MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Dear Customer

Please find enclosed Amendment 10, effective 1 January 2017, to the Acceptable Solution and Verification Method for Clause E1 Surface Water of the New Zealand Building Code. The previous amendment to E1 (Amendment 9) was in February 2014.

Section	**Old E1**	**January 2017 Amendment 10**
Title pages	Remove title page and document history pages 1-2B	Replace with new title page and document history pages 1–2B
References	Remove page 7/8	Replace with new page 7/8
E1/VM1	Remove pages 11/12, 31/32	Replace with new pages 11/12, 31/32

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 10), as detailed in the Document History, is approved by the Chief Executive of the Ministry of Business, Innovation and Employment. It is effective from 1 January 2017 and supersedes all previous versions of this document.

The previous version of this document (Amendment 9) will cease to have effect on 30 May 2017.

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
Note: Page numbers relate to the document at the time of Amendment and may not match page numbers in current document.			

E1: **Document History (continued)**			
	Date	**Alterations**	
Amendment 10	Effective 1 January 2017	pp. 7, 8 Re1erences p. 12 E1/VM1 Table 1	p. 31 E1/VM1 9.0.6

References

Amend 1 Sep 1993

For the purposes of New Zealand Building Code (NZBC) compliance, the Standards and documents referenced in this Verification Method and Acceptable Solution (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 Solution must be used.

Amend 8 Oct 2011

Amend 9 Feb 2014

Amend 7 Sep 2010

Amend 9 Feb 2014

		Where quoted
Standards New Zealand		
NZS/BS 970:-	Specification for wrought steels for mechanical and allied engineering purposes	
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
AS/NZS 1254: 2010	PVC pipes and fittings for stormwater and surface water applications *Amend: 1, 2*	AS1 Table 1, Table 3
AS/NZS 1260: 2009	PVC-U Pipes and fittings for drain, waste and vent application *Amend: 1, 2*	AS1 Table 4
AS/NZS 1734: 1997	Aluminium and aluminium alloys – Flat sheets, coiled sheet and plate	AS1 Table 4, Table 6
AS/NZS 2032: 2006	Installation of PVC Pipe Systems *Amend: 1*	AS1 Table 3, 3.9.8
AS/NZS 2033: 2008	Installation of polyethylene pipe systems *Amend: 1, 2*	AS1 Table 3
AS/NZS 2280: 2014	Ductile iron pipes and fittings *Amend: 1*	AS1 Table 1, Table 3
AS/NZS 2566	Buried Flexible pipelines.	
Part 1: 1998	Structural Design	AS1 3.9.8
Part 2: 2002	Installation *Amend: 1*	AS1 3.9.8, Table 3
NZS 3604: 2011	Timber framed buildings	AS1 3.9.7
AS/NZS 4058: 2007	Precast concrete pipes (pressure and non-pressure)	AS1 Table 1
AS/NZS 4130: 2009	Polyethylene (PE) pipes for pressure applications *Amend: 1*	AS1 Table 1

Amend 1 Sep 1993

Amend 9 Feb 2014

Amend 10 Jan 2017

Amends 9 & 10

Amend 8 Oct 2011

Amend 8 Oct 2011

Amends 9 & 10

Amend 7 Sep 2010

Amend 10 Jan 2017

Amend 8 Oct 2011

Amend 5 July 2001

Amends 1, 4, 7, 8, 9

Amend 7 Sep 2010

Amends 8 , 9, 10

			Where quoted
Amends 1, 4, 10	NZS 4229: 2013	Concrete masonry buildings not requiring specific design	AS1 3.9.7
	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	AS/NZS 5065: 2005	Polyethylene and polypropylene pipe and fittings for drainage and sewerage applications *Amend: 1*	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 Part 1: 2004	Flanges and their joints. 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: 2001	Steel sheet and strip – Hot-dipped zinc-coated or aluminium/zinc-coated	AS1 Table 4, Table 6
	AS 1579: 2001	Arc welded steel pipes and fittings for water and waste water	AS1 Table 1
Amend 7 Sep 2010	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 7 Sep 2010			
Amend 7 Sep 2010 Amend 4 Dec 2000	AS 3706:- Part 1: 2003	Geotextiles – Methods of test 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

Verification Method E1/VM1

(Revised by Amendment 4)

1.0 Scope

1.0.1 This Verification Method shall be used only if the *territorial authority* does not have more accurate data available from sophisticated hydrological modelling of the catchment undertaken as part of its flood management plans.

