SNZ PAS 4509:2008

STANDARDS NEW ZEALAND
PAEREWA AOTEAROA

Publicly Available Specification

New Zealand Fire Service Firefighting Water Supplies Code of Practice

Superseding SNZ PAS 4509:2003

SNZ PAS 4509:2008

NEW ZEALAND FIRE SERVICE
Whakaratonga Iwi

COMMITTEE REPRESENTATION

This Code of Practice was prepared under the supervision of the P 4509 Committee the Standards Council established under the Standards Act 1988.

The committee consisted of representatives of the following:

Nominating Organisation	Committee Member
BRANZ Ltd	Ed Soja
Department of Building and Housing	Alan Moule (Observer)
Fire Protection Association New Zealand Inc	Nigel Robinson
Ingenium	Eric Cawte
Insurance Brokers Association of New Zealand Inc	Peter Hughes
Local Government New Zealand	Logen Logeswaran
New Zealand Fire Equipment Association	David Hipkins
New Zealand Fire Service	Brian Davey
New Zealand Fire Service	Ian Millman
New Zealand Fire Service	James Firestone
New Zealand Water & Wastes Association	Johan Ehlers

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REFERENCED DOCUMENTS

Reference is made in this document to the following:

NEW ZEALAND STANDARDS

NZS 4404:2004	Land development and subdivision engineering
NZS 4512:2003	Fire detection and alarm systems in buildings
NZS 4515:2003	Fire sprinkler systems for residential occupancies
NZS 4517:2002	Fire sprinkler systems for houses
NZS 4521:1974	Specification for boxes for fire brigade connections
NZS 4541:2007	Automatic fire sprinkler systems
NZS 9201.7:2007	Model general bylaws – Water supply
NZS/BS 750:1984	Specification for underground fire hydrants and surface box frames and covers
SNZ PAS 4505:2007	Specification for firefighting waterway equipment

AUSTRALIAN STANDARD

AS 1668.3:2001	The use of ventilation and airconditioning in buildings – Smoke control systems for large single compartments or smoke reservoirs

BRITISH STANDARD

BS 3251:1976	Indicator plates for fire hydrants and emergency water supplies

OTHER PUBLICATIONS

Buchanan A.H.	Structural design for fire safety. Chichester: John Wiley & Sons, 2001
Department of Building and Housing	New Zealand Building Code Handbook and Approved Documents
Land Transport Safety Authority	Traffic note 25, Retroreflective raised pavement markers, 2004
New Zealand Fire Service training note	Flow testing of water mains and hydrant inspections
Transit New Zealand	Manual of traffic signs and markings – Part II: Markings
TNZ M/07:2006	Road marking paints

NEW ZEALAND LEGISLATION

Building Act 2004
Fire Service Act 1975
Health and Safety in Employment Act 1992
Local Government Act 2002 and 1974
Resource Management Act 1991

RELATED DOCUMENTS

A list of related documents is set out in Appendix A.

Latest Revisions

The users of this Publicly Available Specification should ensure that their copies of the above-mentioned Standards are the latest revisions. Amendments to referenced New Zealand and Joint Australian/New Zealand Standards can be found on http://www.standards.co.nz.

Preface

As National Commander of the New Zealand Fire Service, I am pleased to release this revised code of practice for firefighting water supplies.

Those users familiar with the 2003 code of practice will see a number of changes that have resulted from comments and feedback from users of the document. The user will still be able to find tables that deal with fire hazard and specify the water flow requirements to match that hazard. There are now a number of worked examples included that help to understand the intent and application of the code and more detail relating to alternative firefighting water sources.

The code recognises the value of fixed fire protection systems, and particularly sprinkler installations, both in commercial structures and in homes. The Fire Service accepts that its firefighting water requirements can be tailored to a much lower demand in these structures. This edition of the code provides clearer guidance on what constitutes an alternative water supply where there is no reticulated supply, or where the available supply is insufficient for firefighting. The code has quantified firefighting water requirements based on sound engineering principles.

Taken together, these features provide the opportunity for all users to match firefighting water supplies to hazard, and to consider a range of alternatives in changing the water supply or changing the hazard in that process.

As an organisation we are committed to a process of continuous improvement, and this code is no exception. I welcome feedback and have already put a team in place that will work towards the next generation of this code of practice in coming years.

Mike Hall
National Commander New Zealand Fire Service
31 July 2008

Foreword

This code of practice was developed to provide direction on what constitutes a sufficient supply of water for firefighting in urban fire districts. This includes areas covered by any agreements under sections 38 or 39 of the Fire Service Act 1975. This code of practice is not intended to provide specifications for the water supply required for the effective operation of fire protection systems.

It is intended that the code of practice will form the basis of a partnership between the New Zealand Fire Service, territorial authorities, water supply authorities and developers so that the code may be used as a basis for territorial authority and water supply authority (WSA) conditions of supply or be called up, for example, by territorial authorities in rules regulating subdivisions in the district plan.

This code of practice is published under section 30(3) of the Fire Service Act.

Review

Suggestions for improvement of this code of practice will be welcomed. They should be sent to the National Commander, New Zealand Fire Service, PO Box 2133, Wellington.

1 GENERAL

1.1 Aims

This code of practice sets out what constitutes a sufficient minimum supply of water pressure and volume for firefighting in structures in urban fire districts. This includes areas covered by any agreements under section 38 or 39 of the Fire Service Act. Compliance with this code of practice does not guarantee that in each and every case the Fire Service can control or extinguish a fire with the water supply available.

The Fire Service recommends the installation of automatic fire detection devices such as smoke detection systems and fire protection systems such as sprinklers in buildings (irrespective of the water supply) to provide maximum protection for life and property.

Fire districts may have a range of water supply systems such as a fully reticulated water supply system (an urban water supply area), a rural water supply system that feeds a supply tank (a rural water supply area), or a stand-alone tank supply using rain water or a local well or bore for maintaining its contents.

Many areas outside fire districts will normally only have a rural water supply system or a stand-alone tank supply (although there may be some private reticulated water supply systems).

Where this code identifies firefighting water supply requirements for any of the three water supply systems above, these requirements can be used to provide advice for similar systems outside fire districts, that is, in rural areas.

In rural areas there may be water supply systems without firefighting capability. In many cases these systems are not sufficient for fire sprinkler systems unless stand-alone water supplies are provided. These are matters to be considered at the design stage of the sprinkler system.

In rural areas, the effectiveness of a water supply for firefighting is affected by the time and distance from a fire station, the fire loading in the structure, the speed of fire development, ready access to a sufficient quantity of water, and the seasonal sustainability of the water supply. Because structures remote from a fire station are significantly more at risk from fire outbreak, the Fire Service strongly recommends that sprinklers are installed in all structures (and specifically houses) sited more than a 10-minute response time from a fire station.

Property owners need to be aware that when considering fire risk, the provision of a readily available sufficient water supply will affect the extent to which a firefighting resource can save life and property. Should a fire occur, the Fire Service will still respond if called and will commence firefighting operations using whatever water is available, but delays in accessing a water supply allow a fire to continue to develop, to a size that more often results in a complete loss.

This code of practice defines the term firefighting water supply as, among other things, a supply of sufficient duration. Water supplies that are not of a duration considered sufficient by the Fire Service are still suitable for fighting fires. However they will not be classed as a firefighting water supply because in the opinion of the Fire Service they may not provide sufficient water to be able to mount an attack on a well-developed fire. The available water may be sufficient for a defensive fire attack aimed at preventing fire spread rather than rapid extinguishment.

Appendix B is intended to give guidance to territorial authorities, developers, and property owners on how water can be used to provide alternative firefighting water sources that the Fire Service can use in the event of a fire. The approach taken in this document is based on fire engineering principles using options for either a prescriptive or specific engineering solution.

This code of practice provides techniques to define a sufficient firefighting water supply that may vary according to circumstances. It relates to the Fire Service requirements only; territorial authorities and building owners may choose to exceed the provisions. SNZ PAS 4509 is written in a way that will encourage flexibility and provide different options for developers and territorial authorities.

This code of practice does not provide specifications for the total water supply required for the effective operation of fire protection systems that may be installed to protect structures or properties. Requirements for fire protection systems may vary and are dependent upon the system design parameters. Fire protection system water requirements must be considered in addition to firefighting water supplies (FW2 – see table 2) except for special or isolated cases (see Appendix C for guidance). If there are other users in the vicinity of the premises, then to comply with this code, it must be shown that all reasonable and appropriate steps have been taken to ensure that their expected usage has been taken into consideration in applying this code.

NOTE – Where a change of building use occurs, the existing water supply system should be evaluated against the requirements of the changed use and if there is a serious mismatch in requirements, this should be brought to the attention of the WSA and building owner.

1.2 Legal context

This code of practice is published under section 30(3) of the Fire Service Act. The code of practice is intended to assist the National Commander of the New Zealand Fire Service to carry out the duties specified in section 30(2) of the Act.

This code of practice is non-mandatory but could be incorporated into relevant bylaws under section 146(b) of the Local Government Act 2002 or district plans prepared under the Resource Management Act. It may also be referenced in New Zealand Standards and other Standards.

In doing so, the body incorporating the code must make a clear distinction between the obligation on the territorial authority and the water supply authority (WSA) to supply the water and the requirements (if any) placed on third parties to enable the respective authority to meet that obligation.

Section 92(2) of the Fire Service Act enables regulations to be made specifying requirements for fire hydrants. However, the National Commander considers that including guidelines on these requirements in this code of practice will be a more cost effective method for achieving appropriate standards through voluntary compliance. Regulations will only be resorted to if the guidelines in this code prove to be ineffective in achieving compliance.

In making decisions on water supplies, local authorities must consider the requirements of all relevant legislation. The main requirements are listed below.

1.3 Legislative requirements of territorial local authorities

1.3.1 Local Government Act

1.3.1.1 *Summary overview*

Under the Local Government Act 1974, territorial authorities are required to install fire hydrants, and to keep them charged.

The requirement to install fire hydrants is contained in section 647 of the Local Government Act 1974, which requires territorial authorities to provide fire hydrants on all reticulation water mains in such convenient places as it determines for extinguishing any fire, or in any fire district under section 26 of the Fire Service Act, as the New Zealand Fire Service Commission approves.

The requirement to keep pipes charged on which hydrants are fixed is contained in section 648 of the Local Government Act 1974.

Appendix D sets out the requirements of sections 647 and 648 of Part 39 of the Local Government Act 1974, and section 26 of the Fire Service Act.

1.3.1.2 *Interpretation*

Section 647 of the Local Government Act 1974 puts hydrants in two classes. The first relates to reticulations inside urban fire districts. Inside urban fire districts fire hydrants must be fixed in the water main pipes where a water supply is provided under section 130 of the Local Government Act 2002 as the New Zealand Fire Service Commission approves. SNZ PAS 4509 is a means of compliance with the Fire Service Commission's requirements.

NOTE – Section 130 of the Local Government Act 2002 does not apply to private water supplies.

The second group relates to reticulations outside urban fire districts. Fire hydrants must still be fixed in the water main pipes, but in this case it is the council that determines where they are installed. It is conceivable that some rural water supplies may have no firefighting capability at all.

1.3.2 Building Act

Section 18 of the Building Act states that building work must comply with the requirements of the New Zealand Building Code, and no more, unless expressly provided for in any other Act.

Section 46 requires copies of certain building consents to be provided to the Fire Service Commission, and under section 47 the Commission can offer advice on matters relating to provision for means of escape from fire, and could include firefighting water supplies. See Appendix E for more information on building consent documentation.

1.3.3 Resource Management Act

Territorial authorities control development and land use through their district plans, made under the Resource Management Act. Resource consents can include conditions that firefighting capability and fire hydrants are provided, but only insofar as the resource consent process allows. Matters that can be considered are those contained in the District Plan, the resource consent application, and in submissions.

1.3.4 Bylaws

Territorial authorities can make bylaws to manage water supplies. NZS 9201.7 provides a means by which local authorities determine urban water supply areas and rural water supply areas.

1.4 Interpretation

Clauses prefixed 'C' and printed in italic type are intended as comments on the corresponding clauses. They are not to be taken as the only or complete interpretation. This code of practice can be complied with if the comment is ignored.

2 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

Words and phrases used in this code of practice that are defined in the Fire Service Act have the same meanings as defined in the Act.

Additional water	Remaining half of total stipulated firefighting water within 270 m of (main entrance into) structure
Alternative firefighting water source	A non-reticulated supply available for firefighting meeting the requirements outlined in Appendix B
Approved Standard	A Standard listed in Appendix F
Approved tester	A person authorised by the water supply authority or the National Commander as competent to conduct measurements of flow and pressure, to test the adequacy of firefighting water supplies
Building Consent Authority	A Building Consent Authority as defined in the Building Act 2004 and includes a Territorial Authority or a private body acting within the scope of their approval
Couplings	See Fire Service coupling
Distance (from a fire hydrant or alternative firefighting water source)	Distance is measured from the fire hydrant or alternative firefighting water source to the main entrance of the building or structure, or as agreed with the Fire Region Manager
Dynamic pressure	See Running pressure
Extra high hazard	Commercial and industrial occupancies having high fire loads NOTE – Taken from NZS 4541 which provides further information.
Extra light hazard	Non-industrial occupancies where the amount and combustibility of the contents is low NOTE – Taken from NZS 4541 which provides further information.
Firecell	Has the same meaning as in the New Zealand Building Code, Clause A2

Fire district	See Urban fire district
Firefighting water supply	Supply of water, available to the Fire Service for firefighting, that complies with this code of practice; where reticulated, the required flow of water is at a minimum running pressure and of sufficient duration
Fire hazard	The danger of potential harm and degree of exposure arising from: (a) The start and spread of fire; and (b) The smoke and gases that are generated by the start and spread of fire
Fire hazard category	The number (graded 1 to 4 in order of increasing fire severity) as defined in the Compliance Documents for the New Zealand Building Code, Acceptable Solution C/AS1
Fire hydrant	An assembly usually contained in a pit or box below ground level and comprising a valve and outlet connection from a water main, to permit a controlled supply of water for firefighting. A pillar upstand connected to a water main and fitted with a valve and instantaneous coupling(s) adaptor will also constitute a fire hydrant. This does not include ball-type fire hydrants
Fire protection system	Includes detection, alarm, and suppression systems installed and maintained for on-going compliance with approved Standards
Fire Service coupling	Fittings or devices conforming with the Standard(s) listed in Appendix F3 that permit the connection of fire hose or firefighting waterway equipment to a source of water supply
Hardstand	A hard (roading) surface capable of withstanding the fully laden weight of a fire appliance from which fire operations for a structure are conducted. The size of a hardstand must include sufficient room for the fire appliance to enter, exit and manoeuvre and for firefighters to move around it to connect hose and safely access equipment. In most cases the hardstand will be the main road if the structure is close to it

Indexed or key fire hydrant	A fire hydrant with flow characteristics that are representative of that part of the network. The criteria to determine an indexed or key fire hydrant are set out in G5.1
Local authority	As defined by section 5 of the Local Government Act 2002. A regional council or territorial authority
Ordinary hazard	Commercial and industrial occupancies involving the handling, processing and storage of mainly ordinary combustible materials unlikely to develop intensely burning fires in the initial stages NOTE – Taken from NZS 4541 which provides further information.
Peak demand	The water supply flow for domestic and commercial use as determined by the water supply authority
Private fire hydrant	A fire hydrant not owned by a water supply authority. Water from such a fire hydrant may be included in firefighting water supplies, if the fire hydrant complies with approved Standards and is sufficiently maintained
Residual pressure	See Running pressure
Required water flow	Half of total stipulated firefighting water within 135 m of (main entrance into) structure
Roof vent	A part of the building which can be relied upon to provide ventilation, mechanical or otherwise
Running pressure	The water pressure in a water main as measured at an adjacent fire hydrant when the fire hydrant in use is fully open
Rural water supply area	An area formally designated by a water supply authority as an area serviced by a reticulated water supply system that is intended to supply water for specified purposes via restricted flow supplies and/or on-demand supplies but not necessarily with a firefighting capability

