Designers' guide to firefighting operations

Automatic sprinkler systems

F05-06 GD

WHAKARATONGA IWI

FIRE EMERGENCY NEW ZEALAND

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Status of this document

This document is issued by Fire and Emergency New Zealand.

Recommendations for change

The document, its content and specific processes are not to be altered except through Fire and Emergency New Zealand document management processes.

Requests or recommendations for changes to this material should be sent to National Manager Response Capability.

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1. Context

Scope

This chapter sets out Fire and Emergency's requirements for automatic sprinkler systems within buildings.

It describes specific issues that affect firefighting operations in buildings with automatic sprinkler systems. These include how the building's height affects firefighting inside and outside the building.

It also describes how automatic fire sprinkler systems help control or even extinguish fires early in their development, giving emergency services more time to manage the incident.

Who this chapter is for

This chapter is for building owners, designers and other building practitioners and contractors. It provides guidance from Fire and Emergency's perspective on the installation and operation of automatic sprinkler systems.

What is not included in this chapter

NZS 4541:2020 and NZS 4512:2021 cover comprehensive design requirements for sprinkler equipment relevant to firefighting. These requirements are not repeated here.

This chapter gives building industry stakeholders an overview of aspects of our operations that relate to them. However, it is not an exhaustive guide to our operations, nor does it replace any statutory requirements. We recommend you read it alongside other chapters in the guide.

Legislative framework

We aim to reduce the risk to both firefighters and building occupants through encouraging appropriate building design which allows us to achieve our statutory objective (under the Fire and Emergency New Zealand Act 2017) to reduce the incidence of unwanted fire and the associated risk to life and property. Our functions include responding to and suppressing fires and attending to other types of emergencies that may occur in a building.

Read this guide alongside the:

- mandatory requirements of the New Zealand Building Code (Building Code);
- requirements of New Zealand Standards (Standards); and
- Building Act 2004.

This guide **does not** replace any part of the Building Code or Standards or other mandatory building requirements.

The Building Code Fire Safety – Clauses C1 – C6 (Protection from fire) define Building Code performance requirements under the Building Act 2004. C5 is the performance requirement for access and safety for firefighting operations.

Since part 6 of the Acceptable solutions provides limited information on requirements for firefighting operations, Fire and Emergency has published this guide as a guideline to part 6 of the Acceptable Solutions.

There are three New Zealand standards for sprinkler systems:

- NZS 4541:2020 Automatic fire sprinkler systems
- NZS 4515:2009 Fire sprinkler systems for life safety in sleeping occupancies (up to 2000 square metres)
- NZS 4517:2010 Fire sprinkler systems for houses.

This guide specifically relates to NZS 4541 and to NZS 4515. Systems installed to these standards may need inlets or monitoring features to comply.

Buildings designed according to the Acceptable Solutions may be 'deemed to comply' but may not have the automatic fire sprinkler systems and other firefighting facilities that firefighters need to operate effectively. In addition to the standards cited above, the following list includes standards and guidance for building fire safety systems that are mandated for a variety of buildings. This is not an exhaustive list.

- SNS PAS 4509:2008 New Zealand Fire Service firefighting water supplies code of practice
- NZS 4510:2008 Fire hydrant systems for buildings
- NZS 4512: 2021 Fire detection and alarm systems in buildings.

2. Definitions

The following definitions apply for the purposes of this chapter. Defined terms used throughout this document are consistent with the Building Act 2004, Building Code and C/AS2 Acceptable solutions.

Address point	This point is part of the dataset administered by Land Information New Zealand, (LINZ). It is the address (point) where the building is commonly known to be located. It can be either a single point or a range of individual points as described on the LINZ data set.
Appliance	An emergency vehicle that provides capability to Fire and Emergency's mandated functions.
Attendance point	The place where the first attending Fire and Emergency pumping vehicle will stop and set up. **There is only one attendance point**, usually at the building's primary entry point. Firefighters may be deployed to other firefighter access points from here. A full description of the attendance point can be found in F5-02 GD FFO Emergency vehicle access.
Breathing apparatus (BA)	A device firefighters wear to provide breathable air in an atmosphere that is immediately dangerous to life or health. Also known as self-contained breathing apparatus (SCBA) or compressed air breathing apparatus (CABA).
Canopy	Projecting hood supported on brackets, corbels or columns over a door, window or niche.
Collapse zone	The collapse zone is an area around the building measured as 1.5 times the height of the structure. This is the area which would be considered dangerous in the event of an outward failure of a facade element. In this document, the term 'collapse zone' only applies to pre-cast concrete panel (tilt-slab) and unreinforced masonry type construction. Use a pragmatic approach where practicable when designing, and when in doubt, consult Fire and Emergency.