1.0.2 The following approach provides a method for verifying that a proposed *building* will meet the requirements of NZBC E1.3.1 and E1.3.2 in the following circumstances:

a) The catchment area does not exceed 100 ha (but see Paragraph 1.0.6 for soak pits), and

b) The *surface water* results only from rainfall on the catchment and does not include water from other sources such as inundation from rivers, lakes or the sea.

1.0.3 The method describes how to determine:

a) The volume of *surface water* arriving at the *building* site from upper areas of the catchment (see Paragraph 2.0),

b) The size of *drains* necessary to remove *surface water* from the *building* site (see Paragraph 3.0), and

c) The nature and volume of secondary flows likely to reach the *building* 1 from overloaded culverts, *drains* or open channels in the upper catchment (see Paragraph 4.0).

1.0.4 The procedure described for sizing *drains* only applies where free flow occurs at the outlet. The outlet must not be restricted by hydraulic impediments such as control gates, a pump station, or submerged outlets in a river, a lake or the sea.

COMMENT:

The capacity of *drains* which do not have a free flowing outlet shall be calculated by specific design in a manner which incorporates the effect of the restriction.

1.0.5 A method is provided for determining appropriate *outfall* protection.

1.0.6 A procedure is provided for determining soak pit requirements for *surface water* disposal. Such disposal is subject to suitable ground conditions, as confirmed by site tests.

COMMENT:

1. Where soak pits are used the overall ground stability may need to be verified but this is outside of the scope of this Verification Method.
2. Soak pit *surface water* disposal may require a resource management consent.

1.0.7 The design procedures in this document must be performed by a *person* who, on the basis of experience or qualifications, is competent to apply them.

1.0.8 This document makes no allowance for blockages to the intakes of *drains* or culverts. The procedures of this document shall only be used where the designer demonstrates that this approach is justified for the particular *building* work under consideration.

COMMENT:

The likelihood of blockage and the resulting risks will vary from project to project and need to be considered by the designer before applying this document.

1.0.9 The "Comments" in this document provide comment, background or general information but do not form part of this Verification Method.

2.0 Estimation of Surface Water Run-Off

2.0.1 *Surface water* run-off for the catchment shall be calculated using the Rational Method. The formula to be used is:

$Q_c = CIA_c/360$

where

Q_c = catchment run-off (m^3/s).

C = run-off coefficient (see Table 1).

I = rainfall intensity (mm/hr).

A_c = area (hectares) of catchment above the point being considered.

Table 1: Run-off Coefficients
Paragraphs 2.0.1, 2.1.1, 2.1.3

Description of surface	C
Natural surface types	
Bare impermeable clay with no interception channels or run-off control	0.70
Bare uncultivated soil of medium soakage	0.60
Heavy clay soil types:	
– pasture and grass cover	0.40
– bush and scrub cover	0.35
– cultivated	0.30
Medium soakage soil types:	
– pasture and grass cover	0.30
– bush and scrub cover	0.25
– cultivated	0.20
High soakage gravel, sandy and volcanic soil types:	
– pasture and grass cover	0.20
– bush and scrub cover	0.15
– cultivated	0.10
Parks, playgrounds and reserves:	
– mainly grassed	0.30
– predominantly bush	0.25
Gardens, lawns, etc.	0.25
Developed surface types	
Fully roofed and/or sealed developments	0.90
Steel and non-absorbent roof surfaces	0.90
Asphalt and concrete paved surfaces	0.85
Near flat and slightly absorbent roof surfaces	0.80
Stone, brick and precast concrete paving panels	
– with sealed joints	0.80
– with open joints	0.60
Unsealed roads	0.50
Railway and unsealed yards and similar surfaces	0.35
Land use types	
Industrial, commercial, shopping areas and town house developments	0.65
Residential areas in which the impervious area is less than 36% of gross area	0.45
Residential areas in which impervious area is 36% to 50% of gross area	0.55

Note:
Where the impervious area exceeds 50% of gross area, use method of Paragraph 2.1.2.