Static pressure	The water pressure in a water main as measured when none of the fire hydrants are open
Territorial authority	A city or district council
Urban fire district	A fire district declared or constituted under section 26 of the Fire Service Act
Urban water supply area	An area formally designated by a water supply authority as an area serviced by a reticulated water supply system with a firefighting capability, that is intended to supply water to customers via on demand supplies
Water supply authority (WSA)	The operational unit of the Council responsible for the supply of water, including its authorised agent NOTE – Taken from NZS 9201.7 which provides further information.
Water supply classification	An index assigned to a group of fire hydrants or alternative firefighting water sources that meet the specifications contained in table 2

2.2 Abbreviations

The following abbreviations are used in this code:

CBD	Central business district
EHH	Extra high hazard
ELH	Extra light hazard
FH	Fire hazard
FHC	Fire hazard category
FW	Fire water classification number
HRR	Fire heat release rate
LTSA	Land Transport Safety Authority
pH	Measure of the acidity or alkalinity of water
NZFS	New Zealand Fire Service
OH	Ordinary hazard
PRV	Pressure reducing valves
RRPM	Raised reflective pavement markers
WSA	Water supply authority

3 SYMBOLS AND UNITS

The following general symbols and units are used in this code of practice together with others specific to certain applications:

Symbol	Quantity	Unit
A_{exp}	Surface area of adjacent firecell(s) and/or structure(s) exposed to a firecell involved in fire	m^2
A_{fuel}	Surface area of fuel	m^2
A_h	Area of horizontal opening	m^2
A_v	Area of vertical openings	m^2
H_v	Weighted average height of vertical openings.........	m
H_m	Vertical height from the mid-height of the window opening to the mid-height of the horizontal opening	m
M_{exp}	Required water flow rate to protect the exposure....	L/s
M_{fuel}	Mass of fuel in the firecell	kg
M_{water}	Water flow rate required for firefighting....................	L/s
t_{fire}	Fire duration..	s
Q_{fire}	Smaller value of Q_{vent} or Q_{fuel} for a firecell	MW
Q_{fuel}	Rate of heat release from the fuel controlled fire	MW
Q''_{fuel}	Rate of heat release per unit area of fuel burning ...	MW/m^2
Q_{max}	Maximum rate of heat release from fire	MW
Q_{vent}	Rate of heat release from ventilation controlled fire	MW
ΔH_c	Fuel calorific value	MJ/kg

4 USE OF THE CODE OF PRACTICE

4.1 Application

Although this code of practice has been developed for urban fire districts, these provisions are also intended to provide a guide for minimum firefighting water to other areas.

This code of practice is for the use of territorial authorities, water supply authorities, and the Fire Service to establish the quantity of water required for firefighting purposes in relation to the fire hazard in premises located in urban fire districts and to provide guidance in rural areas. It can also be used by developers and property owners to assess the adequacy of the firefighting water supply to new or existing premises.

The code of practice is based on an assessment of the water supplies needed to fight a fire and to limit fire spread. The firefighting water supplies required to address the fire hazard may be established by use of tables, or by calculation (see 4.4).

For any premises, this code of practice establishes the minimum firefighting water supply that is required for the fire hazard. To comply with this code of practice it must be shown that this minimum supply is designed to be available at all times as far as practicable. If it is not then either the supply must be increased or the fire hazard in the premises must be reduced.

This code of practice provides for minimum flows for firefighting water supplies and makes recommendations on the level of domestic and fire sprinkler system demand that water reticulations should deliver concurrently with firefighting water.

Fire service personnel giving advice on firefighting water supplies must do so in accordance with this code of practice.

For planning purposes, the territorial authority or water supply authority may choose to provide a firefighting water supply in accordance with a water supply classification selected from table 1. Any deficiencies identified for particular premises would have to be remedied by increasing the firefighting water supply or reducing the fire hazard in order to meet the requirements of this code.

Under sections 647 and 648 of the Local Government Act 1974, territorial authorities are required to install fire hydrants, and to keep them charged. See 1.3 for further information.

4.2 Classification of water supply

The Fire Region Manager, in consultation with the WSA, shall establish the requirements of the reticulated water supply in accordance with table 2.

It is recommended that water supply systems be designed to provide 60% of annual peak demand in addition to the fire flow. Fire flows are derived from table 2 or by way of the calculation methods outlined in Appendix H and Appendix J.

4.3 Method for determination of firefighting water supply

Compliance with the requirements set out in tables 1 and 2 will meet this code of practice. Fire hazard categories are determined from the methods given in the Compliance Documents for the New Zealand Building Code, Clause C/AS1.

For isolated fire hazards in an area with a lower water supply classification, a risk assessment should be carried out to determine measures to mitigate the hazard or increase the water supply (see 4.4).

4.4 Method for calculation of firefighting water supply

Fire engineers or similar competent persons may use alternative methods, such as those detailed in Appendix H and Appendix J to determine firefighting water supplies. To comply with this code of practice, such alternatives must be submitted for approval to the person(s) nominated by the National Commander. The person(s) so nominated will approve these cases on confirmation that the method and calculations used are correctly applied.

Alternative methods will need to show that the calculated firefighting water supply makes allowances for tactical flow rates (that is, the amount needed above a theoretical amount to absorb the released heat for operational effectiveness).

Table 1 – Method for determining required water supply classification

Sprinklered structures															
Category	**Water supply classification (see table 2)**														
Single family homes with a sprinkler system installed to an approved Standard	FW1														
All other structures (apart from single family homes) with a sprinkler system installed to an approved Standard	FW2														
Non-sprinklered structures															
Category	**Water supply classification (see table 2)**														
Housing; includes single family dwellings, multi-unit dwellings, but excludes multi-storey apartment blocks	FW2														
All other structures (characterised by fire hazard category[1]), examples of which are given below	**Water supply classification (see table 2)**														
	Floor area of largest firecell of the building (m^2)														
	0-199[10]	200-399	400-599	600-799	800-999	1000-1199	1200-1399	1400-1599	1600-1799	1800-1999	2000-2199	2200-2399	2400-2599	2600-2799	> 2800
FHC 1[2]	FW3	FW3	FW3	FW4	FW4	FW4	FW5	FW5	FW5	FW5	FW5	FW5	FW5	FW5	FW6
FHC 2[3]	FW3	FW3	FW4	FW5	FW5	FW5	FW6	FW6	FW6	FW7	FW7	FW7	FW7	FW7	FW7
FHC 3[4]	FW3	FW4	FW5	FW5	FW6	FW6	FW7	FW7	FW7	FW7	FW7	FW7	FW7	FW7	FW7
FHC 4[5]	FW4	FW6	FW6	FW6	FW6	FW7	FW7	FW7	FW7	FW7	FW7	FW7	FW7	FW7	FW7
For special or isolated hazards not covered in above categories [9]	FW7														

NOTE –

(1) Fire hazard category as defined in the compliance documents for the New Zealand Building Code, Acceptable Solution C/AS1.

(2) FHC 1 is sleeping activities including care facilities, motels, hotels, hostels; crowd activities of <100 people including cinemas, art galleries, community halls, lecture halls, churches; working/business/storage activities processing non-combustible materials such as wineries, cattle yards, horticultural products; multistorey apartment blocks.

(3) FHC 2 is crowd activities of >100 people, libraries, book storage, night clubs, restaurants; working/business/storage activities with low fire load such as hairdressers, banks, medical consulting rooms, offices.

(4) FHC 3 is working/business/storage activities with medium fire load such as manufacturing, processing, bulk storage up to 3 metres.

(5) FHC 4 is working/business/storage activities with high fire load such as chemical manufacturing, feed mills, plastics manufacturing, supermarkets or other stores with bulk display over 3 metres.

(6) For special or isolated fire hazards in an area with a lower water supply classification, an assessment should be carried out to determine measures to mitigate the hazard or increase the water supply (see 4.4).

(7) The values in the table were determined by heat release rate modelling for fully developed fires.

(8) All non-sprinkler protected structures, except houses, have an entry level of FW3.

(9) Examples of special or isolated hazards may include bulk fuel installations, timber yards, tyre dumps, wood chip stock piles, recycle depots, and marinas.

(10) For non-sprinkler protected fire hazard category 1 structures less than 50 m^2 in floor area, the FW3 requirement may be reduced by up to 50% with the agreement of the Fire Region Manager. Examples of the sorts of structures intended to be covered by this comment are predominantly garages, sheds, and outbuildings.

Table 2 – Method for determining firefighting water supply

	Reticulated water supply			Non-reticulated water supply	
Fire water classification	**Required water flow within a distance of 135 m**	**Additional water flow within a distance of 270 m**	**Maximum number of fire hydrants to provide flow**	**Minimum water storage within a distance of 90 m** (see Note 8)	
				Time (firefighting) (min)	**Volume** (m^3)
FW1	450 L/min (7.5 L/s) (See Note 3)	–	1	15	7
FW2	750 L/min (12.5 L/s)	750 L/min (12.5 L/s)	2	30	45
FW3	1500 L/min (25 L/s)	1500 L/min (25 L/s)	3	60	180
FW4	3000 L/min (50 L/s)	3000 L/min (50 L/s)	4	90	540
FW5	4500 L/min (75 L/s)	4500 L/min (75 L/s)	6	120	1080
FW6	6000 L/min (100 L/s)	6000 L/min (100 L/s)	8	180	2160
FW7	As calculated (see Note 7)				

NOTE –

(1) Table 1 lists the minimum requirements for firefighting water supplies. In developing towns' main reticulation systems, a water supply authority needs to cater for domestic/industrial water usage in addition to the above. This procedure is outlined in Appendix K.

(2) Special or isolated fire hazards which have higher requirements in an area of lower water supply classification must determine measures to mitigate the hazard or increase the water supply (see 4.4).

(3) Where houses have a sprinkler system installed to an approved Standard, the distance to a fire hydrant or alternative water supply may be negotiated by agreement with the Fire Region Manager.

(4) The water requirements for fire protection systems must be considered in addition to the firefighting water supplies, as detailed in table 1 (FW2), the fire protection system demand plus 1500 L/min (25 L/s) at 1 bar residual pressure.

(5) The minimum flow from a single hydrant must exceed 750 L/min (12.5 L/s), except for those cases where a home sprinkler is installed, in which case the minimum is 450 L/min (7.5 L/s) while the maximum design flow, for safety reasons, is limited to 2100 L/min (35 L/s).

(6) If the minimum water storage requirement as listed in the above table is not available from the reticulated system (reservoir), water can be sourced from an 'alternative supply' as approved by the Fire Region Manager. This water supply must always be within 90 m of the fire risk.

(7) FW7 is for either special or isolated hazards or where the fire hazard due to the size of the largest firecell and its fire hazard category make specific fire engineering assessment necessary. Appendix H and J must be used as the basis for calculating this required firefighting water supply.

(8) See Appendix B.

Commentary to table 2

Example 1

A subdivision is planned for the provision of light industrial buildings all on individual 1000 m^2 sections as zoned in the Council's District Plan. What firefighting water (for the purposes of sizing the water main) is required to be provided to these at present vacant sections assuming that none of those buildings are intended to be sprinkler protected?

Solution

The answer to this depends principally on the size of the largest firecell of the buildings which will be built, most of which will likely be a single firecell, but as this isn't known at this stage of the land development some estimate must be made. If one assumes that on a 1000 m^2 section building is likely to cover between 40% to 79% of this area, then the buildings are approximately at least 400 m^2 to 790 m^2 in size, and for light industrial most likely of Fire Hazard Category 3 (FHC3). Therefore they require a firefighting water supply of FW5 as determined from table 1.

The territorial authority or water supply authority thus decides that the installed inground reticulated water main must supply (just for the purposes of firefighting alone) 9000 L/min (150 L/s). If any buildings subsequently built exceeded this FW5 criterion then either the building could have a sprinkler system installed, or be compartmented into smaller firecells (to reduce the FW classification), or the water main would need to be upgraded, or a water storage tank appropriately sized and positioned on site to make up the shortfall. As an example say a FHC4 building was proposed some years later at a size of 650 m^2. This requires a FW6 classification which is 12 000 L/min (200 L/s).

Therefore either the main is required to be upgraded to meet this or the 180 minutes of expected firefighting at the shortfall of 3000 L/min (50 L/s) means a (180 min x 3000 L/min (50 L/s)) 540 000 L water storage tank is positioned on a site suitably placed to enable Fire Service vehicular access with suitable couplings for direct Fire Service connection.

Example 2

A FHC4 building of size 800 m^2 requires a FW6 classification as assessed from table 1, but is located in an area that only supplies a reticulated water supply capable of supplying FW5. If upgrading of the water main is impractical at this stage the options are:

(a) Install an approved automatic fire sprinkler system which drops the FW classification to FW2;

(b) Divide the building into firecells no larger than 199 m^2, which then only require a FW4 classification; or

(c) Install on site (with the approval of the Fire Region Manager) the shortfall of firefighting water as determined by the firefighting time of 180 minutes x [12 000 L/min (200 L/s) (FW6) – 9000 L/min (50 L/s) (FW5)] which equals 540 000 L.

4.5 Assessment

Appendix H describes a method for determining the maximum fire size in a structure.

Appendix J describes a method for assessing the adequacy of the firefighting water supply to the premises.

Where the available water supply meets or exceeds the required firefighting water supply, the water supply may be assumed for the purposes of section 30(2) of the Fire Service Act to be sufficient.

Where the available water supply is insufficient for firefighting purposes, steps must be taken either to improve the supply or reduce the maximum fire size. Use of Appendix H and Appendix J will indicate the options available in a particular situation.

4.6 Recording of water requirements

Where firefighting water requirements are determined using Appendix H and Appendix J, the Fire Service and the WSA shall keep records of the calculated values.

5 RUNNING (DYNAMIC) PRESSURE

The Fire Service controls water flow from water mains using the pumps on the fire appliance. The minimum running pressure in the water main should not be less than 100 kPa while the water main is flowing the required amount of water from the maximum number of fire hydrants. The minimum running pressure is also known as the residual pressure.

Due to the bore size of a standpipe, the maximum safe flow for design purposes (assuming pressure in the street water main is not a limiting factor) from a hydrant/standpipe assembly is 2100 L/min (35 L/s). Therefore if a structure risk required a firefighting water supply of 6000 L/min (100 L/s), then no less than three hydrants should be located (preferably as a hydrant group) in close proximity to the hardstand.

NOTE – For health and safety, and operating reasons, the Fire Service specifies a maximum working pressure for layflat hoses of 1050 kPa.

6 FIRE SERVICE VEHICLE ACCESS TO WATER SOURCE

6.1 Background

The adequacy of a firefighting water supply includes not only an assessment of the water supply that must be available, but also the location, connections, marking, and access to fire hydrants to enable the water supply to be used.

Roading widths, surface, and gradients where hydrants are located should support the operational requirements of Fire Service appliances. The Compliance Documents for the New Zealand Building Code specify these requirements and have final authority, but in general the roading gradient should not exceed 16%. The roading surface should be sealed, and trafficable at all times. The minimum roading width should not be less than 4 m. The height clearance along access ways (for example trees, hanging cables, and overhanging eaves) must exceed 4 m.

6.2 Fire hydrant location

The location of fire hydrants must follow the provisions contained in Appendix L. This code of practice does not necessarily require fire hydrants to be spaced at regular intervals on water mains.

6.3 Uncharged water mains

The WSA should advise the Fire Service as soon as practicable when new water mains are charged and commissioned or existing water mains are decommissioned and when reinstated either temporarily or permanently. Fire hydrant boxes, lids, markings, and marker posts must be removed from abandoned water mains.

NOTE – It is advised that the building owners should inform the insurers if a water main is uncharged for more than 12 hours.