Fire control centre (FCC)	The principal location where the status of a fire detection system, an alarm system, and a communications and control system are displayed, and from which all systems can be manually controlled. Some industry standards and publications refer to the fire control centre as 'central control station', 'emergency command centre', 'fire service centre' or 'fire control room', (although different standards exist among these).
Fire engineering brief (FEB)	A formal process outlined in the International Fire Engineering Guidelines for all stakeholders to define and agree on the basis and scope of work for the fire engineering analysis.
Fire resistance rating (FRR)	Building Code clause C regarding protection from fire defines FRR as: [t]he term used to describe the minimum fire resistance of primary and secondary elements as determined in the standard test for fire resistance, or in accordance with specific calculation method verified by experimental data from standard fire resistance tests. It comprises three numbers giving the time in minutes for which each of the criteria stability, integrity and insulation are satisfied and is presented always in this order.
Firefighter access point	The place where firefighters gain access to a building. This must comply with NZ Building Code Clause C5.6: Buildings must be designed and constructed in a manner that will allow firefighters, taking into account the firefighters' personal protective equipment and standard training, to: (a) reach the floor of fire origin, (b) search the general area of fire origin, and (c) protect their means of egress.
Hardstanding area (for Fire and Emergency vehicles)	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 A full description of the hard-standing area can be found in F5-02 GD FFO Emergency vehicle access.

3. Our operations

How sprinklers help us fight fires

Sprinkler systems significantly slow the growth and spread of the fire. A design with a working sprinkler system provides many benefits for firefighting including:

- Giving us an automatic warning of a fire where a private fire alarm (PFA) connection is provided
- Allowing more time for us to get to the fire incident and decide our priorities
- Limiting the risk of occupants being exposed to the fire and getting injured and therefore less search and rescue activity is generally required (see F5-10 GD FFO Evacuation and rescues for further information)
- Generally, requires fewer firefighting resources (water, personnel and equipment) in comparison to a building without a sprinkler system
- Provides a safer environment for firefighters to enter.

What we expect from sprinkler systems

When you have a sprinkler in your building, this impacts the decisions we make. If you have a sprinkler system, we generally expect it to:

- activate during a fire (unless indicated otherwise)
- cover the whole building (unless indicated otherwise)
- have an adequate water supply
- be designed to a recognised standard
- be used within the original design constraints. It should account for the fire load in the building (a building with high racks of storage will require a more comprehensive sprinkler design than that for a restaurant)
- control the fire's growth and spread, as long as the system is running with the design flow rates at the sprinkler head.

Figure 1 – Different types of sprinkler arrangements

4. Challenges

4.1. System vulnerabilities

Sprinkler systems are not always effective

In New Zealand, sprinklers designed to a recognised standard are expected to reliably control fire development.

Despite this, there are some common challenges with sprinkler systems that can impact whether, or how efficiently, they can control a fire in your building. If your sprinkler system is not controlling the fire, this makes firefighting more challenging. This is because:

- we need to fight larger more unpredictable fires
- we're more likely to need to carry out rescues
- we'll need considerably more resources for a larger longer duration fire.

Below is a non-exhaustive list of challenges for sprinkler effectiveness that we have observed in our work. If you can avoid these challenges, it helps you get the maximum performance from your sprinkler system. This has benefits for firefighting and is likely to lead to better fire outcomes.

