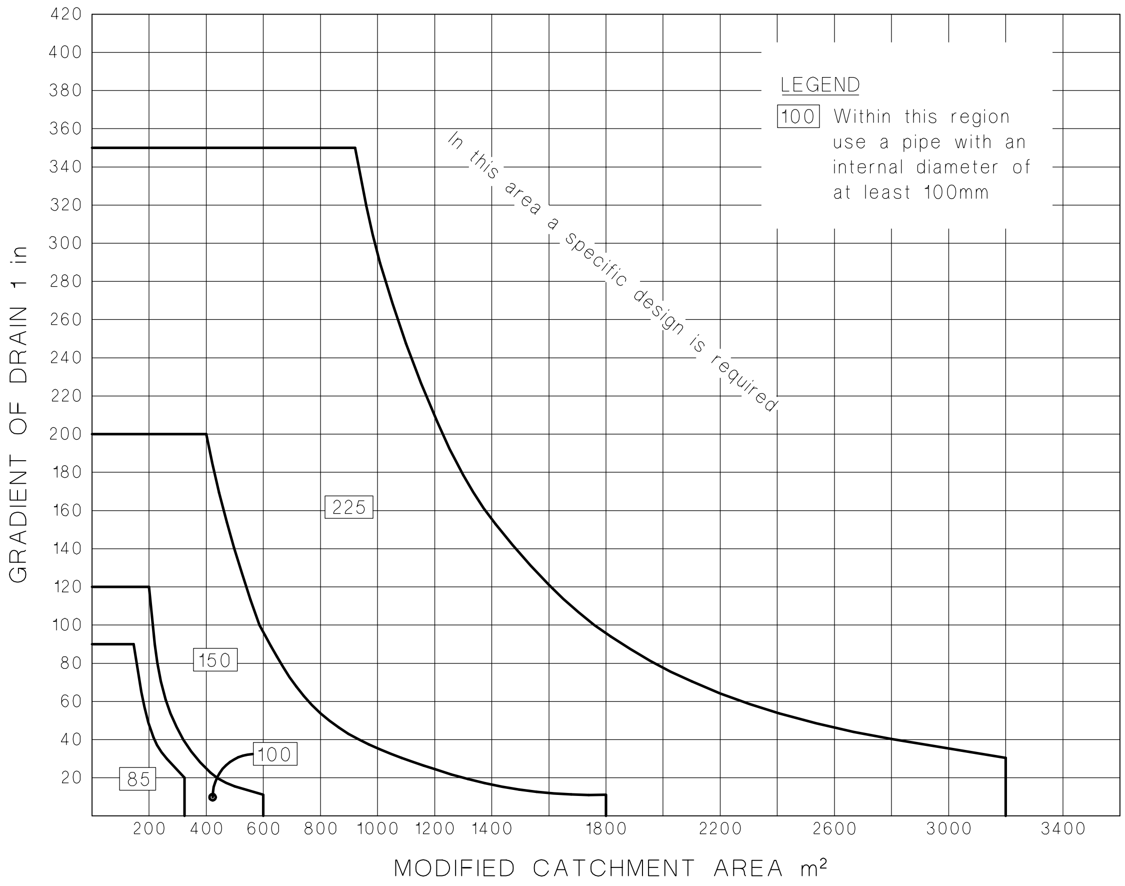
Where the *surface water sewer*, road channel or other *outfall* is at too high a level to allow the gradient required by Table 2, the bubble-up chamber system shown in Figures 6 and 7 may be used provided that:

a) The ground level adjacent to any downpipe discharging to the bubble-up chamber is at least 150 mm higher than the level of the top of the chamber outlet.

b) The connections between the *drain* and downpipes are sealed.

Continued on page 36

Figure 3: **Sizing of Surface Water Drains**
Paragraphs 3.2.2 and 3.2.3



Amend 1
Sep 1993

Figure 4: **Changes of Direction**
Paragraph 3.3.1

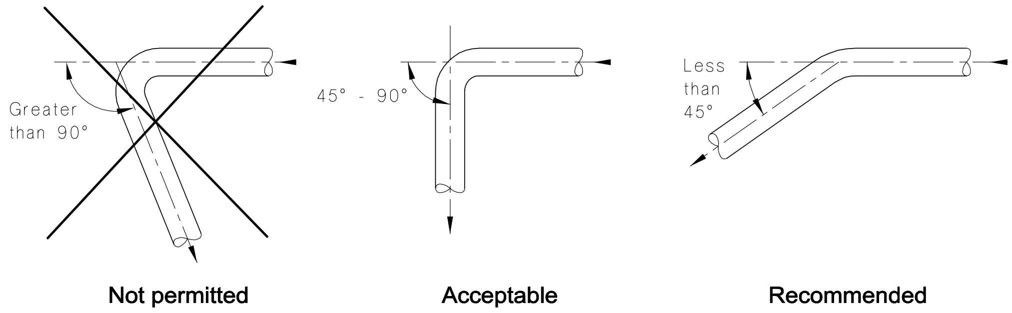


Figure 5: **Junction of Drains**
Paragraph 3.3.2

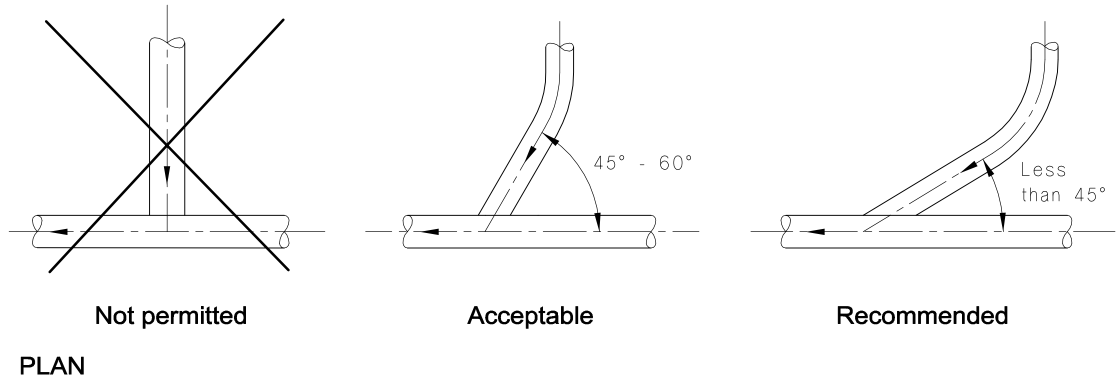
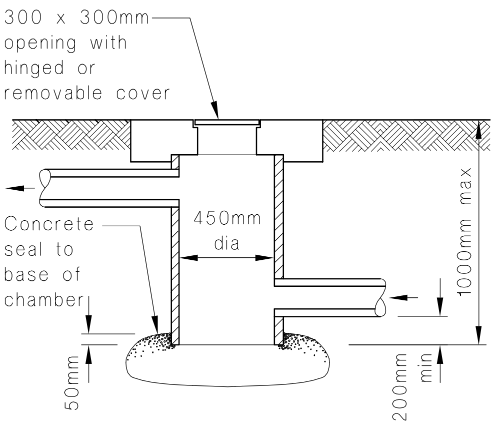


Figure 6: **Bubble-up Chamber**
Paragraph 3.4.2



c) The total chamber depth does not exceed 1.0 m.