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2.1 Run-off Coefficient

2.1.1 Table 1 lists run-off coefficients appropriate to a variety of land uses and soil characteristics. For catchments having a mixture of different types, the run-off coefficient shall be determined by averaging the value for individual parts of the catchment by using the formula:

$$C = \frac{\Sigma C_i A_i}{A_c}$$

where

C = the run-off coefficient for the catchment.

C_i = the run-off coefficient for a particular land use.

A_i = the area of land to which C_i applies.

A_c = the catchment area.

COMMENT:

1. The run-off coefficient C is the variable in the rational formula least able to be precisely determined, and represents the integrated effects of such things as infiltration, storage, evaporation, natural retention and interception, all of which affect the time distribution and peak rate of run-off.
2. The run-off coefficients given in Table 1 assume saturated ground conditions from previous rain, and shall be used in the calculation of *surface water* run-off.

2.1.2 The chosen run-off coefficient shall be based on the conditions likely to exist after the full catchment development allowable by the operative plan under the Resource Management Act 1991.

2.1.3 Slope correction

The values of run-off coefficient given in Table 1 shall be adjusted for slope in accordance with Table 2.

COMMENT:

The values in Table 1 assume an average sloping terrain of 5-10% (i.e. gently rolling). However, if the terrain is flatter or steeper this will have the effect of slowing down or speeding up overland flow. The above adjustment allows for this.

2.2 Rainfall intensity

2.2.1 The rainfall intensity shall be that for a storm having a duration equal to the time of concentration as determined by Paragraph 2.3.1, and a probability of occurrence as given by NZBC E1.3.1 or E1.3.2 as appropriate. Either local rainfall intensity curves produced by the *territorial authority* or rainfall frequency

complying with AS 3706.1. The filter cloth shall have a mass per unit area of 140 grams/m^2 and a minimum thickness of 0.45 mm.

9.0.5 The volume of storage required in the soak pit, V_{stor} (m^3), shall be calculated by:

$V_{stor} = R_c - V_{soak}$

where

R_c = run-off discharged from catchment to soak pit in 1 hour (m^3).

V_{soak} = volume disposed of by soakage in 1 hour (m^3).

and

$R_c = 10CIA$

where

C = run-off coefficient (see Table 1).

I = rainfall intensity (mm/hr) based on 1 hour duration of an event having a 10% probability of occurring annually.

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A = area (hectares) of the catchment discharging to the soak pit.

and

$V_{soak} = A_{sp}S_r/1000$

where

A_{sp} = area of the base of the soak pit (m^2).

S_r = soakage rate (mm/hr) determined from 9.0.2.

COMMENT:
Generally where the test results show a soakage rate of greater than 500 mm/hour, soakage rather than storage will be the main mechanism to remove the water. Where the soakage rate is significantly less than 500 mm/hour, storage will become the dominant factor. Intermediate soakage rates will require a design utilising both in the proportions necessary to ensure the water will dissipate before it overflows from the pit.

9.0.6 Where the soak pit comprises a rock filled hole (see Figure 13 (a)) then the volume of the hole shall be calculated as V_{stor} divided by 0.38.