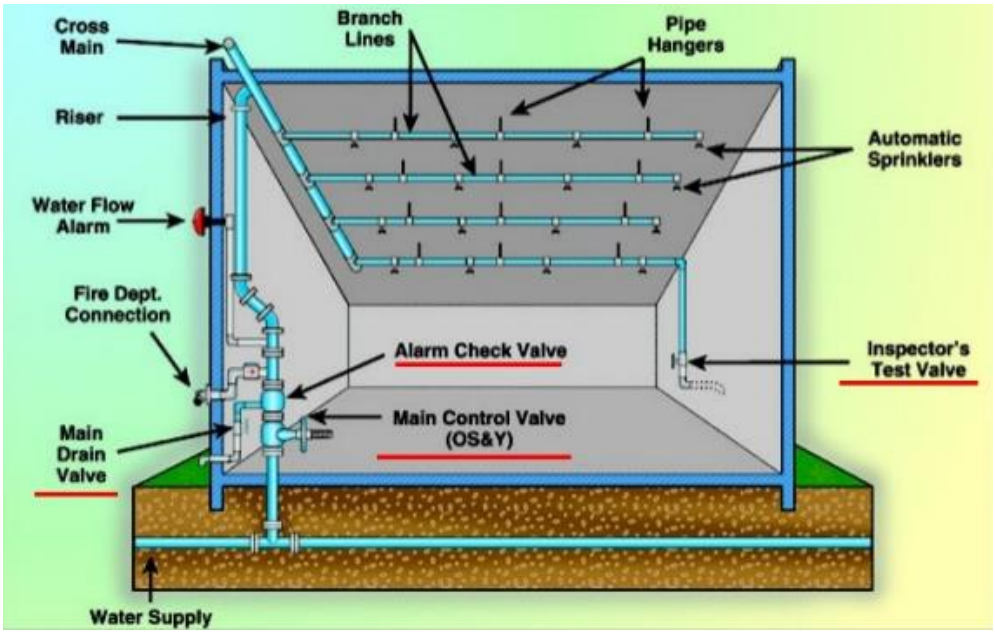

Figure 2 – Typical sprinkler system components

Full or partial sprinkler system temporarily disabled

Sprinkler systems are usually disabled for maintenance, or during non-sprinkler-related construction in the building.

To minimise the risks of temporarily disabling your system, follow the maintenance requirements of the relevant design standard. When isolating the system, the portion isolated should be kept to the least amount of floor area possible so that unprotected spaces are kept to a minimum. The system should be fully recommissioned as soon as maintenance have been completed. It is important that you tell us if your sprinkler system (or part of the system) isn't operative as this will change how we approach a fire in your building. Follow the notification procedure described in NZS 4541:2020.

Ensure that physical impairment notices are provided on the fire alarm panel, sprinkler valve set and on the sprinkler inlet (on the enclosure, if provided). Expired impairment notices should be removed to remove the risk of confusion over the status of the system.

Water supply limitations

Water supplies for sprinkler systems can be compromised when:

- the mains water supply cannot keep up with the sprinkler demand (e.g. reticulated water supply is undergoing maintenance)
- more sprinkler heads than the maximum system design are activating, e.g. because of an unusual fire or where there is more than one fire origin
- the private water supply is close to being exhausted.

The sprinklers standards set out the minimum water supplies required to support your sprinkler system. We recommend that you consider the benefits of adding resilience to your sprinkler water supply by providing a secondary water supply for every sprinklered building. A secondary water source will ensure that the water keeps flowing to the sprinkler system if your primary water source fails or is exhausted.

We acknowledge that providing a secondary water source may mean that you will exceed the minimum requirements of the relevant sprinkler standard.

Sprinkler design and building use not aligned

Sprinkler systems are typically designed around the proposed use of the building according to the minimum requirements of the relevant sprinkler standard.

Over time, the use of your building may change but the sprinkler may not be altered to suit the change of use. This can result in buildings with much larger fire loads than the sprinkler is designed for. For example, a sprinkler originally designed for a workshop is likely to struggle to control a fire in a storage occupancy.

We recommend that you ensure that your sprinkler system design can control a fire in your current building use. Ideally, you should upgrade your system where more onerous fire loads are introduced to your building. Where an upgrade is not feasible, you need to let us know that your sprinkler system is not designed to control a fire in the current building use.

Shielded fires

In a shielded fire, the sprinkler isn't dispersing water directly onto the fire. This makes it challenging for the sprinkler to control the fire. The fire can spread uncontrolled under the shield. This puts strain on the sprinkler system as more than the designed number of sprinkler heads may operate.

Examples of shielded fires include fires within racking systems, under tables/workbenches, under/within vehicles, within non-sprinklered cupboards/cabinets, etc. They can also occur when shipping containers, etc., are used as temporary confined spaces within larger buildings, around kiosks in shopping malls, and where overhead decorative features unintentionally block or disrupt the dispersion pattern of the water from the sprinkler.

While some of these challenges can be mitigated with special design considerations, e.g. in-rack sprinkler systems, it is more difficult to predict and manage others, e.g. shields formed by furniture.