COMMENT:

The bubble-up chamber allows the water to be discharged through pipes laid at the allowable minimum gradients, and for the convenient collection and removal of any silts or debris which might enter the system.

3.5 Jointing of drains

3.5.1 All joints in *drains* shall be watertight and prevent the infiltration of groundwater and the intrusion of tree roots.

3.5.2 Acceptable jointing methods and the relevant standards are given in Table 3. Jointing of *drains* shall be subject to the tests called for in Paragraph 3.8.

3.5.3 Where a *drain* consists of concrete, ceramic, vitrified clay or rubber ring jointed steel or uPVC, a flexible joint shall be installed within 225 mm of the outside wall of any *access chamber* or *inspection chamber*, but outside the line of the base (see Figures 11 and 12).

COMMENT:
This allows for differential settlement between the *access chamber,* or the *inspection chamber,* and the pipeline while minimizing damage to the pipeline.

3.6 Surface water inlets to drains

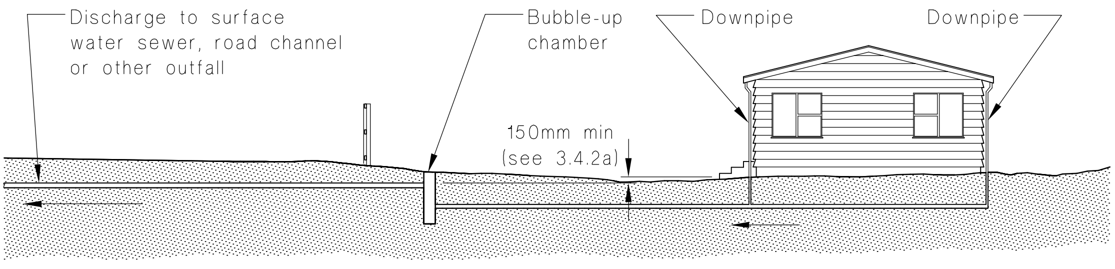
3.6.1 All *surface water*, except that collected directly from a roof, shall enter the *drain* via a *sump* which has:

a) A grating, hinged or removable for maintenance access. The grating shall comprise at least 35% openings. The smaller dimension of any individual opening shall not exceed 35 mm,

b) Capacity at the bottom for settlement of silt and debris, and

c) A submerged (or trapped) outlet which prevents floatable solids entering the *drain*.

Figure 7: **Longitudinal Section of Bubble-up Chamber System**
Paragraph 3.4.2



SECTION

Table 3: **Acceptable Jointing Methods**
Paragraph 3.5.2

Amend 7 Sep 2010

Amend 8 Oct 2011

Pipe material	Jointing method	Standard
Concrete	Elastomeric ring	AS 1646
Steel	Elastomeric ring, welded or flanged	NZS 4442, BS EN 1759.1
Ductile iron	Elastometric ring or flanged	AS/NZS 2280
PVC-U	Electromeric ring or solvent welded	AS 1646, AS/NZS 2032, AS/NZS 1254
Polyethylene	Heat welded or flanged	AS/NZS 2033
Polypropylene		AS/NZS 2566.2

Amend 11 Nov 2020

COMMENT:
For compliance with this Acceptable Solution, *surface water* collected directly from a roof should discharge directly to a *drain*, and should not enter the *drain* via a *sump.*

3.6.2 Two different *sumps* are shown in Figures 8 and 9. The *sump* shown in Figure 8 is suitable for an area of up to 4500/I m^2 and the *sump* illustrated by Figure 9 is suitable for an area up to 40,000/I m^2, where I is the rainfall intensity for a storm with a 10% probability of occurring annually. (See Paragraph 3.2.2.)

3.7 Access for maintenance

3.7.1 Access for maintenance shall be provided on all *drains*. Access is to be achieved via an *inspection point*, *rodding point*, *inspection chamber* or *access chamber*, complying as appropriate with Figures 10, 11 or 12.

COMMENT:
Rodding points rather than *inspection points* are preferred in landscaped or sealed areas.

3.7.2 Points of access shall be spaced at no further than:

a) 50 m where *rodding points* are used.

b) 100 m where *inspection points*, *inspection chambers* or *access chambers* are used.

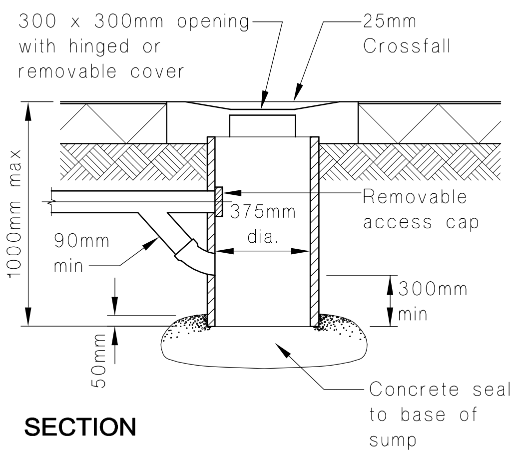
3.7.3 Points of access are required at:

a) Changes in direction of greater than 45°,

b) Changes in gradient of greater than 45°, and

c) Junctions of *drains* other than a *drain*, serving a single downpipe, that is less than 2.0 m long.

Figure 8: **Type-one Surface Water Sump**
Paragraph 3.6.2



3.7.4 *Inspection chambers* or *access chambers* (see Figures 11 and 12) shall be provided where changes in both gradient and direction occur and where either is greater than 22.5°.

Amend 1
Sep 1993

3.7.5 Where the depth to the invert of the *drain* exceeds 1.0 m, an *inspection chamber* is not acceptable and an *access chamber* shall be used.

3.7.6 Drain under buildings

Any *drain* laid under a *building* shall be run in a straight line from one side to the other.

3.7.7 Access to a *drain* laid under a *building* shall be provided immediately outside the *building*. These points of access shall be located within 2.0 m of an exterior wall.

3.7.8 Under a *building* the only acceptable inlets to a *drain* are from sealed roof-water downpipes. Access shall be provided to the *drain* via a sealed access point in the downpipe immediately above ground floor level.