6.4 Hardstand requirements

For a fire appliance to be effective it needs to be able to park in an area as close as possible to both the available water supply and the structure to be protected. This area is termed the ‘hardstand’. For the standard fire appliance this area should not be less than 4.5 m in width by 11 m in length. However, given that the turning circle for this appliance is approximately 17.5 m all reasonable effort should be made to meet this length.

NOTE – An aerial fire appliance has a turning circle of 24.5 m and needs a width of 6 m to enable the stabilising struts to be deployed.

6.5 Access to alternative firefighting water sources

Where a sufficient firefighting water supply cannot be obtained solely from a reticulated supply, certain provisions must be followed to ensure the accessibility and usability of alternative firefighting water sources for firefighting purposes. These provisions are set out in Appendix B.

7 INSPECTION AND TESTING OF FIRE HYDRANTS

The Fire Service Act allows for the Fire Service to check, in any urban fire district, or in any area concerning any property that the Fire Service is under an obligation to protect pursuant to section 38 or section 39 of the Fire Service Act, the adequacy of firefighting water supplies, including volume and pressure in any water main, and to advise the WSA as to their sufficiency or otherwise. A best practice guide for the inspection of fire hydrants and the testing of firefighting water supplies is given in the Fire Service training note *Flow testing of water mains and hydrant inspections*. (See also Appendix G.)

Where a firefighting water supply is from private fire hydrants and water mains, an inspection and testing programme of fire hydrants must be agreed between the owner of the premises and the approved tester in accordance with Appendix G.

8 FIRE PROTECTION SYSTEMS

Fire protection systems protecting premises must comply with approved Standards, including testing and maintenance regimes, if their use is to be included in the assessment of fire hazard as set out in Appendix H. A list of approved Standards is provided in Appendix F.

9 DISPUTES

In the event of a dispute about the application or interpretation of this code of practice, any party to the dispute may refer the dispute to the Fire Service National Commander in writing. The National Commander may determine the matter in dispute in any manner the National Commander considers appropriate. In making a decision on the dispute, the National Commander will follow a process that is fair and reasonable in the circumstances (including providing an opportunity for all affected parties to be heard). When making a decision on a dispute the National Commander will give reasons for the decision.

APPENDIX A – OTHER RELEVANT DOCUMENTS

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APPENDIX B – ALTERNATIVE FIREFIGHTING WATER SOURCES

B1 Use of alternative firefighting water sources

Where reticulated water supplies are unavailable or insufficient, alternative firefighting water sources may be used to provide a firefighting water supply. Alternative sources may come from a mixture of reticulated and static supplies.

Alternative firefighting water sources should meet minimum standards for firefighting (access, security, visibility, adequacy of supply) and have a suitable fire service coupling for firefighting equipment and be sited to provide safe and ready access for Fire Service operations.

NOTE – Where plastic tanks are used for storing firefighting water, consideration needs to be given to shielding them from the effects of radiated heat from a fire.

Where this code of practice is applied in areas outside urban fire districts, Fire Service personnel giving advice on the adequacy of water volumes should take into account any special circumstances such as distance to the nearest fire station, size of buildings and normal use of water from any storage tank when recommending total storage volume.

B1.1 *Security*

The water supply must be reasonably protected from vandalism and tampering that may negate it being usable, for example, with a locked off (with a lightweight chain) valve on the outlet pipe that can be cut with bolt cutters to access.

B1.2 *Firefighting access*

There should be unimpeded access within the specified 90 m distance to a building allowing vehicular access to the firefighting water supply at all times, with the roading able to support a 20 tonne vehicle. In making an allowance for access, consideration must be taken of the complete travel route and access way widths, entry and exit ways, room to manoeuvre, obstructions (overgrown vegetation, hanging cables and building projections), gradients, gateways, and road surfaces. Where, due to the siting of the water tank, vehicle access is not practical, there should be a clear, safe working area, to support the siting of a portable pump and associated equipment, providing agreement is obtained from the Fire Region Manager.

B1.3 *Adequacy of supply*
The owner must establish an acceptable means to reliably maintain any tank to a usable capacity.

Provision shall be made on all storage tanks and elevated tanks to:
(a) Automatically keep the tank topped up;
(b) Manually refill the tank after emptying.

The outlet pipe connection size must be calculated to provide, or be able to provide, 750 L/min (12.5 L/s) at the coupling. In general terms this measurement should be the same size as the fire service coupling complying with the approved Standards in Appendix F3. Where the distance between tank and coupling is excessive, for example, more than 50 m, then this distance will need to be taken into account in the calculation.

B1.4 *Visibility*
The firefighting water supply and firefighting access must be readily identifiable to responding firefighters by use of signs, marker posts or other suitable identifiers.

Alternative firefighting water sources in fire districts must be identified at the premises in a manner acceptable to the Fire Region Manager.

B1.5 *Acceptable sources of supply*
For any water supply (other than a reticulated supply), to be considered suitable for firefighting purposes, it must be proven reliable and accessible at all times.

B2 Suction sources

A suction source is accessible, open or tank water.

The maximum theoretical lift for Fire Service pumps is 10 m and the maximum practical lift is 7.5 m.

The rated capacity of a Fire Service pump is its output in L/min when working from a 3 m lift, see figure B1.

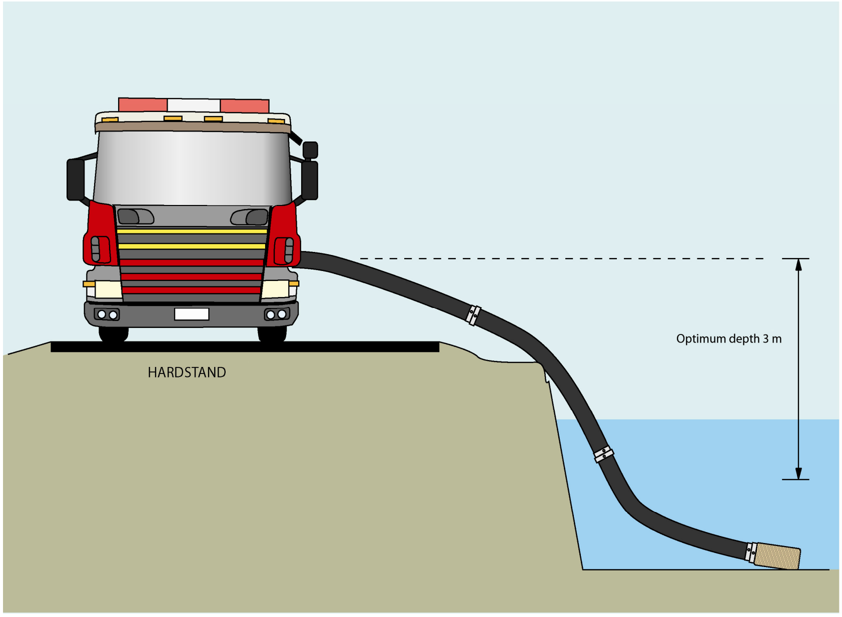


Figure B1 – Suction sources

The following figures show the greater the vertical lift to be overcome, the less water is delivered to the incident:

(a) 3.0 m lift – rated capacity of the pump;

(b) 4.5 m lift – 1/7 loss of capacity;

(c) 6.0 m lift – 1/3 loss of capacity;

(d) 7.0 m lift – 1/2 loss of capacity; and

(e) 7.5 m lift – 2/3 loss of capacity.

Alternatively, a fixed static pick-up pump fitted with a fire service coupling complying with the approved Standards in Appendix F, F3 may be permanently fitted to the source (see figure B2). In this case the vertical depth down from the appliance pump inlet to the water surface may be increased to 7.5 m. This reduces the time needed to make connections for draughting and allows water to be draughted down to the maximum practical depth.

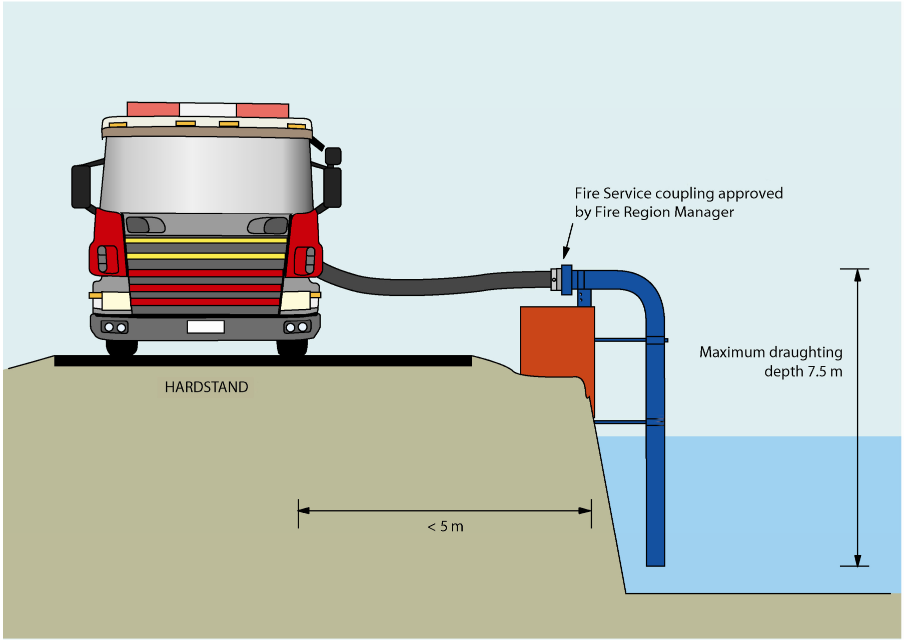


Figure B2 – Suction sources – fixed, static pick-up

There must be a hardstand for a fire appliance so that the appliance pump inlet is within 5 m of the water supply, or the permanent fire service coupling, if fitted. The premises must be within 90 m of the water supply, or the permanent fire service coupling, if fitted.

The fire service coupling to the suction source must be at the discretion of the Fire Region Manager of the urban fire district, complying with the approved Standards in Appendix F, F3. The fire service coupling must be located so that it is not compromised in the event of a fire.

See figure B4 for examples of how alternative water supplies can be delivered to within 90 m of a hazard.

B3 Flooded sources

A flooded source is a tank or supply more than 10 m above road level fitted with a fire service coupling, see figure B3.

There must be a hardstand for a fire appliance as close as reasonably practicable to the fire service coupling, but this distance should not exceed 25 m. The fire service coupling must be within 90 m of the premises (see figure B4).

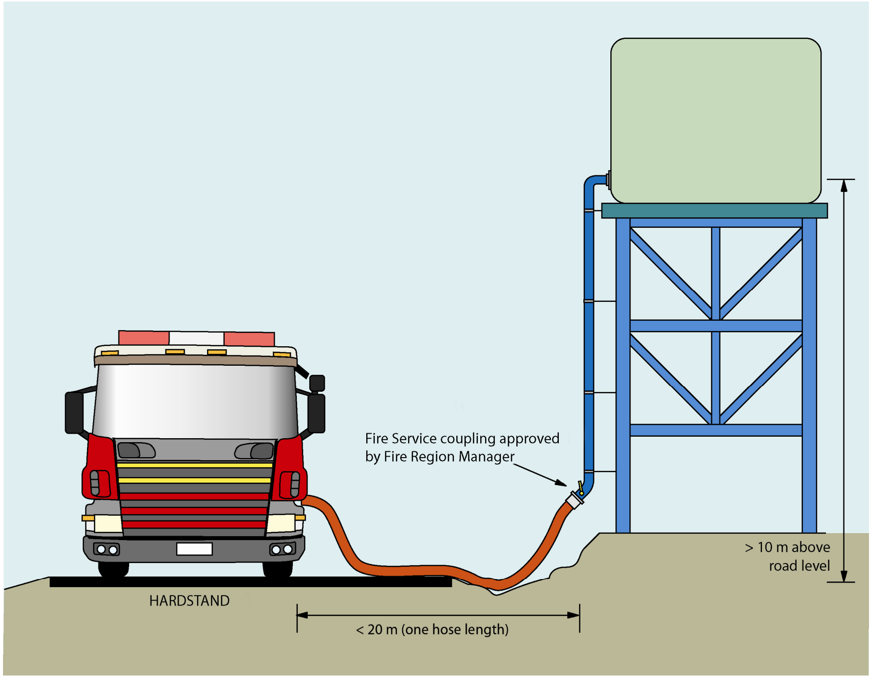


Figure B3 – Flooded sources – water supply above road level

The fire service coupling to a flooded source must be either a female instantaneous coupling or a fire hydrant coupling complying with the approved Standards in Appendix F, F3. The fire service coupling must be located so that it is not compromised in the event of a fire. The pipe work leaving the tank and just prior to terminating at the Fire Service coupling must be properly supported and bracketed. Where a supply tank is intended to be used as a supply for firefighting water, the tank manufacturer or the manufacturer's instructions should be consulted for the fitting requirements of fire service couplings and any associate pipework.

NOTE – Prior to committing to an installation, consult with the tank manufacturer on any restrictions to the size, and type of fitting, and that these are appropriate for the tank construction.

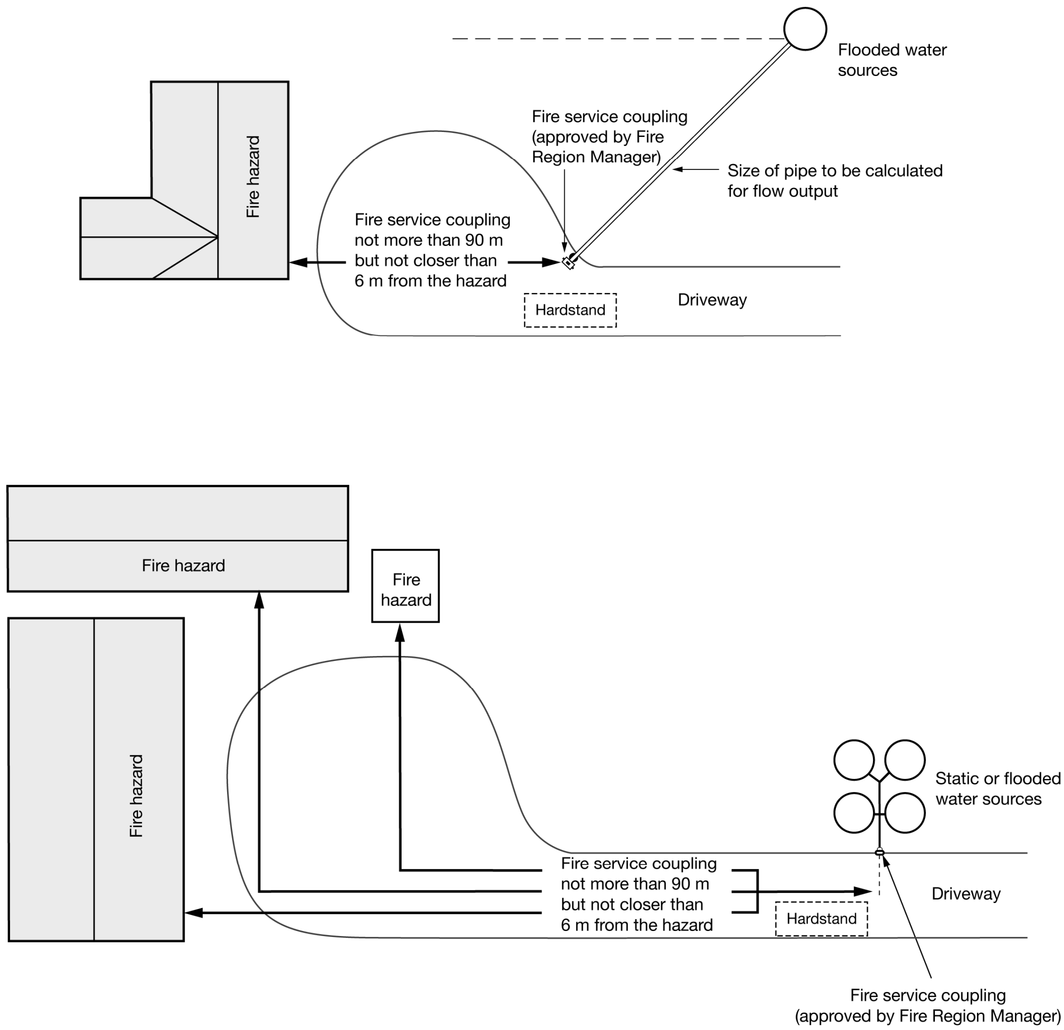


Figure B4 – Examples of how alternative water supplies can be delivered to within 90 m of a hazard

B4 Water pressure, flow, and volume for alternative firefighting water sources

For the purposes of calculation, the pressure at the Fire Service coupling must be assumed to be –60 kPa for suction sources, and must be hydraulically calculated to give a minimum pressure of 100 kPa at the pump inlet for flooded sources at maximum design flow.