We recommend that you consider where a shielded fire could occur in your building and account for this in the sprinkler design. This may result a sprinkler design that has more features than those required by the relevant sprinkler standard.

Sprinkler limitations

There are some fires that sprinklers cannot reasonably be expected to control. These include:

- explosive fires
- fires in spaces above sprinklers, e.g. a fire ignites building paper used as roof underlay

- some concealed spaces.

Equipment hard for firefighters to find

When we arrive at your building, we need to be able to use the equipment you have provided for us, including:

- fire alarm panel (sprinkler notifications)
- sprinkler valve set (sprinkler valve room)
- subsidiary sprinkler valves (located in the zone they serve)
- sprinkler inlet.

If we can't find the equipment, it will delay us from:

- finding the fire
- providing more water efficiently if we need it
- turning off the sprinkler water supply once it is safe to do so.

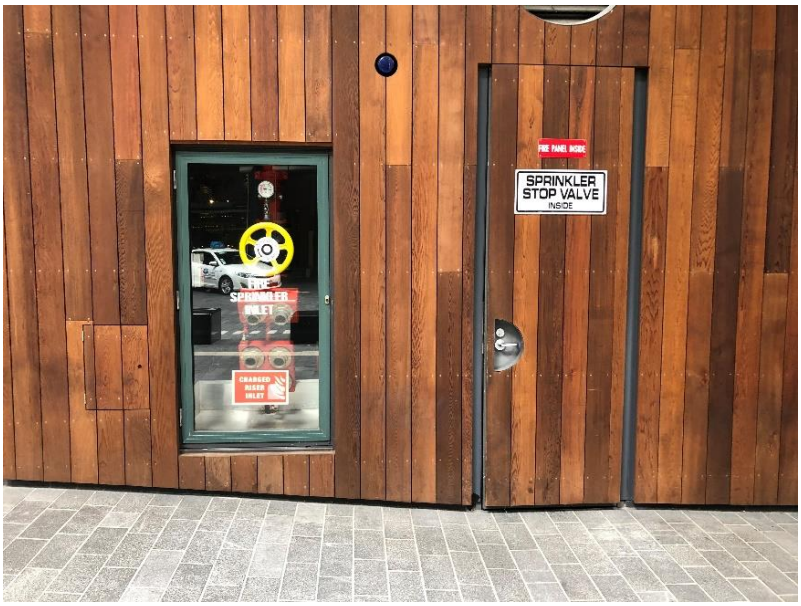

Figure 3 – An example of a well-labelled, easy-to-locate sprinkler valve set

4.2. How we use sprinkler systems

Establishing that the building has a sprinkler system

During a fire, we normally establish that your building has a sprinkler system from the automatic alert the sprinkler system creates which often (but not always) generates a call to us.

When we arrive at your building, we may also become aware of the sprinkler system operation by the sound of a hydraulic gong signalling water flowing in the system.

Sprinkler systems and associated equipment should also be indicated on all fire alarm panels. As with all other equipment provided for firefighter use, if we can't find it, we can't use it.

Location functions for firefighting

When we arrive at the site, we use the sprinkler and fire alarm panel to help establish the location of the fire.

However, while the alarm panel shows us that the sprinkler has activated, it doesn't show where it is activating. Typically, only the sprinkler valve set can give us an indication of where the sprinkler is activating. This can cause delays, because the sprinkler valves and the fire alarm panel are usually in different parts of the building.

To reduce delays, we recommend that the fire alarm panel displays information about sprinkler activation. When attending fire calls at buildings where this approach has been used, we've spent much less time gathering information about the fire.

Sprinkler activation information alarm panel should display

The alarm panel should display the following sprinkler activation information:

- Which part of the sprinkler system is operating (valves, or flow switches if provided)
- A diagram showing the sprinkler zones (which are often different from the fire alarm zones)

Note: Sprinkler activation information on fire panels should supplement, not replace, any other information to be provided on alarm panels. See chapter F5-04 GD FFO Fire alarm panels for more information.