Figure 9: **Type-two Surface Water Sump**
Paragraph 3.6.2

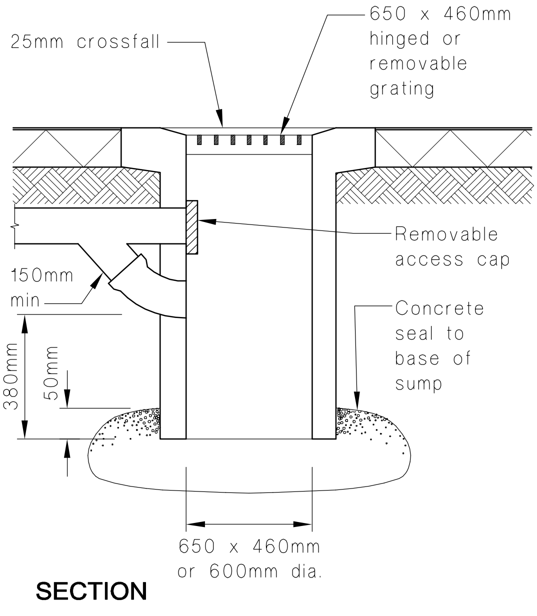


Figure 10: **Typical Rodding Point**
Paragraph 3.7.1

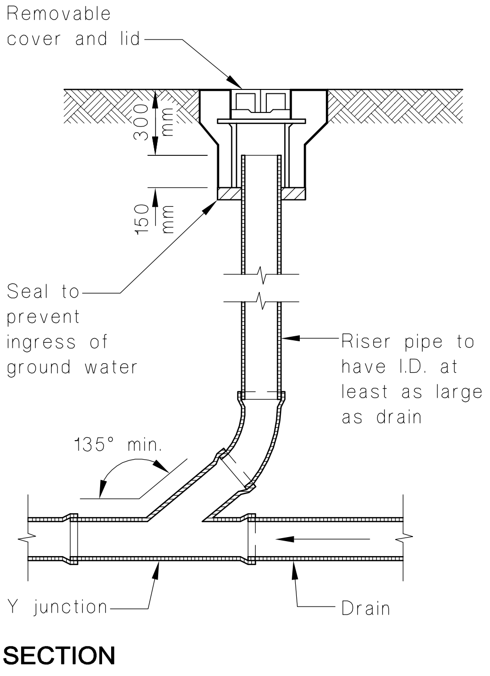
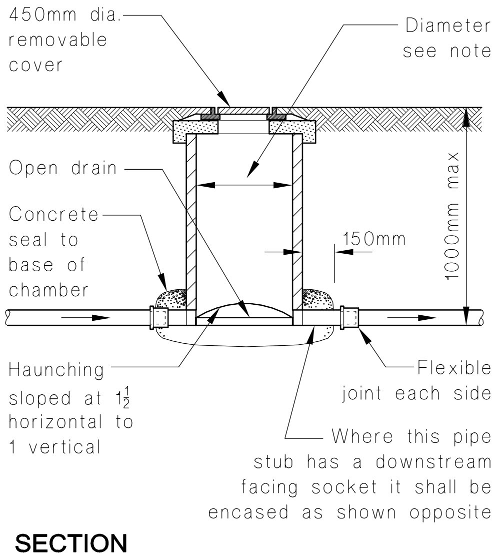
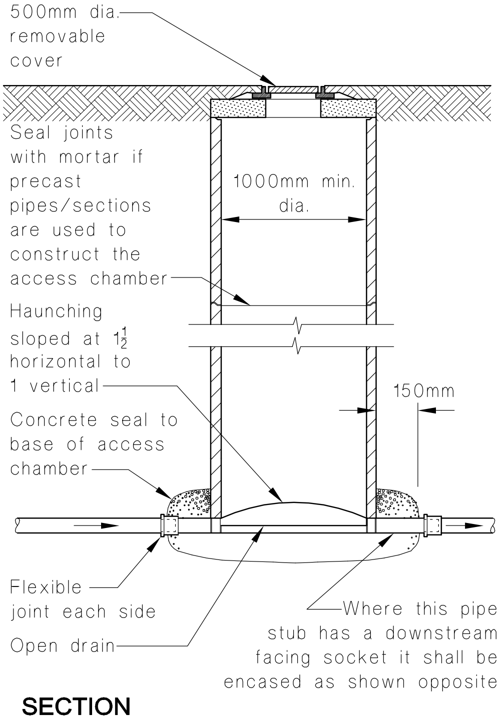


Figure 11: Typical Inspection Chamber
Paragraphs 3.5.3, 3.7.1 and 3.7.4



NOTE:
Inspection chamber diameter to be:
-450 mm for drains 100 mm dia or less.
-600 mm for drains greater than 100 mm dia.

Figure 12: Typical Access Chamber
Paragraphs 3.5.3, 3.7.1 and 3.7.4



3.8 Testing of drains

3.8.1 *Surface water drains* shall be capable of passing one of the tests described in E1/VM1 Paragraph 8.0.

Amend 5
Jul 2001

3.9 Bedding and backfilling

3.9.1 General

NZBC B1 requires all *drains* be constructed to withstand the combination and frequency of loads likely to be placed upon them without collapse, undue damage, undue deflection or undue vibration. In addition, *adequate* support needs to be provided to prevent gradients becoming less than those required by Paragraph 3.4.1 as a result of:

a) Differential settlement, or

b) Deflection of an unsupported span.

3.9.2 Bedding and backfilling

Figure 13 gives acceptable solutions for the bedding and backfilling of the drainage pipes listed in Table 1 except where:

a) The trench is located within or above peat, or

b) Scouring of the trench is likely due to unstable soils, or

c) The horizontal separation between any *building* foundation and the underside of the pipe trench is less than that required by Paragraph 3.9.7, or

d) The cover H to the pipe is more than 2.5 m.

3.9.3 Trench slope

Where the slope of the trench is 1 in 8 or greater, anti-scour blocks shall be provided. These anti-scour blocks shall be:

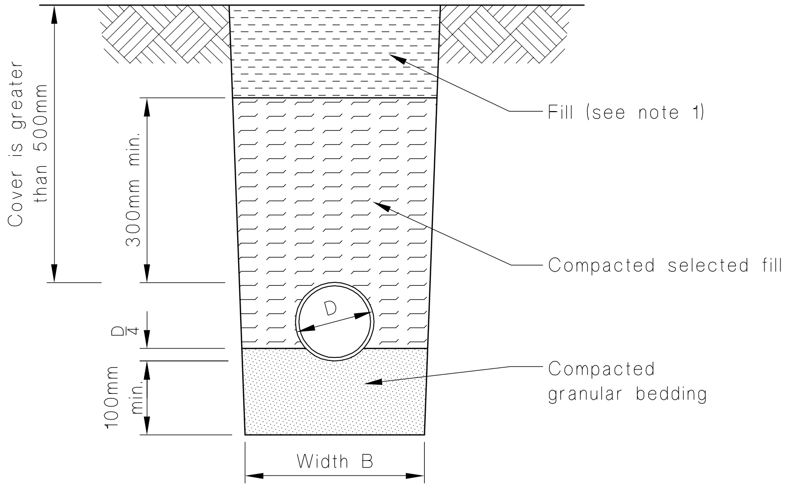
a) Constructed from 150 mm thick concrete (17 MPa),

b) Keyed into the sides and floor of the trench by 150 mm,

c) Extended to 300 mm above the *drain* or to ground level where the *drain* cover is less than 300 mm, and