The required flow from an alternative firefighting water source must be determined from table 2 or calculated from Appendix J, taking into account any available reticulated supplies.

The adequacy of the flow from the alternative firefighting water source must be demonstrated to the satisfaction of the Fire Region Manager of the urban fire district.

The minimum available water storage volume must comply with table 2 or be calculated using Appendix J and the calculated duration of the fire.

The diameter of the pipe that connects the tank or reservoir to the fire service coupling (attachment point) must be sized to ensure that 100 kPa of pressure is maintained at the Fire Service pump inlet.

The firefighting water supply may be water from any year-round source such as:

(a) Dams;

(b) Water tanks;

(c) Man-made pools and lakes (where the available water can be calculated);

(d) Industrial cooling water (in consultation with owner);

(e) Natural pools and lakes able to sustain a continuous accessible depth of at least 1 m;

(f) Flowing river or stream water able to sustain a continuous accessible depth of at least 1 m;

(g) Seawater able to sustain a continuously accessible depth of at least 1 m;

(h) Grey water and recovered firefighting water;

(i) Wells and bores; and

(j) Fixed standpipes into shallow ground water aquifers.

B5 Unacceptable quality of supply

Notwithstanding B4, the following are unacceptable:

(a) Water with dispersed solids greater than 2 mm in diameter;

(b) Chemically contaminated water with a pH outside the limits of pH 3 – 10.5 that is, strongly acidic or alkaline; and

(c) Biologically-contaminated water that would pose a health hazard to firefighters.

APPENDIX C – SPRINKLER DEMAND

Sprinkler systems are individually hydraulically calculated to establish design flows. However, **indicative** design flows are as in table C1.

Table C1 – Example of practical water requirements

Sprinkler system type	Typical design flow for sprinkler system	Flow for firefighting (see table 2)	Demand on water supply reticulation from the fire sprinkler system and for firefighting
Residential or housing domestic sprinkler	60 – 180 L/min (1.0 – 3.0 L/s)	450 L/min (7.5 L/s)	> 510 L/min (> 8.5 L/s)
Extra light hazard (ELH)	360 L/min (6.0 L/s)	1500 L/min (25 L/s)	1860 L/min (31 L/s)
Ordinary hazard (OH)	1200 – 1500 L/min (20 – 25 L/s)	1500 L/min (25 L/s)	> 2700 L/min (> 45 L/s)
Extra high hazard (EHH)	2400 – 6000 L/min (40 – 100 L/s)	1500 L/min (25 L/s)	> 3900 L/min (> 65 L/s) (see Notes)

NOTE –
(1) Due to the range of typical fire flows for EHH systems, consideration will need to be given to the premises that the systems are protecting.
(2) For sprinkled buildings of classification ordinary hazard (OH) or lower, the Fire Region Manager may consider upon application the minimum flow in the water main to be the greater of either the firefighting or fire protection system requirements, but not necessarily both.

To aid in determining the 'practical' water requirement flow for fire protection systems and firefighting water, table C1 gives examples of typical flows that could be expected under normal conditions. The following minimum flows are provided to help interpret the code requirements (see 1.1).

For example, if a node in a town water reticulation had a measured capacity of 8400 L/min (140 L/s), it would have been sized for the following criteria:

(1)	Two thirds of peak annual demand to cater for domestic supply	=	5600 L/min
(2)	The calculated requirements of an OH sprinkler system in a building connected to the water main	=	1240 L/min
(3)	Leaving an available water supply for firefighting (≥1500 L/min)	=	1560 L/min
	Total		**8400 L/min**

APPENDIX D – LEGISLATIVE REQUIREMENTS

Part 39 Local Government Act 1974 – Prevention of fires

Section 647 – Fire hydrants

(1) In every part of the district in which there is a water supply provided under section 130 of the Local Government Act 2002, the council shall fix fire hydrants in the main pipes, other than trunk mains, of the waterworks at the most convenient places for extinguishing any fire as the council determines, or, in any part of the district that is included in a fire district under section 26 of the Fire Service Act 1975, as the New Zealand Fire Service Commission approves, and shall keep those fire hydrants in effective working order.

(2) Where a water supply is provided in the district or in any part of the district by any other local authority, the council may arrange with that local authority to fix fire hydrants in the main pipes, other than trunk mains, situated in the district or in that part, as the case may be.

(3) Fire hydrants shall be fixed at such distances from each other as the council decides or, in the case of hydrants fixed in any part of the district that is included in a fire district of the New Zealand Fire Service Commission, as that Commission approves.

(4) The council shall put near each fire hydrant a conspicuous notice or a mark of a kind approved by the New Zealand Fire Service Commission, in the case of a hydrant fixed in any part of the district that is included in a fire district of that Commission, or, in any other case, approved by the council, showing the situation of the hydrant, and that notice may, if the council thinks fit, be put on any structure.

(5) In this section the term trunk main means a main used for the purpose of conveying water from a source of supply to a filter or reservoir, or from one filter or reservoir to another filter or reservoir, or for the purpose of conveying water in bulk from one part of the limits of supply to another part of those limits, or for the purpose of giving or taking a supply of water in bulk.

(6) Where the council is dissatisfied with any decision of the New Zealand Fire Service Commission under this section, it may, within one month after receiving notice of the decision, appeal against that decision to a District Court, whose decision shall be final.

Section 648 – Pipes to be kept charged with water

(1) Except in case of unusual drought, or of accident, or of shortage from any cause of the water supply, or during necessary repairs, connections, or inspections, or in a case of a state of emergency declared under the Civil Defence Emergency Management Act 2002, the council must at all times keep charged with water the pipes in which fire hydrants are fixed by the council under section 647.

(2) Subject to the overall requirements of any Controller while a state of emergency exists under the Civil Defence Emergency Management Act 2002, the council must allow all persons to take and use water from any waterworks or water race for extinguishing fire without any payment for the same.

Part 3 Fire Service Act 1975 – Organisation of fire service

Section 26 – Fire Districts

(1) Every united urban fire district, urban fire district, and secondary urban fire district which existed immediately before the commencement of this Act is hereby declared to be a Fire District under this Act.

(2) Where the Commission is satisfied that the fire protection of any urban area can be more effectively carried out:

(a) By the inclusion of that urban area in an existing Fire District; or

(b) By the constitution of that urban area as a Fire District, the Commission may by notice in the Gazette, at the request of a territorial authority or of its own motion, include that urban area in an existing Fire District or constitute it a Fire District accordingly. The same or any subsequent notice in the Gazette shall:

(c) Specify the date on which the area is to be included in or, as the case may be, constituted a Fire District:

(d) Assign a name or designation to the Fire District.

(3) Any Fire District constituted under this section may include the whole or any part of any existing Fire District.

(4) The Commission may, by notice in the Gazette, alter the boundaries of, or abolish, any existing Fire District. The same or any subsequent notice shall specify the date on which the boundaries are to be altered or, as the case may be, the Fire District is to be abolished.

(5) Notwithstanding anything in the Local Government Act 2002, the Local Government Commission shall not prepare any scheme providing for the constitution or abolition or alteration of the boundaries of any Fire District.

APPENDIX E – PROCEDURE AND CHECKLIST FOR BUILDING CONSENT DOCUMENTATION

The following checklist is intended to aid territorial authorities (and those applying for a building consent) in assessing the adequacy of (or providing) the firefighting water supply requirements to meet this code of practice.

E1 Step 1 Firefighting water supply classification
From table 1 state the required firefighting water supply (FW) classification for the structure to be built. This is based upon the type of occupancy, and whether it is sprinkler protected, but if not then the fire hazard category (FHC) and largest firecell size.

E2 Step 2 Location of fire hydrants
On a to-scale site plan, show the location (and main entrance/s) of the to-be-built structure/s, detail the current available firefighting water supply, by labelling the exact location, pressure, and flows of the nearest (street) fire hydrants. The distance/s to the first fire hydrant/s should not exceed 135 m and to the second fire hydrant/s to not exceed 270 m. See figures L2(a) – (c). Hydrant flow tests should be conducted at peak times (6.30am to 8.30am or 6.00pm to 8.00pm) subject to water discolouration issues, and include time, date, and tester details.

E3 Step 3 Firefighting water supply
If the available firefighting water supply provided by the fire hydrants meets or exceeds the required FW classification of a structure as outlined in table 2, or by calculation using Appendix H and J, then no further action is required.

E4 Step 4 Alternative firefighting water supply
However if any (or all) firefighting water supply is provided by alternative means, the locations and quantities of this stored water (most often water tanks) must be detailed on this 'to-scale' site plan. Where alternative firefighting water is to be provided, the site plan must show how Fire Service vehicular access is provided within the required distance and label a 'hardstand' location (see 6.4). To assess whether the proposed alternative firefighting water is acceptable, see Appendix B.

E5 Step 5 Fire Service couplings
The supplied documentation must specify the appropriate Fire Service couplings to access any stored water suitable for Fire Service connection. These are detailed in SNZ PAS 4505.

E6 Example 1

A house (without a sprinkler system) is to be built at the back of a subdivided section. Reticulated water is available from a street main, which has fire hydrants.

Step 1 = FW2, non-sprinkler protected house (of proposed floor area = 200 m^2)

Step 2 =

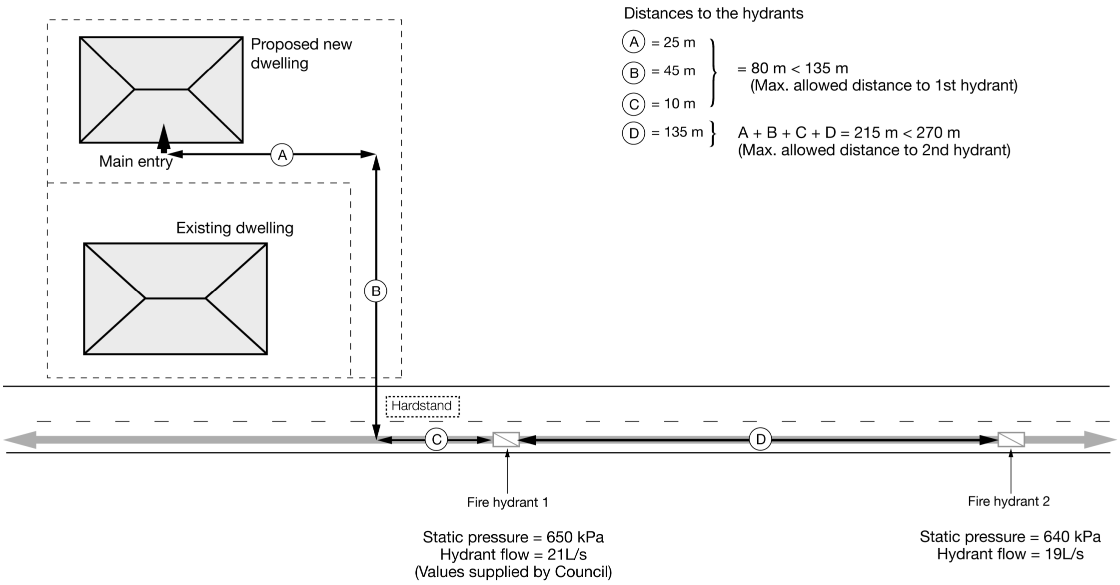


Figure E1 – Firefighting water supply requirements for a non-sprinklered house with access to a reticulated supply

Step 3 = FH1 = 21 L/s at 650 kPa > 12.5 L/s at the minimum 100 kPa (FW2) within 135 m.

FH2 = 19.5 L/s at 640 kPa > 12.5 L/s at the minimum 100 kPa (FW2) within 270 m.

Therefore code of practice requirements have been met, no further action needed.

Step 4 = Not applicable

Step 5 = Not applicable

E7 Example 2

A house (without a sprinkler system) is to be built out in the country, where there is no street reticulation.

Step 1 = FW2 (non-sprinkler protected house of proposed floor area 300 m^2)

Step 2 =

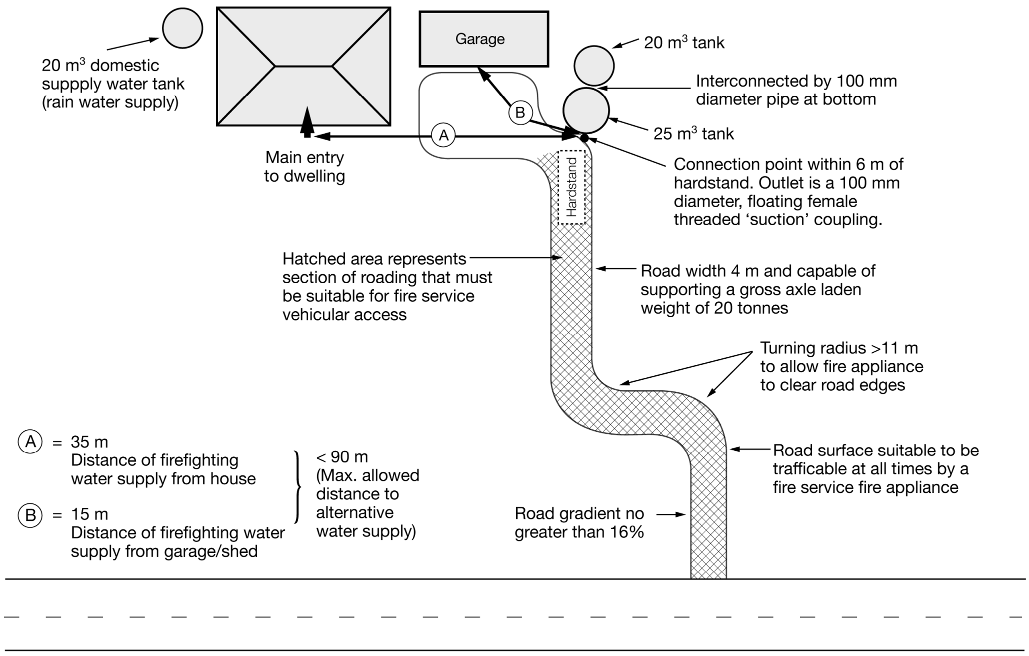


Figure E2 – Firefighting water supply requirements for an unsprinklered house with no access to a reticulated water supply

Step 3 = Not applicable

Step 4 = See plan. Conditions meet requirements as neither distance A or B exceed 90 m.

Step 5 = See plan. 'Suction coupling' compliant with SNZ PAS 4505 to be installed.

Total firefighting water supply = 20 m^3 + 25 m^3
= 45 m^3
= FW 2

E8 Example 3

A house (with a sprinkler system compliant with NZS 4517) is to be built out in the country, where there is no street reticulation.