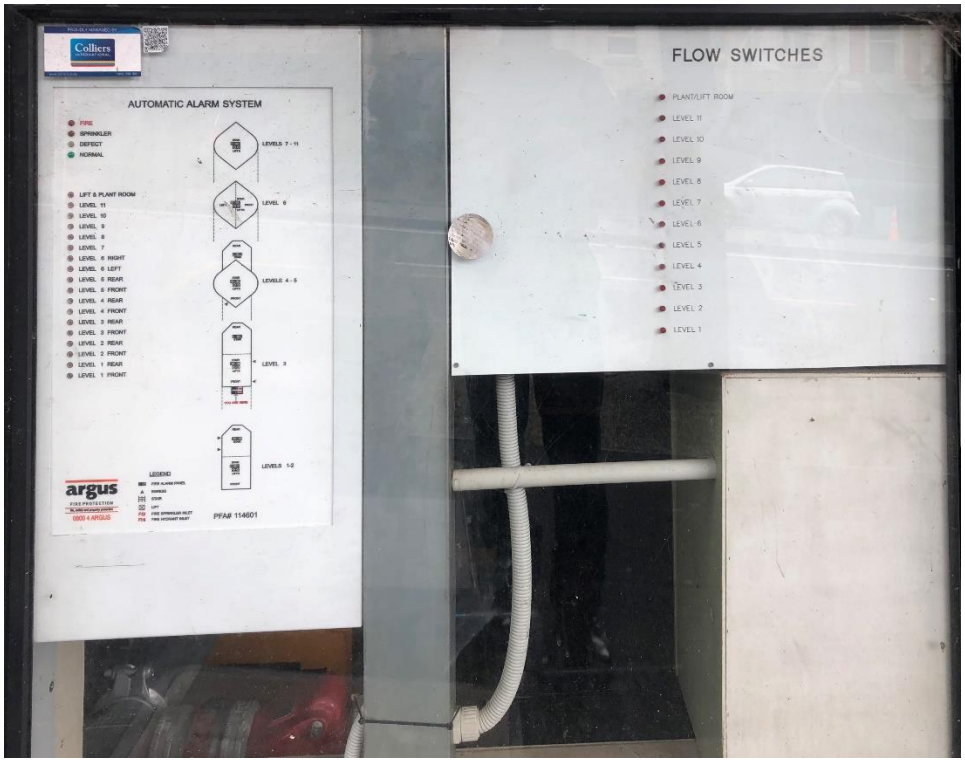

Figure 4 – Panel with flow switch zoning indicated

Support functions for firefighting

Support functions are limited to 'boosting' the system to provide more water if required.

We boost the system by connecting our pumping appliance emergency vehicle to the sprinkler inlet from either a reticulated town main or a static supply (e.g. tank, swimming pool, etc.). Your sprinkler inlet therefore needs to be in a location:

- that meets the requirements set out in NZS 4541:2020, clause 6.10.2 and enclosure designed as per NZS 4541:2020, clause 6.10.3,
- where we can find it and within 20 m of a hard-standing (the hose that we use to connect from our emergency vehicle to the inlet is around 25 m long)
- where it is easy to get to and use
- where using the inlet will not block escape routes and firefighter access points
- co-located with other equipment provided for firefighters, such as hydrant inlets and alarm panels.

Control functions for firefighting

Stop valves are the main control function of the sprinkler system that firefighters have. These allow us to cut off the water supply to the area where the sprinkler is activating. We only do this once we are confident the fire and any associated risks are under control.

We expect to find the sprinkler stop valves in the sprinkler valve room (also called the 'sprinkler valve house').

The sprinkler valve room needs to be:

- internally designed as per any relevant requirements from NZS 4541:2020, clause 4.4.1.2 – this is to provide a safe, well-lit space with adequate floor area for firefighters to use the equipment
- in a location where we can easily find it and which meets the requirements of NZS 4541:2020, clause 4.4.1.2, so that we don't waste time looking for and getting to/into the sprinkler valve room
- never used for the storage of non-sprinkler-system-related materials/equipment
- highlighted on the fire alarm panel
- preferably accessible from outside your building
- secured using a padlock opened with a Lockwood 197 key; the valves should be secured with a padlock opened with a Lockwood 144 key (see photo). Avoid electronic or pin/number pad access controls, as these can delay our access to the room, and we may have to force the door open.

Figure 5 – Typical valve group arrangement with main stop valve prominent

Subsidiary valves

Where subsidiary valves are provided, so that it is possible to limit the water shut-off of individual sections of the sprinkler system only, they need to be located where we can find them, and in accordance with NZS 4541:2020, clause 4.4.2.4.

We are most likely to use subsidiary valves provided in multi-storey buildings when they are:

- located in the stairwells containing building hydrants
- easily identifiable
- located on the stair landing at a height that we don't need a ladder to access.