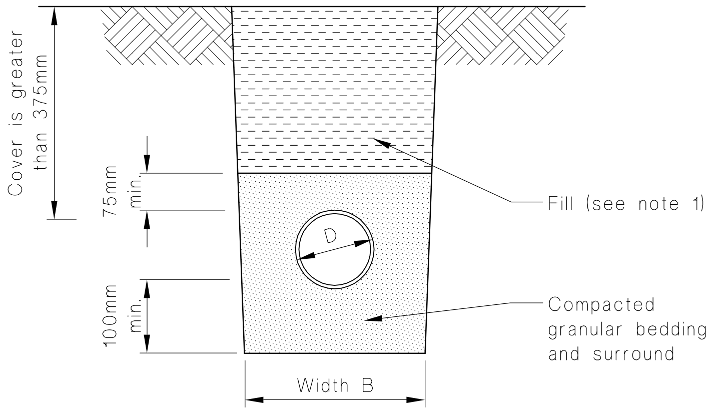
Continued on page 41

Figure 13: Bedding and backfilling
Paragraphs 3.9.2, 3.9.4 and 3.9.5



Amends 1 and 11

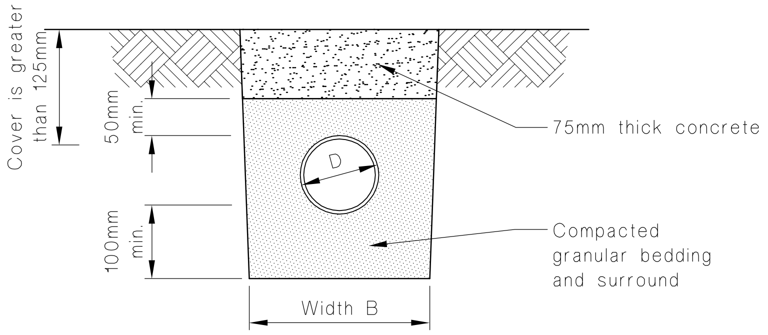
(a) Cover greater than 500mm



Amend 1 Sep 1993

Amends 1 and 11

(b) Cover greater than 375mm



Amend 1 Sep 1993

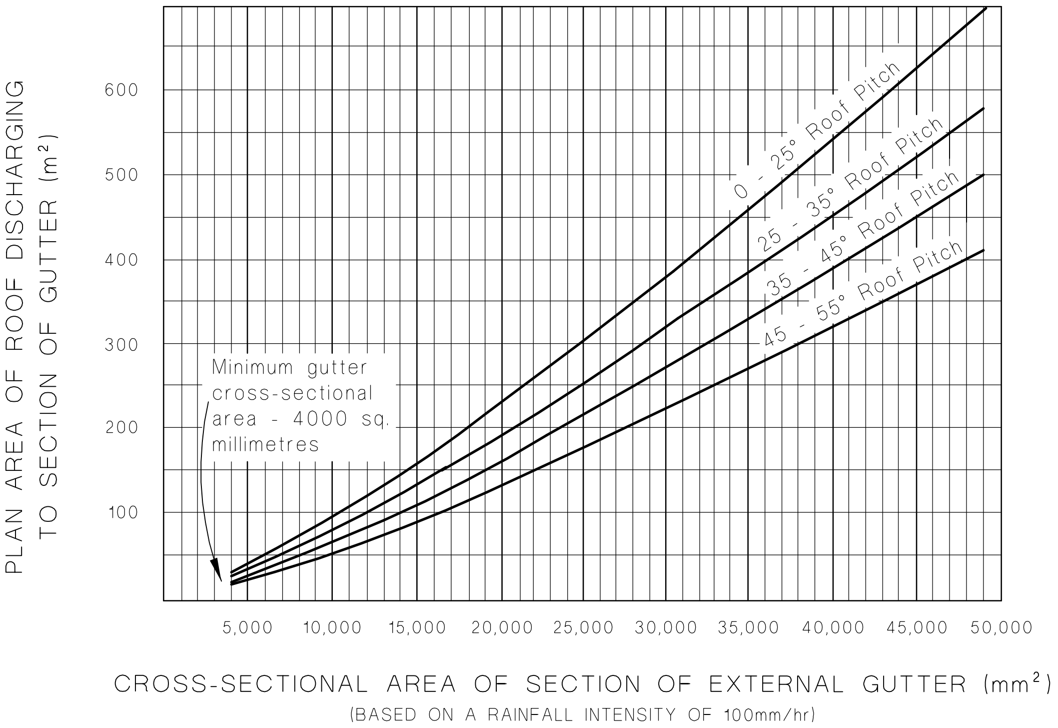
Amends 1 and 11

(c) Cover greater than 125mm

Amend 1 Sep 1993

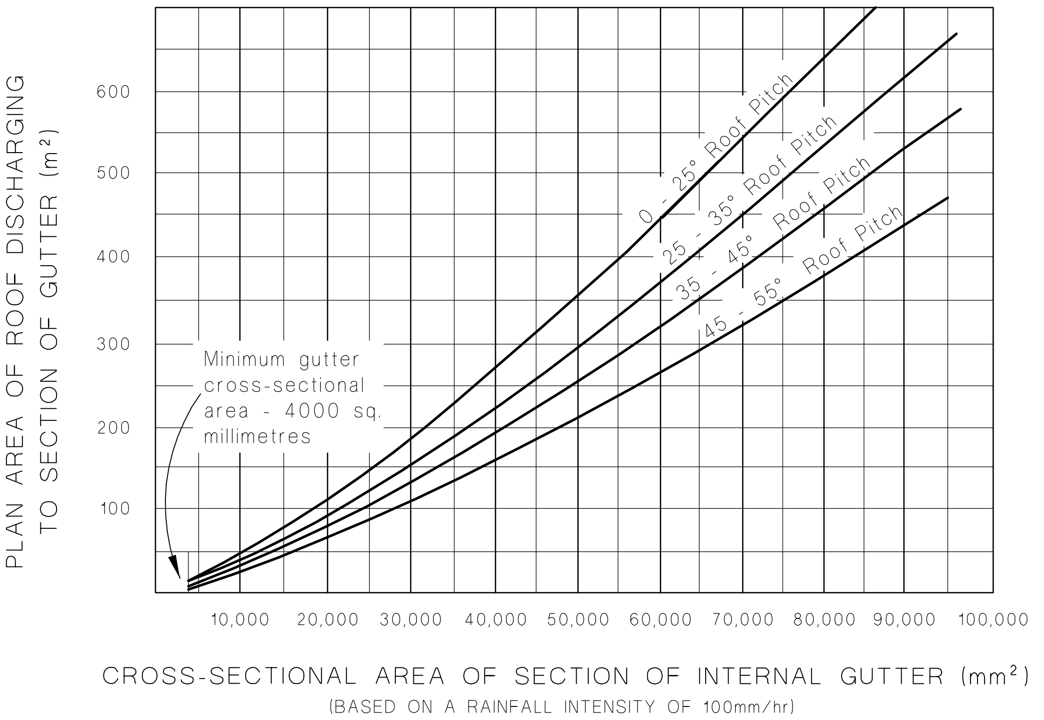
NOTE:
1. Fill shall be:
-Ordinary fill where drains are located below gardens and open country.
-Compacted selected fill where the drains are located below residential driveways and similar areas subjected to light traffic.

Figure 15: **Cross-sectional Area of External Gutter**
Paragraphs 5.1.2 and 5.1.3



Amend 1
Sep 1993

Figure 16: **Cross-sectional Area of Internal Gutter**
Paragraphs 5.1.2 and 5.1.3



Erratum 1
Sep 2010

Amend 1
Sep 1993

Amend 1
Sep 1993

5.1.4 In no case shall the cross-sectional area of any gutter be less than 4000 mm^2.

5.1.5 Internal gutters shall be constructed with:

a) A minimum width of 300 mm, and

b) Freeboard allowance of at least 30 mm greater depth than that determined from Figure 16 in situations where overtopping could enter a *building*.

COMMENT:
Refer to Acceptable Solution E2/AS1 for the design of valley gutters.

Amend 11
Nov 2020

5.2 Materials

5.2.1 Roof gutter materials shall comply with the standards stated in Table 6.

COMMENT:
Proprietary membrane systems using bitumen, rubber or epoxy resins may also be acceptable.