Step 1 = FW1 (sprinkler protected house) of proposed floor area 300 m^2

Step 2 =

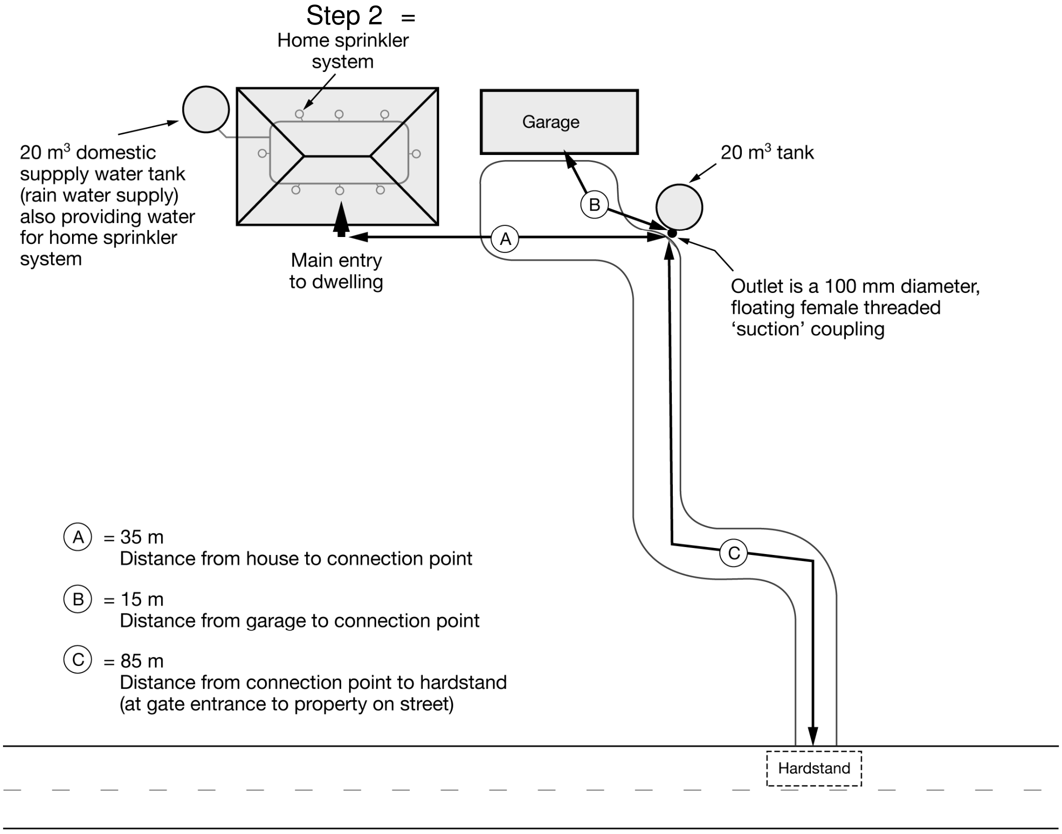


Figure E3 – Firefighting water supply requirements for a sprinklered house with no access to a reticulated water supply

Step 3 = Not applicable

Step 4 = Firefighting water proposed to be 20 m^3 tank beside garage, which exceeds the required 7 m^3 amount, and is within 90 m of the structures. However there is no Fire Service vehicular access to it, with the closest hardstand 85 m away and A + C = 120 m from the entrance to the furthest away structure. This distance should be within 90 m, however in discussion with the Fire Region Manager the use of portable pumps from the fire appliance are agreed to as is the extra distance.

Step 5 = Couplings suitable for a New Zealand Fire Service portable pump installed in both 20 m^3 tanks compliant with SNZ PAS 4505.

APPENDIX F – APPROVED STANDARDS

F1 Fire protection Standards

NZS 4512:2003	Fire detection and alarm systems in buildings
NZS 4515:2003	Fire sprinkler systems for residential occupancies
NZS 4517:2002	Fire sprinkler systems for houses
NZS 4541:2007	Automatic fire sprinkler systems

F2 Firefighting water connections

NZS/BS 750: 1984	Specification for underground fire hydrants and surface box frames and covers
NZS 4521:1974	Specification for boxes for fire brigade connections

F3 Firefighting waterway equipment

SNZ PAS 4505:2007	Specification for firefighting waterway equipment

F4 Fire hydrant marking

NZS 4404:2004	Land development and subdivision engineering
BS 3251:1976	Indicator plates for fire hydrants and emergency water supplies

F5 Others

Other standards (including international Standards) may be applicable. Refer to the National Commander.

APPENDIX G – TESTING OF FIRE HYDRANTS

G1 Purpose

The Fire Service Act allows the Fire Service, from time to time, as it considers necessary, to check firefighting water supplies for (among other things) volume and pressure, and to advise the WSA on their sufficiency or otherwise.

When water testing is conducted by the Fire Service, it also enables the Fire Service to gather information about the water volume and pressure of any water systems that may be necessary for the operation of fire protection systems.

The testing of fire hydrants by the Fire Service is to be in accordance with the Fire Service training note on *Flow testing of water mains and hydrant inspections*. This training note must be followed by Fire Service personnel involved in water testing. For other approved testers, its provisions are advisory.

Fire hydrants should be tested during daily peak demand periods. Fire hydrant testing must have the approval of the water supply authority as described in G3.

NOTE –

(1) Attention is drawn to the need to meet other legislative (for example Health and Safety in Employment Act, Resource Management Act), and WSA requirements.

(2) The release during testing of water from a hydrant that is discharged onto land or into water (for example, a stormwater drain) may require a consent from the regional council. Check with the local authority.

(3) When carrying out fire hydrant tests, approved testers need to be aware that where large pressure reducing valves (PRVs) are installed, at low flows the running pressure will drop as expected. However, where large flows occur, the running pressure may rise then fall as the PRV attempts to maintain a set pressure. Similar results could be expected where reticulated supplies use manual or automatic booster pumps to maintain pressure at high flows.

(4) Although the Fire Service tests fire hydrants to check firefighting water supplies, water supply authorities and other users operate fire hydrants for other purposes, such as removing air blocks.

(5) A traffic management plan (TMP) should be approved by the road controlling authority (RCA) before conducting water testing on roadways.

G2 Responsibility for testing and inspecting

To ensure operational effectiveness, the Fire Service needs to monitor the adequacy of the firefighting water supply and the condition of fire hydrants. The maintenance of fire hydrants is the responsibility of the water supply authority or for private fire hydrants, the owner. Effective liaison with the water supply authorities is necessary in all matters related to water supplies. To comply with this code of practice, water supply authorities must ensure that fire hydrants are tested in accordance with this Appendix.

By agreement, testing and inspection of fire hydrants may be carried out by any of the following:
(a) New Zealand Fire Service;
(b) Water supply authority;
(c) Approved tester.

For the duration of any test, the water supply authority may have representatives present.

G3 Notifications

To minimise the risk of damage to a water system, a formal procedure for notification needs to be agreed between those carrying out the testing and the water supply authority. The procedure should include:
(a) Notification by agreed means to the water supply authority of an intention to test (testing would normally be carried out at times of peak demand);
(b) Notification to give an agreed period of notice;
(c) Notification to specify all fire hydrants to be tested and the planned testing schedule;
(d) Water supply authority to notify those conducting the test if the system is not under normal operational control;
(e) Water supply authority to advise if there are reasons why the test should not be carried out as planned (for example, home haemodialysis, special commercial or industrial user);
(f) Notification by agreed means to the appropriate authority of any intended disposal of water to drains;
(g) Notification of results by agreed means to water supply authority; and
(h) Statement to WSA whether or not the water supplies are sufficient for firefighting.

G4 Fire hydrant inspections

All fire hydrants must be inspected and flushed every five years by an approved tester. To achieve this, a progressive inspection programme must be agreed between the Fire Service and the WSA.

Fire hydrant inspections include:
(a) A visual check to ensure the fire hydrant is marked correctly;
(b) A visual check of the condition of the fire hydrant box and lid, including fitting;
(c) Identification of any debris or soil build-up in the fire hydrant box that would affect the operation of the fire hydrant;
(d) Fitting a standpipe and flowing water to check the unobstructed flow of water and operation of the fire hydrant valve spindle;
(e) With a blank cap in the open outlet of the standpipe and when water is flowing, gradually shut off the valve on the head of the standpipe so that the standpipe is pressurised to the pressure in the mains and check the hydrant flange gasket for leakage;
(f) Any faults or leaks are to be reported to the water supply authority;

(g) Inspection date and results are to be recorded in a manner agreed between the Fire Service and the water supply authority. These results are to be available to all interested parties; and
(h) Shut down the fire hydrant and before leaving the site, check that there is no leakage.

Private fire hydrants should be inspected in a similar manner.

G5 Single fire hydrant tests

G5. 1

The Fire Service and the water supply authority are to consider all fire hydrants on a water supply system and jointly determine indexed or key fire hydrants. A key fire hydrant is one with flow characteristics that are representative of that part of the network.

The criteria to determine an indexed or key fire hydrant include:
(a) A selected number of fire hydrants between isolating valves;
(b) A selected number of fire hydrants on different pressure zones due to location or other agreed criteria;
(c) Any fire hydrant considered by the Fire Service or water supply authority as an indexed or key fire hydrant;
(d) Fire hydrants at high points of the reticulation, and any other locations where low supply pressures are to be expected due to conditions such as high industrial demand, pumping outage, reticulation valving, and so on.

NOTE –
(1) It is important to identify fire hydrants that will experience the lowest supply pressure in order to assess the minimum allowable pressure of 100 kPa in any part of the reticulation.
(2) Consideration should also be given to the pressure available to fire hydrants at high points in the reticulation when water is being drawn from lower levels, either from hydrants, by large industrial users, or at times of peak domestic demand.

Key fire hydrants must be tested to measure flow and pressure at least every five years. Where the flow and pressure from the fire hydrants under test does not meet the minimum values of section 5 and table J3, or the recorded calculated values, the WSA must be advised of the inadequacy.

Inspection date and test results are to be recorded in a manner agreed between the Fire Service and the water supply authority.

Where the necessary firefighting water is supplied by more than one fire hydrant, the capacity of a water main may be estimated as in G5.2.

G5. 2 *Graph of pressure/flow characteristics of a hydrant supply*

G5.2. 1
This method is suitable for single or multiple hydrant flow tests from single pipe or network systems on the same pressure zone.

A 1.85 semi-log graph is used for interpolating or extrapolating test results to establish expected pressure at a nominated flow. By using this type of graph, the pressure/flow characteristics of a hydrant supply can be represented by a straight line.

Step 1
In addition to the static pressure, two or preferably more readings of flow against pressure are recorded in the table at the bottom of the graph. The pressure is usually recorded in kPa, and the flow may be recorded in any convenient units (normally L/min or L/sec). These should include a static or no-flow pressure recording. The higher the test flows, the more accurate will be the graph.

Step 2
Plot these recorded values on the graph with the pressure recorded on the y-axis and the flow on the x-axis.

The x-axis points are established by selecting a suitable divisor and applying this to the recorded flow values. The divisor should be selected to enable the desired flow/pressure point to appear in the graph.

NOTE – For example, if the required flow is 8,400 L/min (140 L/sec) and the x-axis is numbered to 15, then a suitable divisor would be 10; 8,400 L/min (140 L/sec) would be represented by 14 along the x-axis.

By selecting a suitable value for the divisor, the graph is suitable for all flows.

Step 3
Draw a line-of-best-fit through the recorded points and extend it to the x-axis. This line is the characteristic line for that particular pipe or network and represents a good approximation of residual pressure for any assumed flow.

NOTE – For example, 8,400 L/min (140 L/sec) plotted on a graph numbered as in the above note would be represented by 14 on the x-axis. A vertical line from this point would intersect the characteristic line at the expected residual pressure for this flow.

G5.2. 2 *Generating the 1.85 graph*
A 1.85 graph can be constructed manually by establishing a series of 15 values (in the case of the example in G5.2.1) from a base measurement to the exponent of 1.85.

Step 1

Select a base measurement for the desired size of the graph. A base measurement of 1.0 mm will produce a graph to 15 which is approximately 150 mm wide; a base measurement of 1.5 mm will produce a graph approximately 300 mm wide.

In the case of a 1 mm base measurement, the x-axis numbers will be the 1 – 15 series. In the case of a base of 1.5 mm, the numbers will be represented by the series: 1.5, 3.0, 4.5, 6.0, and so on for 15 values.

Step 2

Construct a series of columns to the 1.85 exponent values measured from the zero point.

The rows representing the pressure values are linear.

NOTE – A good approximation of the above can be computer-generated by a spreadsheet program by entering a column width established from the exponential figures after subtracting the preceding value in each case. The column dimensions are displayed in the number of standard characters able to be accommodated in the column width which is slightly inaccurate in linear dimension.

The figures below in table G1 indicate the values for a graph based on 1.0 mm, see figure G1.

Table G1 – Values indicative of a graph on a linear scale

Linear scale	Exponential value of linear values = linear values to 1.85 power	Column width = exponential value – preceding value
1	1	1
2	3.61	2.61
3	7.63	4.03
4	13.00	5.36
5	19.64	6.64
6	27.52	7.88
7	36.60	9.08
8	46.85	10.25
9	58.26	11.41
10	70.79	12.54
11	84.45	13.65
12	99.19	14.75
13	115.03	15.83
14	131.93	16.90
15	149.89	17.96

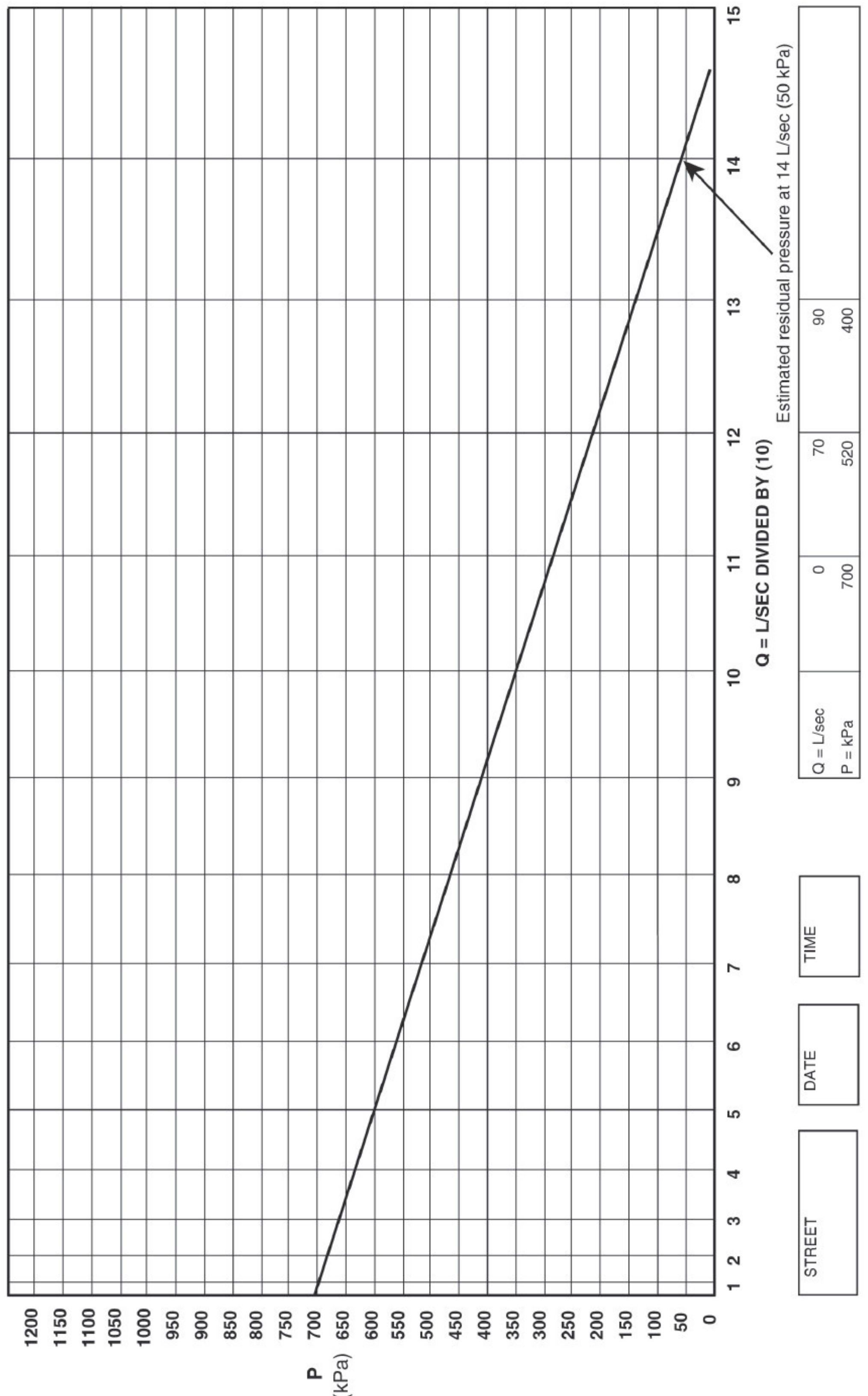


Figure G1 – Example of pressure/flow characteristic of a hydrant supply

G6 Comprehensive flow testing

Where the necessary firefighting water is supplied by more than one fire hydrant, a comprehensive flow test should be carried out.