4.3. Other important information we need to know

Legacy or special risk sprinkler systems

Although we strongly recommend that you update your sprinkler to deal with changes to your building's fire load, we acknowledge that there may be some occasions when this is not possible.

If your building has an existing sprinkler system that is not designed for the current building's use, or covers only part of the building, this needs to be obvious to us when we arrive at your building. It is important that we are aware that the sprinkler system may not be capable of controlling the fire as this will change how we organise our priorities.

NZS 4541:2020 clause 2.4.2 requires a sign to be provided at the sprinkler inlet with the following wording:

"**BUILDING NOT FULLY SPRINKLER PROTECTED**"

We also need you to provide this information on all alarm panels, on the door of the sprinkler valve room, and in any hard copies of building information provided for firefighter use.

If your building has a legacy sprinkler system which may not be designed to control a fire with the current occupancy, we need you to warn us by providing signage in the same locations as above with the following wording: "**LIMITED CAPABILITY SPRINKLER SYSTEM – MAY NOT CONTROL FIRE**"

If the performance of your sprinkler is not captured in the sign wording indicated above, please engage with us at designers.guide@fireandemergency.nz to agree on suitable wording.

Decom-missioned sprinkler systems

If a sprinkler system in your building has been decommissioned, you need to remove all associated features, so we don't incorrectly assume that your building has sprinkler protection.

It is important that you follow the NZS 4541:2020, clause 1.20 requirement to remove any visible evidence of the past sprinkler systems, including but not limited to:

- signage
- water motor alarms
- fire brigade inlet connections
- exposed sprinklers
- painting any remaining red pipework a different colour
- removing references to the sprinkler system from fire alarm panels.

4.4. Recovery after a sprinkler-controlled fire

Returning your building to normal after a sprinkler-controlled fire

Buildings with a working sprinkler system can often be recommissioned soon after a fire. This limits the disruption of occupants in spaces the fire didn't affect and minimises breaks in business continuity.

How you manage the spread of the water from the sprinkler system during and after a fire affects how soon you can get your building operational again.

Your first line of defence should be to ensure that your sprinkler system:

- is designed to the current building use
- has easily located equipment for firefighting
- has sectional valves.

The following options can also make the recommissioning process easier.

Building design to manage water from sprinkler systems

Water from sprinkler systems (also called 'sprinkler run-off') can travel between floors, down stairwells and into lift shafts. You can try to limit this by containing, draining or removing the water discharged from the sprinkler.

We recommend that you provide:

- floor drains (similar to those provided in bathrooms or shower rooms) to allow water to passively drain. Ensure that you follow local by-laws on where the water should drain to
- bunds between areas of the building to contain and limit water spread. (these should be located so that they do not interfere with access or means of escape requirements)
- any other design solutions to contain and drain the sprinkler run-off.

Prepare and practice a post-fire recovery action plan

A post-fire recovery action plan will help you to efficiently manage the post-fire period. The plan could include:

- who is to take charge of the clean-up
- what the clean-up would involve
- a management plan for any hazardous substances on site that may affect how the sprinkler run-off should be treated
- instructions on how to source equipment to remove water, such as mops, buckets, pumps etc. (you may have some items but need to hire others)
- contractors who could assist, e.g. sprinkler contractors, cleaning crews, sewage management, etc.
- a list of important items that should be salvaged/removed/protected
- relevant building contacts, e.g. building manager, insurer, tenants etc.

To ensure that the plan is carried out, you need to identify the relevant people in the plan and train them on how/when to use the plan, and where to find any relevant materials or equipment.

5. Recommendations

System vulnerabilities	• Remember that sprinklers aren't always effective. • Ensure that your system is active, especially after maintenance or construction works. • Ensure that your system will have enough water – provide resilience with a second water supply. • Ensure your sprinkler is capable of controlling a fire in your current building use. • Minimise the risk of a shielded fire occurring. • Minimise ignition and fire spread risks in areas where sprinklers do not/cannot cover. • Minimise the risk of explosion – this includes managing hazardous substances appropriately. • Ensure that any equipment provided for firefighters is located so that we can easily find it

How we use sprinkler systems	• Provide as much sprinkler system information as possible on the fire alarm panel so that firefighters only need the alarm panel to establish the location of the fire.
	• Provide locations of sprinkler inlets, sprinkler valve room and subsidiary valves on the alarm panel.
	• Provide sprinkler inlets:
	  ○ near a proposed hard-standing
	  ○ near the alarm panel and hydrant inlets (if applicable)
	  ○ in a location where they don't block the escape route or firefighting access points.
	• Ensure the sprinkler valve room is easy to find and get into.
	• Ensure that any secured equipment or locations can be accessed with standard keys carried by firefighters
	• Provide subsidiary valves:
	  ○ in multi-storey buildings in the fire-separated stairwell containing the building hydrant
	  ○ on each floor at a height that firefighters don't need a ladder to access.