Table 6: **Acceptable Material Standards for Roof Gutters**
Paragraph 5.2.1

PVC-U	AS 1273
Galvanised steel	AS 1397
Copper	BS EN 1172
Aluminium	AS/NZS 1734
Stainless steel	NZS/BS 970
Zinc aluminium	AS 1397

Amends
2 and 11

Amend 7
Sep 2010

5.3 Gradients

5.3.1 Roof gutters shall fall to an outlet.

5.4 Thermal movement

5.4.1 Allowance shall be made for the thermal expansion and contraction of gutters. Table 7 shows for different materials the change in length of 5.0 m of guttering when subjected to a 50°C change in temperature.

COMMENT:
The provision of expansion joints is particularly important where both ends of a gutter are restrained against movement, and on PVC-U guttering due to its relatively high rate of thermal expansion.

Amend 7
Sep 2010

Table 7: **Thermal Expansion of 5 m length over 50°C**
Paragraph 5.4.1

Material	Expansion (mm)
PVC-U	17.5
Zinc	5.0
Galvanised steel	2.5
Copper	4.5
Aluminium	5.8
Stainless steel	3.8

Amend 7
Sep 2010

5.5 Overflow outlets

5.5.1 All internal gutters shall be fitted with overflow outlets which drain to the exterior of the *building*. The top of the outlet shall be set at least 50 mm below the top of the gutter. The cross-sectional area of the outlet shall be no less than the cross-sectional area of the downpipes (determined by Paragraph 4.2.1) serving the gutter.

COMMENT:
An internal gutter overflow outlet should be located to give an early, conspicuous warning to the *building* occupier that maintenance is required.

5.5.2 External gutters do not require overflow outlets but shall be installed to ensure any overflow from the gutter spills to the outside of the *building*.

COMMENT:
Although specific overflow provision is not necessary it is nevertheless important to ensure any overflowing water cannot track back inside the *building* where it could cause problems.

Amend 9
Feb 2014

E1/AS1 Appendix A Rainfall Intensities

Table A: **Rainfall Intensities**
10 minute duration rainfall intensities for various locations in New Zealand

Location	Latitude degrees	Longitude degrees	10% AEP intensity mm/hr	2% AEP intensity mm/hr
NORTHLAND				
Taipa Bay-Mangōnui	-35	173.5	86	117
Awanui	-35.05	173.25	85	116
Kaeo	-35.1	173.78	91	123
Kaitaia	-35.11	173.26	86	117
Ahipara	-35.17	173.17	86	116
Kerikeri	-35.23	173.95	101	135
Russell	-35.27	174.12	109	147
Paihia	-35.29	174.09	110	148
Ōkaihau	-35.32	173.77	97	130
Ōhaeawai	-35.35	173.88	99	132
Moerewa	-35.38	174.02	108	144
Kawakawa	-35.38	174.07	110	147
Rawene	-35.4	173.5	85	114
Kaikohe	-35.41	173.81	94	125
Ōmāpere and Opononi	-35.51	173.4	85	114
Whangārei	-35.72	174.3	103	140
Maungatapere	-35.75	174.2	101	137
Dargaville	-35.95	173.87	82	110
Te Kōpuru	-36.03	173.92	83	112
Mangawhai Heads	-36.05	174.59	94	130
Kaiwaka	-36.1	174.39	90	123
Maungaturoto	-36.12	174.35	89	121
Ruawai	-36.13	174.03	83	112
AUCKLAND				
Leigh	-36.19	174.63	95	130
Snells Beach	-36.21	174.69	93	127
Algies Bay-Mahurangi	-36.26	174.76	92	124
Wellsford	-36.3	174.52	100	135
Parakai	-36.38	174.45	95	128
Warkworth	-36.4	174.66	99	134
Muriwai Beach	-36.52	174.69	98	129
Helensville	-36.68	174.45	95	125
North Shore	-36.81	174.79	98	129
Waiheke Island	-36.81	175.12	102	137
Auckland	-36.87	174.77	97	127
Waitākere	-36.91	174.69	97	128
Manukau	-36.97	174.82	93	121
Bombay	-37.05	174.95	97	129
Pukekohe	-37.2	174.9	97	131
Waiuku	-37.25	174.73	92	122

Amend 11
Nov 2020

Amend 11
Nov 2020

Table A: **Rainfall Intensities continued**
10 minute duration rainfall intensities for various locations in New Zealand

Location	Latitude degrees	Longitude degrees	10% AEP intensity mm/hr	2% AEP intensity mm/hr
WAIKATO				
Coromandel	-36.74	175.5	96	132
Pauanui	-37.02	175.86	97	137
Te Puru-Thornton Bay	-37.04	175.52	91	127
Thames	-37.14	175.53	88	124
Whangamatā	-37.21	175.86	97	137
Ngatea	-37.27	175.5	88	123
Kerepehi	-37.3	175.53	87	121
Meremere	-37.32	175.07	96	132
Paeroa	-37.38	175.67	88	125
Te Kauwhata	-37.4	175.15	92	127
Waihi	-37.4	175.83	107	152
Te Aroha	-37.53	175.7	94	135
Huntly	-37.56	175.16	91	125
Waitoa	-37.6	175.63	90	129
Morrinsville	-37.65	175.53	91	130
Waharoa	-37.75	175.75	89	129
Hamilton	-37.78	175.27	92	129
Raglan	-37.8	174.86	89	121
Matamata	-37.82	175.77	89	129
Cambridge	-37.89	175.45	91	129
Te Awamutu	-38.02	175.32	92	129
Putāruru	-38.05	175.78	85	121
Mamaku	-38.06	176.05	102	143
Otorohanga	-38.18	175.19	94	132
Tokoroa	-38.23	175.84	85	121
Te Kuiti	-38.33	175.17	96	136
Mangakino	-38.38	175.74	75	107
Piopio	-38.47	175.02	95	134
Reporoa	-38.5	176.36	84	121
Taupō	-38.7	176.07	73	107
Tūrangi	-38.99	175.79	71	103
BAY OF PLENTY				
Waihi Beach	-37.4	175.93	99	141
Island View - Pios Beach	-37.46	175.99	95	136
Katikati	-37.56	175.9	93	133
Tauranga	-37.68	176.17	101	145
Maketu	-37.77	176.45	109	156
Te Puke	-37.78	176.33	103	148
Paengaroa	-37.82	176.42	106	152
Te Kaha	-37.82	177.67	96	136
Matatā	-37.89	176.75	116	163

Table A: **Rainfall Intensities continued**
10 minute duration rainfall intensities for various locations in New Zealand