NOTE – Refer to the New Zealand Fire Service training note on flow testing of water mains and hydrant inspections.

G7 Recording of test results

The results of the tests must be recorded in an appropriate manner agreeable to all parties involved.

The minimum details to be recorded are:

(a) Date;

(b) Time;

(c) Location/address/identifier, of both the flowing hydrant(s) and the pressure hydrant;

(d) Measured flow (L/s);

(e) Static pressure: (kPa);

(f) Running pressure (kPa);

(g) Diameter of water main (mm);

(h) Vertical height difference (approximate) between the flow and pressure hydrants.

From these details it is possible to calculate water mains capacity as indicated in G6.

G8 Computer modelling of water supplies

Where a computer modelling system has been assessed as accurate against ground tests, the Fire Service may accept the outputs from such modelling in place of testing of certain fire hydrants. This should not replace the testing of key fire hydrants.

APPENDIX H – CALCULATION OF MAXIMUM FIRE SIZE

H1 Overview

The methods outlined in Appendix H and Appendix J determine the maximum fire size and from this, the quantity of firefighting water required.

H2 Introduction

Appendix H outlines a method to calculate the maximum fire size. The result of this calculation is used in Appendix J to calculate the firefighting water required. The required firefighting water quantity is then compared with the available firefighting water supply to determine if it is sufficient. If insufficient to comply with this code, either the water supply must be increased or the maximum fire size reduced.

H3 Fire size

The maximum fire size occurs when:

(a) The complete firecell is involved in fire;

(b) The Fire Service begins applying effective firefighting water to the fire; or

(c) An approved installed automatic sprinkler system operates (which is assumed to control the fire to the size it was when activation occurs).

In (a) the ignition is assumed to have occurred and the fire has grown till the fire is either constrained by the amount of ventilation or the quantity of fuel. This appendix provides a method to calculate the ventilation and fuel controlled fire size for each firecell within a structure. The smaller value is the limiting figure. This is repeated for all the firecells. The firecell with the largest fire size is then modified by two coefficients. The result of this calculation is used as the input to the firefighting water calculations outlined in Appendix J.

In (b) the fire growth is assumed to continue until the Fire Service intervenes by the application of water. The fire size is calculated using existing fire engineering methods. The derivation of time for Fire Service involvement will require input from the Fire Service.

In (c) the fire size and time of activation of the automatic sprinkler system are calculated by approved fire engineering calculation. The fire size is then assumed to be controlled to this level. Thus the total required water supply should be that required for the sprinkler system plus the remaining fire size, controlled by the sprinkler. For an example, see figure H1.

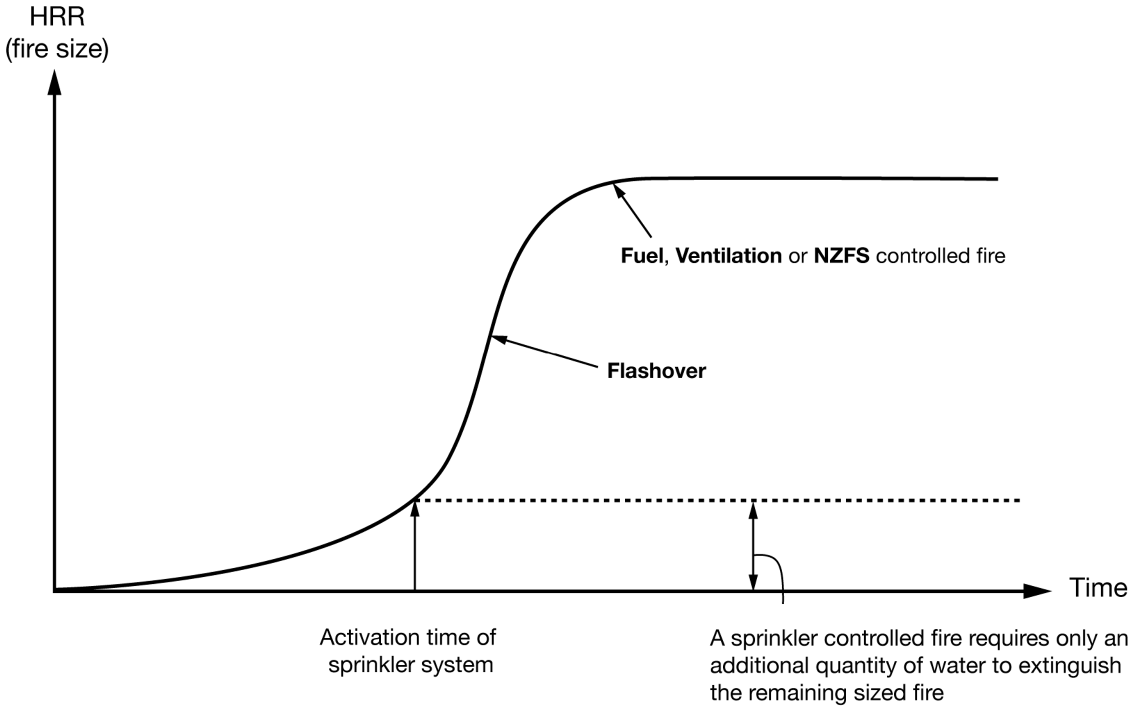


Figure H1 – Fire growth curve

H4 Outcome

The comparison of actual water quantities with required firefighting water quantities indicates whether sufficient firefighting water is available to treat the fire hazard.

If the available water is insufficient, then some remedial action should take place to either reduce the hazard or improve the water supply. If no remedial action takes place, the structure owner or their agent should be advised.

Firefighters can only actively control or extinguish a fire if they arrive before it gets too large. The Fire Service has insufficient resources to control a large post-flashover fire. For this reason, early notification is essential and hence the importance of either fire suppression or detection systems. Another alternative to limit the maximum fire size is the use of smaller firecells.

H5 Calculation of maximum fire size

This analysis assumes that the Fire Service will arrive after the fire has become fully involved in the firecell of origin and thus has involved the firecell but prior to the failure of the passive fire protection of the firecell. If this assumption is incorrect due to no or a low fire resistance rating or long brigade travel times, then calculation of the fire size must assume a fuel controlled fire – go to Step 2 (see H7). Any analysis should assume the worst case scenario. For special hazards such as stacked timber/pallets or tyre stockpiles out in the open, a fuel controlled fire calculation must be used.

H6 Step 1 – Calculate maximum ventilation-controlled fire size

H6. 1 *Step 1.1 – Calculate ventilation openings for each large firecell*

NOTE – For the purposes of this calculation, a ventilation opening includes non-fire-rated glazing and roof vents.

The maximum fire size from a ventilation controlled fire is given by equation H1.

Heat release rate:

$$Q_{vent} = 0.092 \Delta H_c A_v \sqrt{H_v} \quad \text{(Eq. H1)}$$

where

Q_{vent} is the rate of heat release from ventilation controlled fire (MW)

ΔH_c is the fuel calorific value (MJ/kg)

For this analysis assume:

ΔH_c is 18 MJ/kg

A_v is the area of vertical openings (m^2)

H_v is the height of vertical openings (m).

NOTE – This method is only valid where the Fire Service can apply water on the fire prior to the failure of the passive fire protection of the firecell.

The following method is used to calculate the ventilation factors for a firecell containing multiple openings. A_v is the sum of the total area of the openings and H_v is the weighted average height of all the windows and doors. This factor is calculated by summing the areas of an opening multiplied by their height and dividing the total by the total area of the openings. This can be achieved easily in tabular form as demonstrated in the example given in figure H2 and table H1.

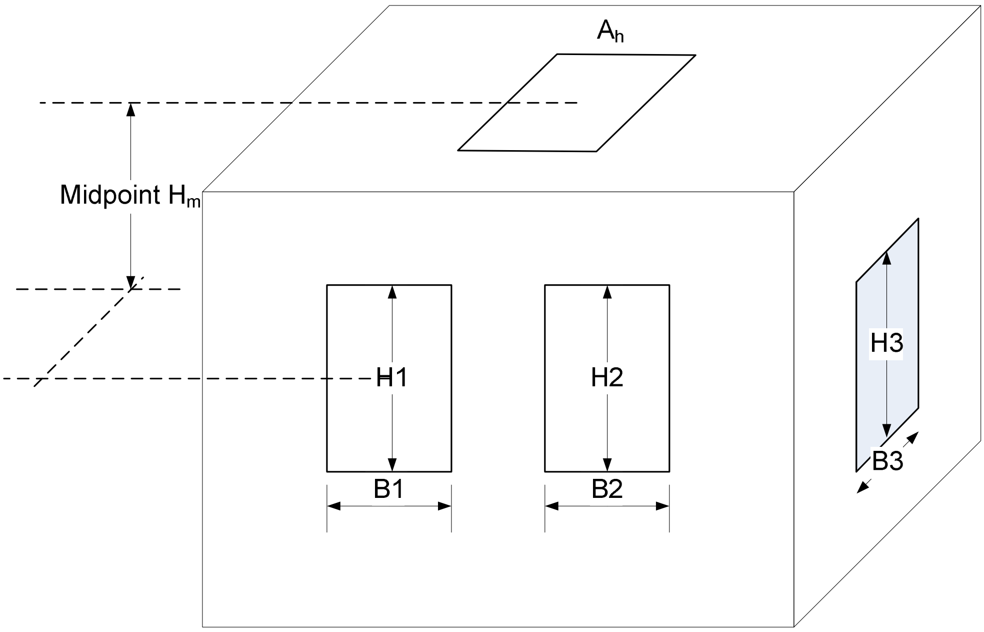


Figure H2 – Single firecell structure with 3 windows and 1 roof vent

Table H1 – Single firecell structure with 3 windows and 1 roof vent

i	**Height of opening** H_i	**Width of opening** B_i	**Area** $H_i B_i$	**Height x Area** $H_i A_i$
1	H_1	B_1	$H_1 B_1$	$H_1{}^2 B_1$
2	H_2	B_2	$H_2 B_2$	$H_2{}^2 B_2$
3	H_3	B_3	$H_3 B_3$	$H_3{}^2 B_3$
$\sum =$			$\sum A_i$	$\sum H_i A_i$

where

$$A_v = \sum_{i=1}^{i=3} A_i = H_1 B_1 + H_2 B_2 + H_3 B_3$$

and

$$H_v = \frac{\sum H_i A_i}{\sum A_i} \quad \text{(Eq. H2)}$$

If the structure has both vertical and horizontal opening(s) use the calculation method below, as outlined in Buchanan, 2001, noting the limitations indicated. A simplified ventilation factor, $(A_v \sqrt{H_v})_{(fict)}$ may be calculated:

$$(A_v \sqrt{H_v})_{(fict)} = A_v \sqrt{H_v} + 2.33 A_h \sqrt{H_m} \quad \text{(Eq. H3)}$$

where

A_v and H_v come from equation H2 above
A_h is the area of horizontal opening (m^2)
H_m is the vertical height from the mid-height of the window opening to the mid-height of the horizontal opening (m)

This is only valid if

$$0.3 < \frac{A_h \sqrt{H_m}}{A_v \sqrt{H_v}} < 1.5 \quad \text{(Eq. H4)}$$

Check validity. If outside these limits assume fuel controlled fire and thus go to Step 3 (see H8).

H6. 2 *Step 1.2 – Calculate maximum fire size by selecting largest ventilation factor*
Select the firecell with largest ventilation factor, that is $(A_v \sqrt{H_v})_{(fict)}$.

The rate of heat release Q_{vent} from the ventilation controlled fire is calculated from equation H1 as:

$$Q_{vent} = 0.12 \Delta H_c A_v \sqrt{H_v} \quad \text{(From Eq. H1)}$$

(Answer H1)

H7 Step 2 – Calculate maximum fuel-controlled fire size
The heat release rate from the fuel-controlled fire depends on the area of fuel burning and the heat release rate per unit area.

$$Q_{fuel} = A_{fuel} . Q''_{fuel} \quad \text{(Eq. H5)}$$

(Answer H2)

where
Q_{fuel} is the rate of heat release from the fuel controlled fire (MW)
A_{fuel} is the surface area of fuel (m^2)
Q''_{fuel} is the rate of heat release per unit area of fuel burning (MW/m^2)

Assume a 1:1 ratio of fuel surface area to floor area except for rack storage. Rack storage will require calculation of fuel surface area.

Table H2 gives typical values for the heat release rate per unit area of fuel burning.

Table H2 – Typical heat release rates from fuel controlled fires for various structure types

Building Use	FHC(1)	Q"fuel (MW/m²)
Retail	2	0.35
	4	1.0(2)
Offices	1	0.25(2)
	2	0.35
Warehouse	2	0.35
	3	0.5(2)
	4	1.0(2)

NOTE –
(1) Based on the compliance documents for the New Zealand Building Code, C/AS1.
(2) Figures derived from AS 1668.3.

H8 Step 3 – Select smaller value of the ventilation or fuel controlled fire size

For each firecell, the heat release rate of the fire Q_{fire} … (Answer H3) is the smaller value of Q_{vent} (Answer H1) or Q_{fuel} (Answer H2).

H9 Step 4 – Select firecell with largest value

Repeat steps 1 to 4 for all firecells. Select cell with largest value of Q_{fire}. Use this figure in Step 5 (See H10).

H10 Step 5 – Modification of heat release rates

The heat release rate, Q_{fire} as determined from Step 3 (Answer H3) may be reduced by a number of factors. To account for these factors it is proposed to determine Q_{max} the heat release rate required to be used for firefighting water supply purposes as follows:

$$Q_{max} = K_1 . K_2 . Q_{fire} \qquad \text{(Eq.H6)}$$

(Answer H4)

Proposed values for these coefficients are given in table H3 and table H4. In particular cases, it may be feasible to develop more appropriate figures.

H10. 1 *Step 5.1 – K_1 coefficient*

K_1 coefficient to account for human intervention and first aid firefighting, see table H3.

Table H3 – K_1 Human intervention

	No facilities or structure unoccupied	Structure occupied and hand operated firefighting equipment available	Structure occupant trained in firefighting and present 24 hours
K_1*	1	0.9	0.8
* This value can be further reduced upon documented agreement with the NZFS that an industrial brigade is effectively resourced and available at all times to mitigate any fire to the satisfaction of the National Commander.			

H10. 2 *Step 5.2 – K2 coefficient*

K_2 coefficient to account for fire safety features, see table H4.