Other important information we need to know	• You need to tell us if your building has a sprinkler system that will not be capable of controlling the fire – use signage and place it on any equipment firefighters will use. • Remove/disguise any features of any decommissioned sprinkler systems so that we are aware that the building isn't sprinklered.
Recovery after a sprinkler-controlled fire	• Ensure that your system is designed to control a fire in your building. • Provide means of containing and draining the sprinkler water after the fire. • Prepare and practise a post-fire recovery plan and train the relevant people on how to carry it out.
Sourcing additional water for sprinklers	Where it is necessary, and if we have the resources, we will try to 'boost' your sprinkler system by providing extra water via the sprinkler inlet. We can only do this when we have access to a water supply and can easily locate the sprinkler inlet (see further detail in section below). Water to boost the sprinklers can come from reticulated or non-reticulated sources.

Provide a sprinkler system for your current building use	Ensure that your sprinkler design suits the current use of the building so that it is likely to control a fire. Once we consider it safe to do so, and/or we have firefighters and hose lines in place, we will stop the flow of water to your sprinkler system. If your sprinkler system isn't controlling the fire, we are much less likely to stop the flow of water to it.
Provide easily located equipment for firefighting	Provide sprinkler equipment relevant for firefighting in suitable, readily accessible locations (see section above). This is especially critical if there is short time frame between when we arrive at your building and when the system can be shut off, e.g. for false alarms.
Subsidiary valves and system drains	Providing subsidiary valves will minimise the volume of water that will drain from the system once the water supply has been stopped. It is important to remember that once the sprinkler system water supply has been switched off, the water will not stop flowing until the sprinkler zone drains of all the water in the system. Sprinkler systems do have a means of draining the water from the system. However, this may not always prevent some of the remaining water from discharging through the open (activated) sprinkler heads. The smaller your sprinkler zone, the sooner the water will stop flowing.

5.1. Completing the firefighting facilities checklist

Completing the checklist	When completing F5 SC Part C: 4 Waterway of the firefighting facilities checklist (FFFC), you should state what equipment will be installed and clearly outline where the inlet will be located. This will allow us to understand the proposed layout and ensure that it is installed in the most appropriate location for firefighting operations. Remember that all these systems are put in place for us to use in emergency situations – always consult us when deciding where to locate them – email designers.guide@fireandemergency.nz

6. Related information

6.1. Designers' guide to firefighting operations

- F5 01 GD FFO Introduction
- F5-02 GD FFO Emergency vehicles access
- F5-03 GD FFO Radio communications
- F5-04 GD FFO Fire alarm panels
- F5-05 GD FFO Building hydrant systems
- F5-06 GD FFO Automatic sprinkler systems
- F5-07 GD FFO Stairs in buildings
- F5-08 GD FFO Lifts
- F5-09 GD FFO Fire Control Centres
- F5-10 GD FFO Evacuation and rescues
- F5-11 GD FFO Water supplies
- F5-12 GD FFO Construction, refurbishment and demolition sites
- F5-13 GD FFO Multi-tiered vehicle stacking buildings
- F5-14 GD FFO Firefighting shafts in taller buildings

6.2. Legislation

- Fire and Emergency New Zealand Act 2017
- Building Act 2004
- Building Regulations 1992 > NZ building code > Fire safety

6.3. Standards

- NZS 4541:2020 Automatic fire sprinkler systemsNZS 4510:2008 Fire hydrant systems for buildings
- NZS 4512:2021 Fire detection and alarm systems in buildings
- NZS 4515:2009 Fire sprinkler systems for life safety in sleeping occupancies up to 2000 square metres
- NZS 4517:2010 Fire sprinkler systems for houses

6.4. References

- C/AS2 Acceptable solutions
- Australian Building Codes Board, International fire engineering guidelines, Edition 2005, Canberra, Australia.

Note: The legislation, standards and references referred to in this guide (including those listed above) are relevant at the time that this document was published. Note however that these may have been updated since this document was published.

Document information

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