Location	Latitude degrees	Longitude degrees	10% AEP intensity mm/hr	2% AEP intensity mm/hr
Edgecumbe	-37.97	176.83	112	160
Whakatāne	-37.97	176.99	100	142
Ōpōtiki	-38.01	177.28	102	146
Te Teko	-38.03	176.8	98	139
Tāneatua	-38.07	176.98	95	135
Kawerau	-38.1	176.7	95	136
Rotorua	-38.14	176.26	96	136
Kaingaroa Forest	-38.36	176.68	91	128
Murupara	-38.45	176.7	84	119
GISBORNE				
Ruatoria	-37.9	178.32	80	119
Tokomaru Bay	-38.12	178.3	68	103
Patutahi	-38.38	177.53	59	83
Tolaga Bay	-38.37	178.3	61	93
Manutuke	-38.41	177.55	52	74
Te Karaka	-38.47	177.87	47	73
Gisborne	-38.66	178.02	67	102
MANAWATU-WHANGANUI				
Ōhura	-38.85	174.98	86	124
Taumarunui	-38.88	175.26	84	123
Ohakune	-39.41	175.41	77	111
Raetihi	-39.42	175.27	90	130
Waiouru	-39.47	175.67	62	91
Taihape	-39.68	175.78	65	97
Whanganui	-39.93	175.03	68	100
Hunterville	-39.93	175.57	70	103
Rātana	-40.03	175.17	66	96
Marton	-40.08	175.38	69	101
Halcombe	-40.13	175.48	73	107
Bulls	-40.17	175.38	71	102
Sanson	-40.22	175.42	70	102
Feilding	-40.22	175.57	69	101
Dannevirke	-40.21	176.09	77	119
Rongotea	-40.3	175.42	67	97
Himatangi Beach	-40.32	175.24	66	93
Woodville	-40.33	175.87	66	99
Palmerston North	-40.36	175.62	65	94
Pahiatua	-40.45	175.83	61	91
Foxton	-40.47	175.28	71	100
Tokomaru	-40.47	175.5	68	98
Shannon	-40.55	175.4	70	100
Levin	-40.61	175.27	74	104

Amend 11
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Table A: **Rainfall Intensities continued**
10 minute duration rainfall intensities for various locations in New Zealand

Location	Latitude degrees	Longitude degrees	10% AEP intensity mm/hr	2% AEP intensity mm/hr
Te Horo	-40.63	175.19	76	107
Eketāhuna	-40.65	175.7	73	105
HAWKES BAY				
Tuai	-38.82	177.15	69	98
Frasertown	-38.97	177.4	70	103
Wairoa	-39.04	177.42	82	121
Nūhaka	-39.03	177.75	84	126
Napier	-39.5	176.89	69	105
Hastings	-39.64	176.83	62	95
Ōtāne	-39.9	176.62	69	106
Waipawa	-39.95	176.57	67	104
Waipukurau	-40	176.56	65	100
Takapau	-40.03	176.35	72	113
TARANAKI				
Waitara	-39	174.23	98	136
Urenui	-39	174.38	95	133
New Plymouth	-39.05	174.07	100	138
Egmont Village	-39.14	174.12	114	158
Inglewood	-39.15	174.2	117	163
Ōkato	-39.2	173.88	111	153
Rahotu	-39.28	173.78	99	137
Stratford	-39.35	174.27	99	138
Kaponga	-39.43	174.15	94	132
Eltham	-39.43	174.3	97	137
Ōpunake	-39.46	173.84	87	121
Manaia	-39.55	174.12	83	117
Hāwera	-39.59	174.28	84	119
Pātea	-39.75	174.47	79	112
Waverley	-39.77	174.63	80	115
TASMAN				
Tākaka	-40.85	172.8	78	108
Riwaka	-41.05	173	77	108
Motueka	-41.11	173.02	68	94
Brightwater	-41.38	173.1	80	115
Wakefield	-41.4	173.05	81	117
Murchison	-41.8	172.33	56	85
WELLINGTON				
Ōtaki	-40.75	175.13	82	114
Kapiti	-40.94	174.99	75	103
Masterton	-40.95	175.67	54	80
Carterton	-41.02	175.52	57	83
Greytown	-41.08	175.45	57	82

Table A: **Rainfall Intensities continued**
10 minute duration rainfall intensities for various locations in New Zealand

Location	Latitude degrees	Longitude degrees	10% AEP intensity mm/hr	2% AEP intensity mm/hr
Upper Hutt	-41.12	175.07	72	99
Featherston	-41.12	175.32	63	88
Porirua	-41.13	174.83	76	105
Mākara-Ohariu	-41.2	174.75	74	102
Lower Hutt	-41.21	174.91	72	100
Martinborough	-41.22	175.44	54	77
Wellington	-41.28	174.77	70	97
WEST COAST				
Hector-Ngakawau	-41.63	171.87	84	122
Westport	-41.75	171.58	101	145
Reefton	-42.11	171.87	71	103
Blackball	-42.3	171.49	92	132
Dobson	-42.39	171.44	93	133
Greymouth	-42.45	171.21	95	133
Hokitika	-42.72	170.97	104	144
Ross	-42.9	170.82	110	149
Franz Josef/ Waiau	-43.38	170.17	92	124
Fox Glacier	-43.42	170.05	99	133
NELSON				
Nelson	-41.27	173.3	77	107
MARLBOROUGH				
Havelock	-41.28	173.77	70	98
Picton	-41.3	174.01	59	83
Blenheim	-41.52	173.95	48	69
Seddon	-41.67	174.07	49	70
CANTERBURY				
Kaikōura	-42.4	173.69	53	79
Hanmer Springs	-42.52	172.83	46	72
Culverden	-42.77	172.85	43	67
Cheviot	-42.81	173.26	45	70
Amberley	-43.15	172.72	42	65
Rangiora	-43.3	172.6	46	71
Oxford	-43.3	172.18	60	93
Woodend	-43.32	172.67	42	65
Cust	-43.32	172.37	53	84
Darfield	-43.48	172.12	47	75
Christchurch	-43.53	172.62	39	62
Rolleston	-43.58	172.38	48	77
Lyttelton	-43.60	172.72	26	41
Burnham Military Camp	-43.61	172.32	47	75
Lincoln	-43.63	172.48	51	82
Methven	-43.63	171.63	54	83

Amend 11
Nov 2020

Table A: Rainfall Intensities continued

10 minute duration rainfall intensities for various locations in New Zealand

Location	Latitude degrees	Longitude degrees	10% AEP intensity mm/hr	2% AEP intensity mm/hr
Dunsandel	-43.67	172.2	46	74
Tai Tapu	-43.68	172.54	41	65
Aoraki/Mount Cook	-43.66	170.17	72	102
Rakaia	-43.75	172.02	48	76
Leeston	-43.77	172.3	47	75
Akaroa	-43.81	172.97	45	69
Southbridge	-43.82	172.25	46	72
Ashburton	-43.88	171.76	52	80
Lake Tekapo	-44	170.5	33	53
Geraldine	-44.1	171.23	48	75
Fairlie	-44.1	170.83	55	86
Temuka	-44.23	171.27	44	71
Pleasant Point	-44.27	171.13	47	75
Twizel	-44.25	170.1	37	58
Timaru	-44.4	171.26	46	73
Pareora	-44.47	171.22	48	77
Omarama	-44.48	169.97	35	57
Otematata	-44.6	170.18	38	61
Waimate	-44.74	171.06	42	65
Kurow	-44.73	170.47	42	65
OTAGO				
Wanaka	-44.7	169.13	26	40
Arrowtown	-44.93	168.83	32	50
Oamaru	-45.09	170.98	42	65
Cromwell	-45.05	169.2	36	59
Queenstown	-45.04	168.65	34	53
Ranfurly	-45.12	170.1	52	85
Kakanui	-45.18	170.9	42	65
Clyde	-45.18	169.32	45	75
Alexandra	-45.25	169.38	44	73
Hampden	-45.33	170.82	43	67
Palmerston	-45.48	170.72	45	71
Roxburgh	-45.53	169.32	53	90
Waikouaiti	-45.6	170.68	44	69
Karitane	-45.63	170.65	44	70
Warrington	-45.72	170.59	43	68
Waitati	-45.75	170.57	43	69
Outram	-45.87	170.23	51	81
Dunedin	-45.89	170.5	47	73
Lawrence	-45.92	169.68	54	87
Tapanui	-45.95	169.27	54	90