Table H4 – K_2 Fire safety features

	No detection or suppression system	Smoke or heat detection system, installed to approved Standard without direct connection to NZFS alarm receiving equipment	Smoke or heat detection system, installed to approved Standard with a direct connection to NZFS alarm receiving equipment	A sprinkler system installed to an approved Standard with a direct connection to NZFS alarm receiving equipment
K_2	1	1	0.8	0.1

The maximum heat release rate Q_{max} for firefighting water supply purposes is then used to determine the required firefighting water flow rate in accordance with Appendix J.

APPENDIX J – WATER EXTINGUISHING CAPABILITY

J1 Introduction

This Appendix outlines the method of calculating the extinguishing capability of the available water and hence the required firefighting water supply. For information on capped fire size, see figure H1.

J2 Step 1 – Maximum fire heat release rate

Take value for Q_{max} derived from Appendix H.

J3 Step 2 – Calculate water flow required for firefighting

Calculate water flow required for firefighting

$M_{water} = 0.58\ Q_{max}$ (L/s) ....(Eq. J1)

(Answer J1)

where

Q_{max} is the maximum rate of heat release from fire (MW)... (Answer J4)

M_{water} is the water flow rate required for firefighting (L/s)

J4 Step 3 – Calculate exposure protection

Additional water is required to protect other structures from a fire in the structure under consideration. This is called exposure protection. The calculation for the protection of exposures is necessary where any exposed surface on an adjacent structure can be affected by radiation.

An exposed surface is defined as any external cladding on an adjacent structure that is combustible or coated with a combustible coating. An exposed surface is affected by radiation where the surface is within the horizontal distance calculated in accordance with the Compliance Documents for the New Zealand Building Code, Part 7, C/AS1.

As these distances have been derived for timber cladding, where plastic claddings and substrates have been used, add another 10 m to the distances derived above.

$M_{exp} = A_{exp} . \phi$ (L/s)...(Eq. J2)

(Answer J2)

where

M_{exp} is the required water flow rate to protect the exposure (L/s)

A_{exp} is the surface area of adjacent firecell(s) and/or structure(s) exposed to a firecell involved in fire (m^2)

ϕ is known as the water wetting rate and = 0.1 (L/s/m^2)

J5 Step 4 – Calculate total water flow required

The total water flow rate required M_{tot} is therefore:

$$M_{tot} = M_{water} + M_{exp} \text{ (L/s)} \quad \text{(Eq. J3)}$$

$$M_{tot} = \text{Answer J1} + \text{Answer J2} \quad \text{(Answer J3)}$$

J6 Step 5 – Assess the adequacy of the available firefighting water

$M_{measured}$ is the measured flow rate recorded from flow tests conducted in accordance with Appendix G. The total firefighting water available $M_{available}$ may be sourced from reticulated and/or static supplies. To reflect the difference in accessibility and reliability of different sources of water supply, divide the measured flow rate from the source by the appropriate coefficents from table J1 and table J2 to obtain the available water flow, $M_{available}$.

$$M_{available} = M_{measured} / C_1.C_2 \quad \text{(Eq. J4)}$$

(Answer J4)

In the case of firefighting water supplies from several different sources, add the individual available supplies together to come up with a cumulative value for $M_{available}$.

Table J1 – Water accessibility coefficient C_1

	Reticulated fire hydrants marked	Static supply, flooded instantaneous coupling	Static supply, flooded suction	Static supply, no coupling suction	Tanker or relay (no supply within 270 m)
C_1	1	1.15	1.25	1.5	2

Table J2 – Water reliability coefficient C_2

	Networked gravity	Dual system static/pump	Pump with emergency backup	Pump with no emergency power backup
C_2	1	1.1	1.1	1.5

If $M_{tot} > M_{available}$ = Failure

then it is necessary to reassess the fire safety features of a structure or improve the water supply.

If $M_{tot} < M_{available}$ = Pass

then there is a sufficient firefighting water supply.

J7 Access to firefighting water

Where the required firefighting water supply is available from fire hydrants then these must be located as given in table J3. Where firefighting water supply is available from alternative firefighting water sources, then the Fire Service access to the alternative firefighting water source must comply with Appendix B.

J8 Duration of fire

The fire duration may be estimated conservatively from:

$$t_{fire} = (\Delta H_c \,.\, M_{fuel}) / Q_{max} \quad \text{(Eq. J5)}$$

(Answer J5)

where

t_{fire} is the fire duration (s)
M_{fuel} is the mass of fuel in the firecell (kg)

This time is used to estimate the firefighting water supply storage volumes.

Table J3 – Water flows from fire hydrants

Calculated firefighting water supply (Answer J3) L/min (L/s)	**Water flow required in a distance of 135 m** L/min (L/s)	**Additional water flow required in a distance of 270 m** L/min (L/s)	**Maximum number of fire hydrants to provide flow**	**Water storage volume in reservoir and/or from alternative water source** (L)
< 750 (12.5)	Calculated flow	Not applicable	1	Water flow (Answer J3 x fire duration = Answer J5)
750 – 1500 (12.5 – 25)	750 (12.5)	Remainder of flow	2	
1560 – 3000 (26 – 50)	1500 (25)	Remainder of flow	2	
3060 – 6000 (51 – 100)	Half of calculated flow	Half of calculated flow	4	
6060 – 12 000 (101 – 200)	Half of calculated flow	Half of calculated flow	8	
> 12 000 (200)	Half of calculated flow	Half of calculated flow	8	

APPENDIX K – WATER SUPPLY SYSTEM CLASSIFICATION

Tables 1 and 2 are well suited for determining firefighting water requirements for individual fire risks. However, the flow rates and storage volumes that reticulated water supply systems should be designed for should be assessed on the range of fire risks that can be present in any one reticulation zone. The purpose of this appendix is to give guidance to water supply system designers in determining the design firefighting flow rates and storage volumes for reticulated water supplies.

It is important to note that firefighting water requirements are IN ADDITION to the domestic/commercial/industrial water supply needs and fire sprinkler demand. When water for firefighting is provided from hydrants it must be at a pressure of not less than 100 kPa.

K1 Water supply classifications

K1. 1 *Background*

Firefighting water supplies can be classified using the scale shown in table 2, taking into account factors such as the size (firecell area) of the average fire risk and the highest expected fire risks in the area, and anticipated future development. Provision is also made for FW7, for which flow rates and storage requirements can be determined on a case by case basis, using methods such as those outlined in Appendices H and J.

Table 1 shows the fire water supply classifications that are required to protect individual fire risks.

K1. 2 *General procedure for establishing classifications for water supply reticulations*

The capacity of existing water supplies to store and deliver water for firefighting can be measured by undertaking comprehensive flow testing or estimated through computer modelling. Water supply authorities should undertake this work in partnership with the Fire Service. If necessary the WSA can establish water classification zones after consultation with the Fire Service, so that the minimum storage and flow requirements in the zones are clearly defined. Due to the capital intensive nature of water reticulations long lead times may be required to make improvements. Strategies should therefore be put in place in consultation with the Fire Service that clearly describe how any known deficiencies in the water supply are managed and how they will be remedied. Any consultations with the Fire Service should occur at the Fire Region Manager level or their delegated authority.

To determine the firefighting capacity for new water supplies in greenfield areas the WSA should make an assessment of the developments that are likely to occur in that area, and design the water supply system for the average fire risk using tables 1 and 2 taking account of other factors such as future growth after consultation with the Fire Service. Any new developments should be assessed against the capacity of the water supply system, to ensure that developers design within the reticulated supply capacity, and in cases where the required fire water exceeds the reticulation capacity, remedy the effects by providing additional on site storage or increasing the reticulated capacity.

K2 Storage

The volume of storage that is reserved for firefighting purposes must not be used for normal operational requirements, see figure K1. Additional storage must be provided to balance diurnal peak demand, seasonal peak demand and normal system failures, for instance power outages. The intent is that there are always sufficient volumes of water available for firefighting, except during civil defence emergencies or by prior arrangement with the Fire Region Manager.

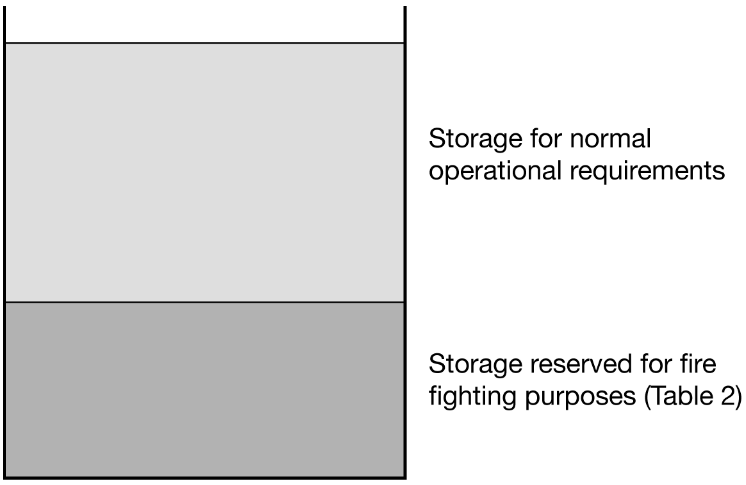


Figure K1 – Reservoir storage

K3 Flow

The flow rate that is available for firefighting from hydrants can be measured by undertaking comprehensive flow tests or be estimated through network modelling.

Comprehensive flow tests should be carried out at times of reasonably high consumer demand (domestic, industrial, and commercial water usage) so that the test results will reflect the effects of any reduced reticulation pressure at such times. The timing for such tests must be determined in consultation with the water supply authority to manage any discolouration and reduced pressures that may result.

When the available firefighting flow rates are estimated by running computer models, it is necessary to include background consumer demand concurrently with the fire water flows from hydrants. As a guide, two thirds of the annual peak consumer demand should be used consecutively with fire flows from hydrants, with resulting reticulation pressures not less than 100 kPa. The annual peak demand varies from zone to zone, but as a guide in residential areas, can be estimated as follows:

Zones less than 1000 dwellings: $Q_{peak} = 0.596D^{0.632}$ L/s

Zones larger than 1000 dwellings: $Q_{peak} = 0.0467D$ L/s

where Q_{peak} = Peak annual demand (L/s)

D = Number of dwellings

Individual water suppliers may use different formulae particular to their suppliers, based on observed peak flow rates.

In most cases several modelling runs would be needed to assess the impact of different fire scenarios at different locations, but scenarios should allow for only one fire at a time.

Where structures are fitted with compliant fire sprinkler systems, the required water supply classification is no greater than FW2. NZS 4541 requires the fire sprinkler flows to be delivered concurrently with a flow of 1500 L/min (25 L/s) from the nearest fire hydrants at the pressure determined as part of the sprinkler system design and flow tests. By default a flow test should therefore be available that takes into account the effect of reduced pressure due to consumer demand.

Computer modelling can be used to verify that the level of consumer demand at the time the flow test was conducted was at least two thirds of peak annual demand. In cases where the modelled pressure is less than the observed pressure, further work should be carried out to determine the appropriate available reticulation pressure that the fire sprinkler system should be designed for.

K3. 1 *Example*

A water reticulation has to be designed for a proposed business park. Average lot size will be 2000 m^2. Working/business/storage activities with medium fire load such as manufacturing, processing, and bulk storage up to 3 metres will be permitted under the proposed district plan provisions.

Using tables 1 and 2, the water supply qualifications and firefighting water requirements in table K1 are possible.

Table K1 – Example of calculating flow

Options	Building sprinklered	Firecell size (m²)	Fire water classification	Flow rate from hydrants L/min (L/s)	Storage in reservoir (m^3)
1	Yes	UNLIMITED	FW2	1500 (25)	45
2	No	0 – 199	FW3	3000 (50)	180
3	No	200 – 399	FW4	6000 (100)	540
4	No	400 – 799	FW5	9000 (150)	1080
5	No	800 – 1199	FW6	12 000 (200)	2160
6	No	>1199	FW7	Specific design	
NOTE – The 'storage in reservoir' column is to ensure that the specified firefighting water is a dedicated amount purposefully allowed for in a town water reticulation design IN ADDITION to the domestic, commercial, and/or industrial needs. It is obtained by multiplying the expected firefighting duration by the required fire flow rate from the hydrants.					

After consultation with the Fire Service and through the Resource Management process it is agreed to provide reticulated firefighting capacity for sprinklered buildings and for non-sprinklered buildings up to FW3. All buildings with firecells not greater than 199 m^2 can therefore be protected using water from the reticulated supply, but any proposal to construct a firecell larger than 199 m^2 will require a sprinkler system to be installed or on-site storage to be provided to make up the shortfall.

An example of the application of this is as follows:

If a non-sprinkler protected building whose largest firecell is 600 m^2 is to be built in this area it would have a FW classification of FW5. However the water reticulation network supplying this zone is only rated at FW3. Table K2 shows a comparison of the firefighting capacity of the water supply network with the firefighting water requirements for the fire risk.

Table K2 – Comparison of firefighting capacity of the water supply network with the firefighting water requirements

	Flow rate L/min (L/sec)	**Storage** (m^3)
Reticulation designed to meet FW3 requirements	3000 (50)	180
Fire risk FW5	9000 (150)	1080
Theoretical water supply system deficit	6000 (100)	900
Possible solutions to provide for flow and storage deficits	(a) Provide additional flow from on-site storage source (b) Check whether actual water reticulation capacity is higher than 50 L/s (c) Increase water reticulation capacity (d) Combination of the above	(a) Provide on-site storage (b) Check whether additional storage from the water supply reservoir can be dedicated for firefighting purposes (c) Increase water supply system storage volume (d) Combination of the above

APPENDIX L – SPECIFICATION, LOCATION, AND MARKING OF FIRE HYDRANTS

L1 Scope

The purpose of this Appendix is to provide a specification and a suitable system for marking the location of fire hydrants and water supplies so they can be readily identified by the Fire Service and, where necessary, by the general public. Fire hydrant installation is covered by NZS 4404.

L2 General requirements

Fire hydrants must comply with an approved Standard, see Appendix F.

Every fire hydrant must have its position identified by a combination of markings and indicators as set down in this code of practice. Fire hydrants should not be marked until the water main is commissioned, and markings must be removed if the water main is uncharged or abandoned.

NOTE – This clause does not apply if the water main is temporarily uncharged or decommissioned, in which case the Fire Service needs to be informed.

Road controlling authorities must approve any devices or markings installed in a road reserve. This includes any markings on the roadway and any markers or other devices installed beside the roadway.

L3 Forms of markings and indicators

L3.1 *Required markings for underground fire hydrants located on or adjacent to sealed roads*

The position of the underground fire hydrant must be identified by:

(a) The lid of the fire hydrant box painted with yellow paint; and

(b) An isosceles triangle of solid colour with 600 mm sides and 450 mm base, painted yellow, on or near the centre of the carriageway, with the apex pointing towards the underground fire hydrant; and

(c) In addition, a circle of 1.2 m outside diameter with a line width of 100 mm painted yellow as concentrically as possible around the underground fire hydrant, where, in the opinion of the person responsible to the WSA for the installation, maintenance, and marking of fire hydrants, access to the fire hydrant may be obstructed by parked vehicles.

See figure L1.

The paint used must comply with the requirements of TNZ M/07.