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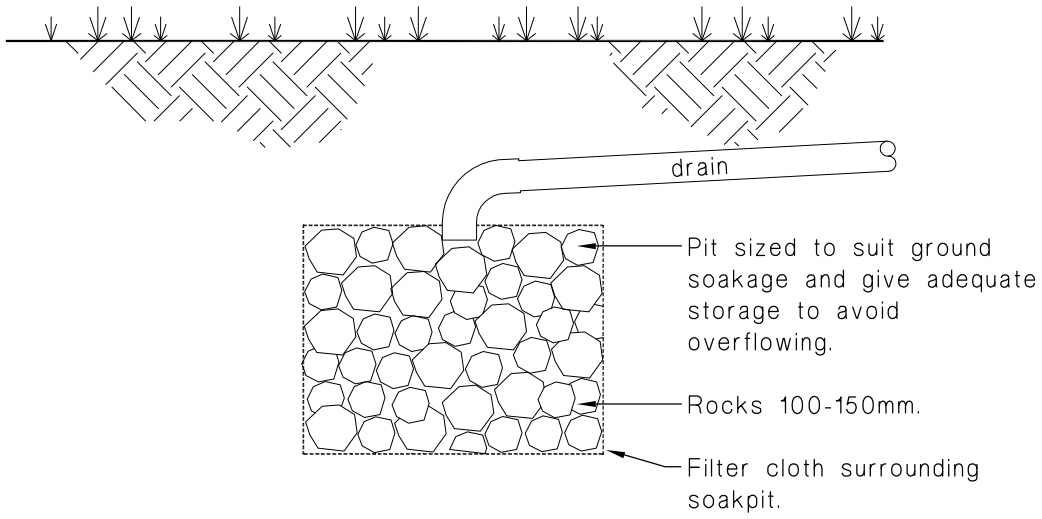
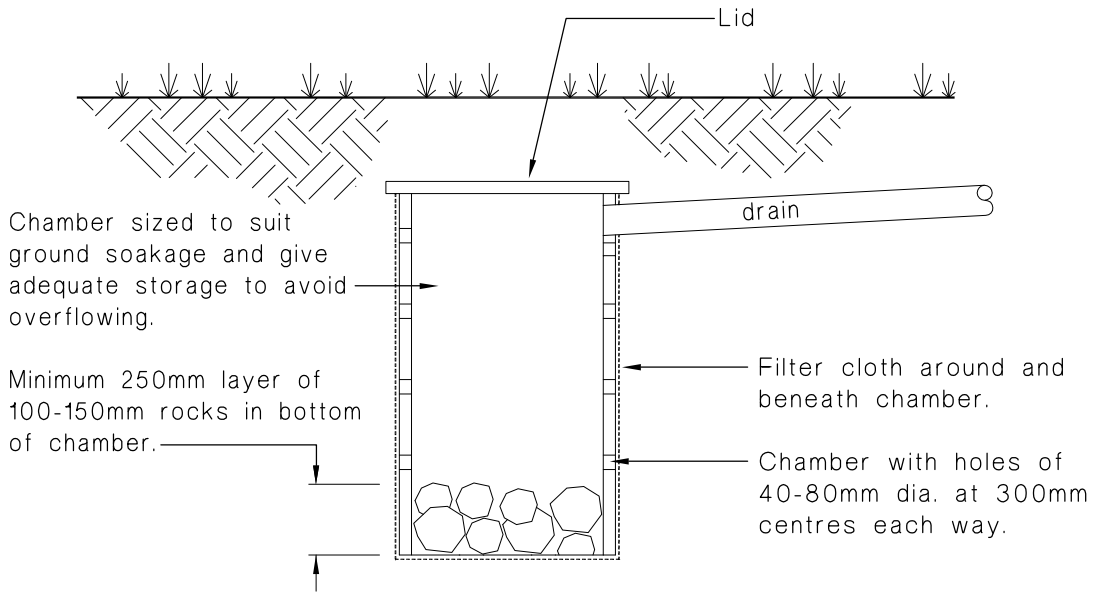
Figure 13: **Soak Pit for Surface Water Disposal**
Paragraph 9.0.4



(a) Rock soak pit



(b) Chamber soak pit