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Table A: **Rainfall Intensities continued**

10 minute duration rainfall intensities for various locations in New Zealand

Location	Latitude degrees	Longitude degrees	10% AEP intensity mm/hr	2% AEP intensity mm/hr
Milton	-46.12	169.97	56	88
Clinton	-46.2	169.38	53	86
Balclutha	-46.23	169.73	55	87
Stirling	-46.25	169.78	54	85
Kaitangata	-46.28	169.85	54	85
Owaka	-46.45	169.65	49	77
OTAGO				
Te Anau	-45.42	167.72	48	75
Manapouri	-45.57	167.62	51	78
Lumsden	-45.73	168.43	52	87
Riversdale	-45.9	168.73	50	84
Ohai	-45.93	167.95	50	80
Gore	-46.1	168.93	57	95
Winton	-46.15	168.32	47	76
Tuatapere	-46.13	167.68	45	71
Otautau	-46.15	168	46	74
Edendale	-46.32	168.78	48	80
Wyndham	-46.33	168.85	49	82
Riverton/Aparima	-46.36	168	49	77
Invercargill	-46.41	168.32	54	87
Bluff	-46.49	168.29	51	81

Notes:

This table is based on information produced by the National Institute for Water and Atmospheric Research (NIWA) in December 2019, and the rainfall intensities are based on historical rain gauge data.

Rainfall intensity data is also available online in digital form from the National Institute for Water and Atmospheric Research (NIWA) High Intensity Rainfall Design System (HIRDS).

HIRDS provides rainfall intensity estimates for any location in New Zealand based on historical rain gauge data and projections of future rainfall intensities for various climate change scenarios.

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Acceptable Solution E1/AS2

(Included in Amendment 11)

1.0 AS/NZS 3500.3 Stormwater drainage

1.0.1 AS/NZS 3500.3, as modified by Paragraph 1.0.4, is an Acceptable Solution for the design and installation of *surface water* drainage systems.

COMMENT:

Comparable terminology

AS/NZS 3500.3	**E1/AS1**
Eaves gutter	External gutter
Box gutter	Internal gutter
Inlet pit	Surface water sump
Stormwater pit	Access/Inspection chamber

1.0.2 This Acceptable Solution is limited to *buildings* and *sitework* where *surface water* results only from rainfall, and which are:

a) Free from a history of flooding,

b) Not adjacent to a watercourse,

c) Not located in low lying area, and

d) Not located in a secondary flow path.

1.0.3 *Buildings* to which this Acceptable Solution is applied shall comply with the requirements of Acceptable Solution E1/AS1 Section 2.0 Minimum Acceptable Floor Level.

1.0.4 Modifications to AS/NZS 3500.3

Clause 1.2.2 Delete and replace with:

"In New Zealand, this Standard may be used for compliance with NZBC Clause E1 Surface Water, in accordance with NZBC Acceptable Solution E1/AS2.

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

Clause 3.3.5.2 Delete and replace with:

"Ten minutes duration rainfall intensity (in mm/hr) for New Zealand shall be determined for ARIs of 10 years (10% AEP) and 50 years (2% AEP) using rainfall frequency duration information available from:

(a) the local territorial authority,

(b) NZBC Acceptable Solution E1/AS1 Appendix A, or

(c) the National Institute for Water and Atmospheric Research (NIWA).

NOTES:

1 Rainfall intensity data is available online in digital form from the National Institute for Water and Atmospheric Research (NIWA) High Intensity Rainfall Design System (HIRDS).

HIRDS provides rainfall intensity estimates for any location in New Zealand based on historical rain gauge data and also provides projections of future rainfall intensities for various climate change scenarios.

2 Where there are differences between the design rainfall intensities obtained using sources (a), (b) and (c) for a particular location, the most conservative rainfall intensity should be used for design calculations.

3 Territorial Authorities may refer to any available Regional Council rainfall data to establish design rainfall intensities for their city or district."

Clause 3.4.5 Delete and replace with:

"**3.4.5 Higher catchment area**

Stormwater from a higher catchment area shall be discharged directly to a rainhead or a sump, and the rainhead or sump shall be sized in accordance with this Standard.

Alternatively, a spreader that meets the requirements of NZBC Acceptable Solution E2/AS1 may be used.

The downpipe and gutter system of the lower catchment shall be sized in accordance with Clause 3.4 to take into account the total flow from both catchments.

1 The rainhead or sump may need to be larger than that sized in accordance with this Standard and include a device to dissipate energy. Sizing of such a rainhead or sump is beyond the scope of this Standard and may require hydraulic tests.

2 Where spreaders are used, an allowance for an increased overflow provision for the gutter on the lower catchment should be considered."

Clause 3.6 Delete and replace with:

"Refer to NZBC Acceptable Solution E2/AS1 for the design of valley gutters."

Clause 3.7.3 (c) NOTE 3 Delete and replace with:

"3 The minimum width of a box gutter is 300 mm."

Clause 3.7.7.1 Insert:

"NOTE: Overflow outlets should be located to give an early, conspicuous warning to the building occupier that maintenance is required."

Clause 3.8 Delete and replace with:

"**3.8 Balcony and terrace areas**

Systems for draining balconies and terraces shall be designed for —

(a) a 10 year ARI (10% AEP) rainfall intensity; and

(b) a 50 year ARI (2% AEP) rainfall intensity for overflow."

Clause 4.5.6 Insert:

"(f) *Connections to drains* Downpipes shall discharge directly into a site stormwater drain, and should not discharge via an inlet pit."

Clause 5.2.3 Delete and replace with:

"**5.2.3 Design rainfall intensity**

Elements shall be designed to contain minor storm flows of the appropriate annual exceedance probability (AEP) or average recurrence interval (ARI) specified in Table 5.4.3 within surface water drains, gutters or formed flow paths.

NOTE: Surface water drainage systems should be designed to ensure overflows, in storm events with an AEP of 1% in Australia or an ARI of 50 years (2% AEP) in New Zealand, do not present a hazard to people or cause damage to property."

Clause 5.3.1.1 Delete "Stormwater from roof areas shall…" and replace with "Stormwater from roof areas, including balconies and terraces, shall …"

Clause 5.4.5 (b) Delete and replace with:

"(b) In New Zealand from:

(i) the local territorial authority,

(ii) NZBC Acceptable Solution E1/AS1 Appendix A, or

(iii) the National Institute for Water and Atmospheric Research (NIWA).

NOTES:

1 Rainfall intensity data is available online in digital form from the National Institute for Water and Atmospheric Research (NIWA) High Intensity Rainfall Design System (HIRDS).

HIRDS provides rainfall intensity estimates for any location in New Zealand based on historical rain gauge data and also provides projections of future rainfall intensities for various climate change scenarios.

2 Where there are differences between the design rainfall intensities obtained using sources (i), (ii) and (iii) for a particular location, the most conservative rainfall intensity should be used for design calculations.

3 Territorial Authorities may refer to any available Regional Council rainfall data to establish design rainfall intensities for their city or district."