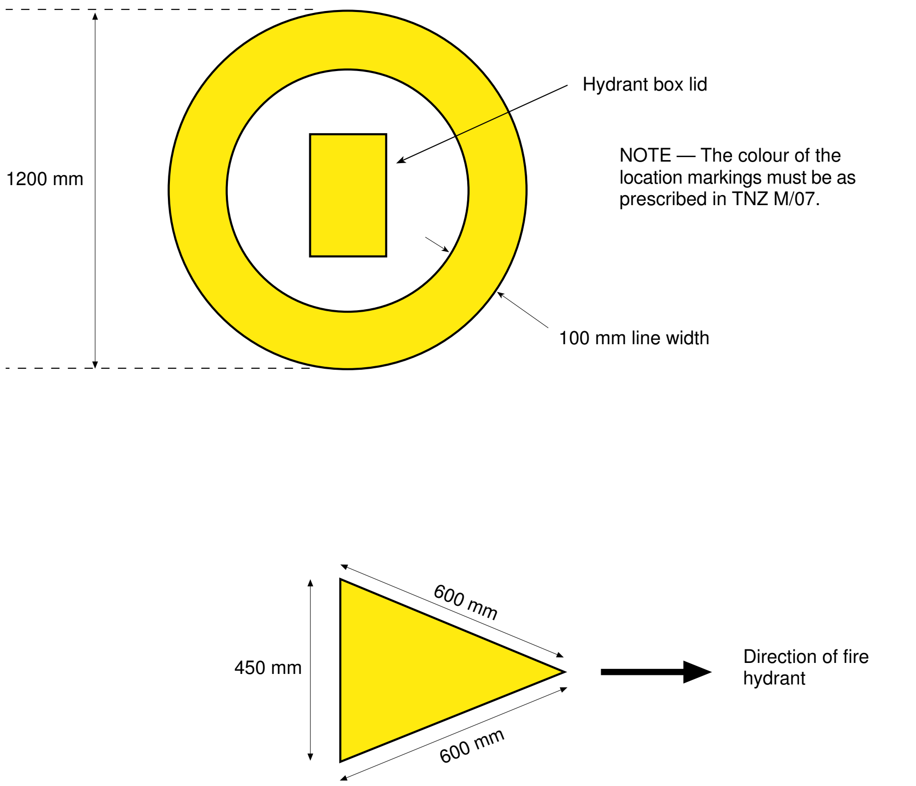


Figure L1 – Fire hydrant marking

L3.2 *Required markings for underground fire hydrants located on or adjacent to unsealed roads*

The position of the underground fire hydrant must be identified by:

(a) The lid of the fire hydrant box painted with yellow paint;

(b) An indicator plate or marker post in accordance with L3.4.

L3.3 *Required markings for outlets other than fire hydrants*

Other pressurised water outlets used for firefighting water supplies must be marked to the satisfaction of the National Commander.

L3.4 *Requirements for indicator plates or marker posts*

Where the fire hydrant location may be difficult to identify, or where it may be obscured by snow or vegetation, an indicator plate or marker post may be used.

If an indicator plate is used, it must comply with the requirements of BS 3251 except that the background colour (specified in 8.2 of BS 3251) must be yellow and comply with TNZ M/07.

The indicator plate must not be less than 600 mm and not more than 3 m above the road level and must be placed on or near a boundary line, wall or structure. Alternative siting may be used in exceptional circumstances subject to the approval of the Fire Region Manager.

If a marker post is used, it must comply with the dimensions specified for Type C edge marker posts in the Transit New Zealand *Manual of* *traffic signs and markings* – Part II: *Markings*. The two yellow reflectors must be replaced with two blue reflectors and these must be repeated on the reverse side of the post so it will be visible from both directions. The post must be located in the same manner as the standard edge marker posts in relation to the trafficable portion of the carriageway and in line with the fire hydrant.

NOTE – Road controlling authorities must approve any installation of edge markers.

The road reserve between the carriageway and the indicator plate or marker post must be maintained so that the indicator plate or marker post is readily visible from the carriageway.

L3. 5 *Additional markings*
Any additional markings placed near an underground fire hydrant should not obliterate or confuse any of the markings set down in this code of practice, for example, markings to prohibit parking.

Where deemed necessary by the Fire Region Manager of the urban fire district or the WSA, the following additional markings may apply:
(a) Standard yellow post with FH marking;
(b) Kerb marking in yellow.

Additional marks may indicate:
(a) Fire hydrants installed on water mains with running pressure in excess of 1200 kPa;
(b) Fire hydrant that is the last one on a dead-end water main.

L3. 6 *Blue raised reflective pavement markers (RRPM)*
The use of RRPM on roads is controlled by road controlling authorities, therefore the use of these markers must be with their consent. The use of RRPM is recommended as additional means of identifying fire hydrant locations.

The Land Transport Safety Authority (LTSA) (now Land Transport New Zealand) has supported the use of blue RRPM through recent editions of the Road Code and has issued Traffic Note 25, that is sent to all local authorities and other organisations involved with roads. This notice allows for the use of RRPM for marking fire hydrant locations. Where they are used, they must be located close to, and on the fire hydrant side of, the centre of the roadway at or near the base of any yellow triangle marked on the surface. It is suggested in Traffic Note 25 that road controlling authorities prohibit the use of these blue RRPM for any purpose other than indicating fire hydrants.

NOTE – Traffic Note 25 allows the use of the blue RRPM, but does not make them compulsory.

L4 Location of fire hydrants

Where the required firefighting water supply has been calculated using Appendix J, the distance to fire hydrants is given in table J3, that is: 135 m for **required water** flow, with **additional water** within 270 m.

This maximum hydrant to structure distance is calculated as straight line segments along the road, main access path, or drive to the front door (main entrance). This is the ‘as you would lay the hose’ distance, which means that this path must be free from obstructions, smooth, and accessible at all times. See figure L2(a) and (b).

It is important to understand that firefighting water supply is most effective when targeted for a specific risk, so where a structure requires say 6000 L/min (100 L/s) of firefighting water, then (as each hydrant for design purposes cannot provide more than 2100 L/min (35 L/s)) these (minimum of three) hydrants should be grouped as close as reasonably possible to the ‘hardstand’ (for this structure). This hardstand is the pumping platform, from which firefighting operations will take place. If the structure is very large or the main entry point (front door) is located more than 18 m from the road’s edge, a ring water main and/or grouped hydrants at the main entry points is the better solution. This will facilitate fastest Fire Service set-up and thus likelihood of fire control. See figure L2(c).

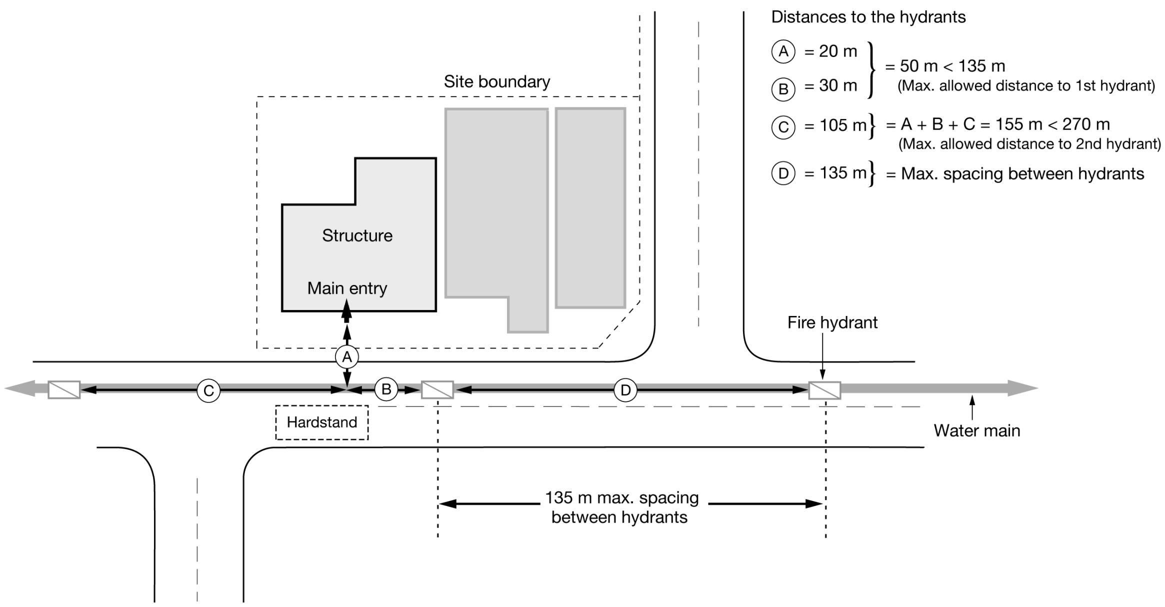
This code of practice focuses on how the most effective firefighting water supply can be provided for a structure. To be of practical use hydrants should be within 25 m (one hose length) of the hardstand and must be readily accessible for the fire appliance. However, in assessing where hydrants should be sited, each structure needs to be assessed based upon its location to the street frontage, which is most often where the NZFS hardstand for the structure will be. Thus the principal means of assessing this maximum distance of a fire hydrant (or fire hydrant group) from a structure (main entry point) is calculated by summing the straight line segments as the hose would be laid on an unobstructed surface, between them. See figure L2(c).

The recommended spacing between fire hydrants should not exceed 135 m. Where there are no premises to be protected, the spacing may be greater. To enable the required flow to be obtained from a water main, fire hydrants may be installed in groups in the same water main. The Fire Region Manager must approve the location and number of these grouped fire hydrants.

Fire hydrants must be readily accessible for fire appliances and should be ideally positioned near road or street intersections and not less than 6 m from any building structure to maintain a clear working space.

Existing fire hydrants may be found at the sides of buildings or structures, or within 6 m of them. These fire hydrants do not comply with this code of practice but may be included in the calculation of firefighting water supply at the discretion of the Fire Region Manager of the urban fire district.

NOTE – For determining whether a building is in the specified distance to a fire hydrant (or water source), the 'as you would lay the hose distance' as measured from the main entrance to the building to the water supply, should be used. If as in a greenfields subdivision no building platforms have been specified, the value to be used to obtain the distance to the main entrance of the building should be not less than half the longest lot dimension. For example, a lot measuring 40 m x 60 m would require not less than 30 m to be added to the 'as you would lay the hose' distance.



NOTE – Notwithstanding meeting the **required** and **additional** distances to a hydrant, hydrant-to-hydrant spacing should not exceed 135 m.

Figure L2(a) – Code requirements for the location and spacing of fire hydrants (Example 1)

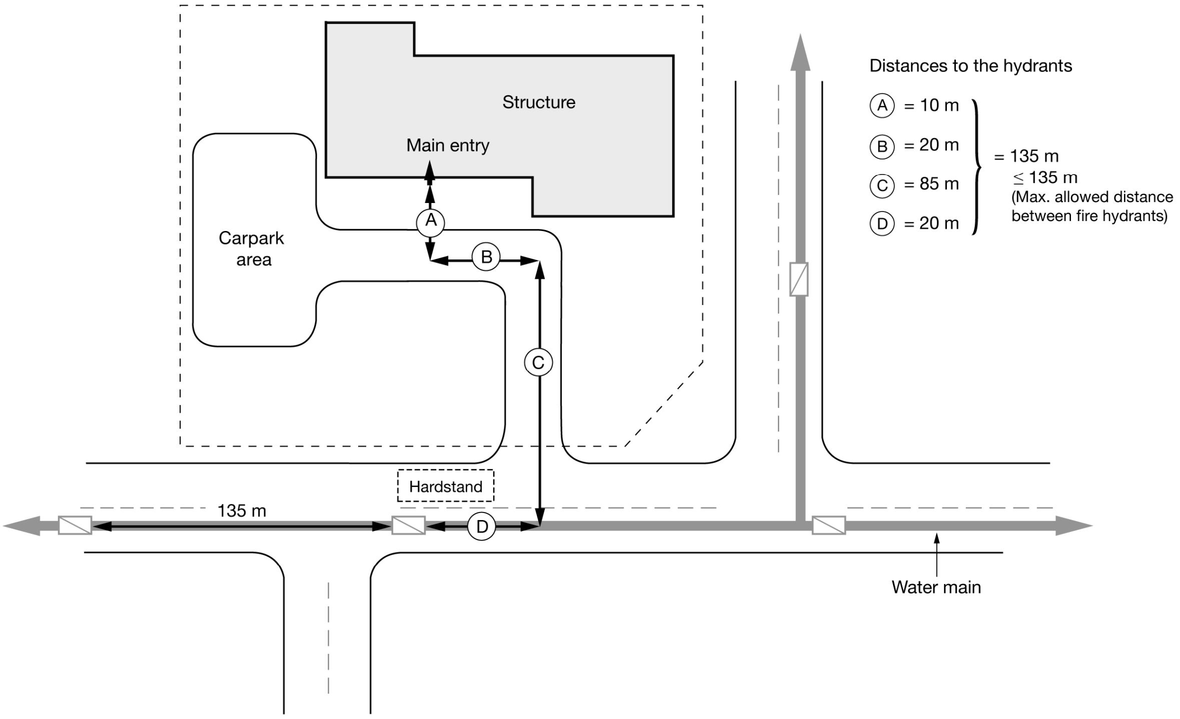


Figure L2(b) – Code requirements for the location and spacing of fire hydrants
(Example 2)

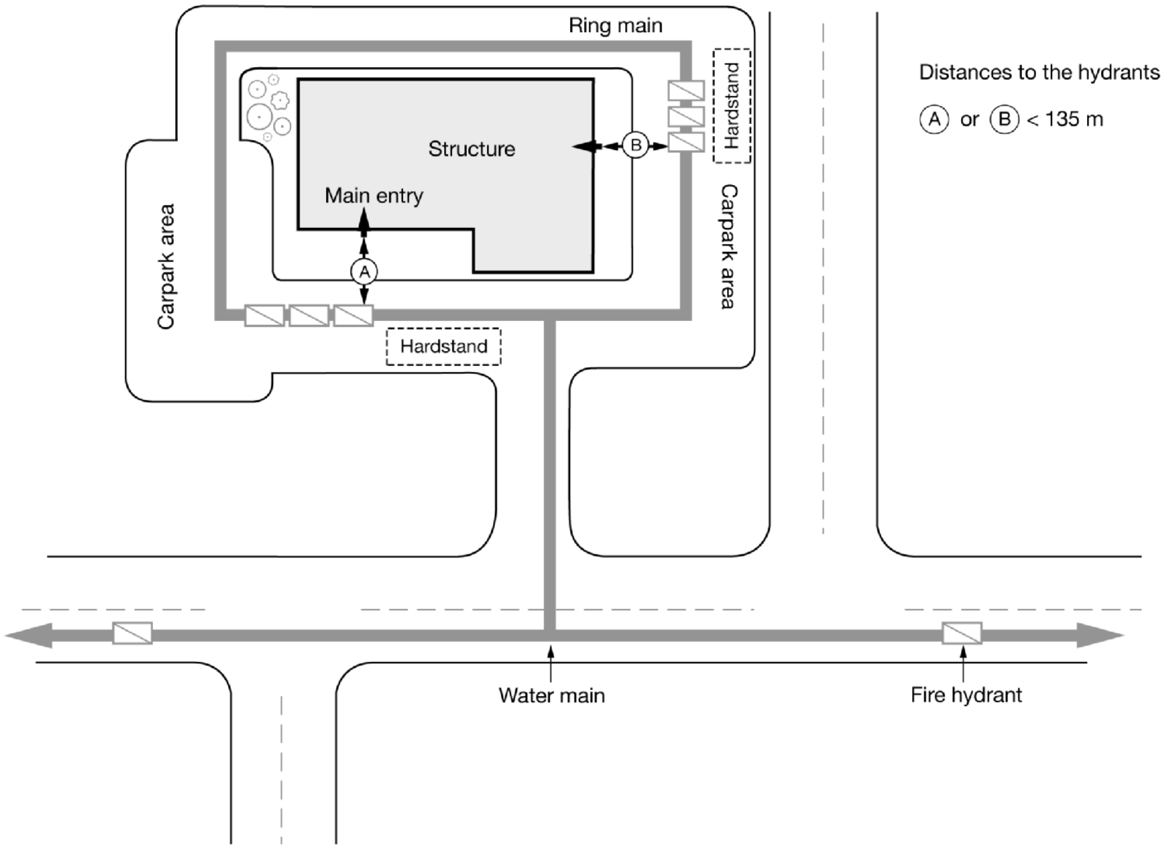


Figure L2(c) – Code requirements for the location and spacing of fire hydrants
Large structures more than 18 m from the road’s edge with multiple entrances and large firefighting water supply requirements.

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