Clause 5.4.8 (b) (ii) Delete and replace with: "10 min duration in New Zealand."

Clause 5.4.11.1 (b) Delete and replace with: "be laid with any change of direction or cross-section occurring at either a fitting or at a stormwater pit;"

Clause 5.4.12 Delete.

Clause 5.5 Delete.

Clause 6.2.3 Insert:

"Alternatively, trenches shall be no less than the 300 mm wide for pipes DN 100 or smaller."

Table 6.2.5 1 (a) (i) and (a) (ii) Delete and replace with (a):

Table 6.2.5: Minimum pipe cover–finished surface to top of pipe

Location	Ductile iron, galvanised steel	Plastics
1 Not subject to vehicular loading:	Minimum cover, mm	
(a) Without pavement	100	300

Clause 6.2.8 (d) (ii) Delete and replace with:

"In New Zealand, as specified in NZBC Acceptable Solution E1/AS1."

Clause 6.3.1.1 (d) Delete and replace with:

"(d) using 45°, sweep or oblique junctions; and

(e) with changes in direction not exceeding 90° at any point."

Clause 6.3.3 (b) Delete and replace with:

"For other properties, the minimum diameter of a stormwater drain that is downstream of a stormwater pit or inlet pit shall be the greater of —

(i) the diameter of the largest pipe entering the pit; or

(ii) DN 100."

Clause 6.4 Subsoil drains Insert:

"In New Zealand, this Clause is informative only."

Clause 6.4.1 NOTES Insert:

"4 Subsoil drains should discharge to the site stormwater drainage system via an inlet pit or silt arrester.

5 Subsoil drains should be laid at grade with a uniform fall of not less than 1:300."

Clause 7.4.1 Delete and replace with:

"**7.4.1 Location**

For other than single dwellings, inspection openings for the maintenance of site stormwater drains shall be installed at —

(a) each point of connection;

(b) even spacings not more than 30 m apart;

(c) each end of any inclined jump-up that exceeds 6 m in length;

(d) each connection to an existing site stormwater drain; and

(e) at any change of direction greater than 45°.

NOTES:

1 Inspection openings may be replaced by a stormwater pit.

2 No inspection opening is needed at a connection to a site stormwater drain where the branch drain serves only a single external downpipe or an inlet pit."

Clause 7.4.3 Delete and replace with:

"**7.4.3 Access**

Access to below-ground inspection openings shall be either by—

(a) a stormwater pit,

(b) a sealed riser terminated at ground level or floor level in an accessible position; or

(c) a removable cap at drain level for drains of DN 150 or smaller.

NOTE: Options (a) or (b) are preferred in landscaped or sealed areas, or where the depth of an inspection opening would be greater than 1000 mm below finished ground level."

Clause 7.5.1.1 (b) Delete.

Clause 7.5.1.2 Delete and replace with:

"**7.5.1.2 Inlet pits**

Inlet pits shall be installed —

(a) to allow the collection and ingress of surface water to a site stormwater drain,

(b) with sufficient capacity at the bottom for the settlement of silt and debris, and

(c) with a submerged (or trapped) outlet which prevents floatable solids entering the site stormwater drain.

NOTES:

1. Inlet pits should not receive discharge from stormwater drains.
2. Refer to NZBC Acceptable Solution E1/AS1 Figure 8 and Figure 9 for examples of surface water sumps (inlet pits) which incorporate submerged outlets and provide sufficient capacity for the settlement of silt and debris."

Clause 7.7.1 (a) Delete and replace with:

"(a) a 45° junction, a sweep junction or an oblique junction at an upstream angle not greater than 60°, as shown in Figure 7.7.1(A);"

Clause 7.10 On-Site Stormwater Detention (OSD) Systems Insert:

"In New Zealand, this Clause is informative only."

Section 8 Pumped Systems Insert:

"In New Zealand, this Section is informative only."

Section 10 Siphonic Drainage Systems Insert: "In New Zealand, this Section is informative only."

Appendix D – D.2.2 New Zealand Delete and replace with:

"The procedure for the determination of rainfall intensities, in mm/hr, for the site considered is as follows:

(a) Use the applicable rainfall intensity figures provided by the local territorial authority, or

(b) Use the applicable rainfall intensity figures provided in NZBC Acceptable Solution E1/AS1 Appendix A, or

(c) Use the applicable rainfall intensity figures provided by the National Institute for Water and Atmospheric Research (NIWA) High Intensity Rainfall Design System (HIRDS).

NOTES:

1 Where there are differences between the design rainfall intensities obtained using sources (a), (b) and (c) for a particular location, the most conservative rainfall intensity should be used for design calculations.

2 Territorial Authorities may refer to any available Regional Council rainfall data to establish design rainfall intensities for their city or district."

Appendix F Delete.

Appendix I Figure I1 NOTE Delete and replace with:

"NOTE: The minimum width of a box gutter is 300 mm."

Appendix K Insert:

"This Appendix applies to Australia only.

NOTE: The design solution examples for surface water drainage systems shown in Appendix K do not address the modifications made to AS/NZS 3500.3 by NZBC Acceptable Solution E1/AS2 and do not reflect requirements in New Zealand."

Index E1/VM1 & AS1/AS2

(Revised by Amendment 4)

All references to Verification Methods and Acceptable Solutions are preceded by **VM** or **AS** respectively.

Building site **VM1** 3.2.2, 4.0.1, 4.1.10, **AS1** 1.0.1
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Buildings **AS1** 1.0.1
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Catchment
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Downpipes . . . .**AS1** 3.4.2 b), 3.7.8, 4.0, 5.1.1
  installation **AS1** 4.3
  materials . . . . **AS1** 4.1, Table 4
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Drainage
  access points **AS1** 3.7, 3.7.3, 3.7.7, 3.7.8
    access chambers . . . . **VM1** 5.0.1, **AS1** 3.7.1, 3.7.2 b), 3.7.4, 3.7.5, Figure 12
    inspection chambers . . . .**AS1** 3.7.1, 3.7.2 b), 3.7.4, 3.7.5, Figure 11
    inspection points . . . . **AS1** 3.7.1, 3.7.2 b)
    rodding points . . . .**AS1** 3.7.1, 3.7.2 a), Figure 10
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    other Acceptable Solutions **AS1** 3.9.8
    materials **AS1** 3.9.5
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    trench slope **AS1** 3.9.3
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  bubble-up chamber system . . . .**AS1** 3.4.2, Figures 6 and 7
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    quantity **VM1** 4.1.10
    tailwater depth. **VM1** 4.1.6, 4.1.7

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  - secondary flow . . . . **VM1** 4.0, **AS1** 1.0.1 d)
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  - site – outfall protection **VM1** 7.0
  - sizing . . . . **VM1** 3.0, **AS1** 3.2, Figure 3
    - energy losses. **VM1** 5.0
    - hydraulic design of drains . . . . . . **VM1** 1.0.4, 3.2, Figures 6 and 7
      - air entrainment **VM1** 3.2.4
      - headwater depth . . . . **VM1** 3.2.2, Figure 5 a)
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  - Rational Method **VM1** 2.0.1
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    - run-off coefficient. . . . . **VM1** 2.1, Table 1
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    - time of concentration. **VM1** 2.2.1, 2.3
      - alternative procedure. **VM1** 2.3.6, 2.3.7
      - catchment slopes **VM1** 2.3.7
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