FIRE SPRINKLERS NEED WATER

Water is arguably the best extinguishing agent for fire. It's cheap, effective, environmentally friendly and it's everywhere – or is it?

By Tim O'Brien, Manager, VeriFire Limited, Auckland

In New Zealand the pressure and flow characteristics of some town mains water supplies have been reducing over recent years. The result in these towns is inadequate water supply for automatic fire sprinklers. So why are town mains pressures reducing? What are the effects of inadequate water supplies on sprinkler protection and what is being done to quantify and address the issue?

Many advantages with automatic fire sprinklers

Water achieves fire control by removing heat (largely through vaporisation), smothering, and pre-wetting surrounding material to prevent fire spread.

Sprinklers are the most effective way of delivering water to control or suppress fire. They are incredibly reliable and provide complete coverage throughout a protected building. They only operate in the immediate vicinity of a fire and deliver an appropriate amount of water to control a fire, minimising water use and water damage. Sprinklers respond rapidly following the development of flames, often operating within the first few minutes of ignition. Commercial and residential sprinkler systems will automatically raise an alarm and contact the fire brigade. And sprinklers are ready to operate at all times.

Sprinkler systems certified as compliant with New Zealand Standards have been statistically proven to be among the best fire protection in the world.

Safety margins less than thought

The design basis for automatic sprinkler systems in New Zealand comes from fire tests and a study of loss histories in the 1960s. We know what has worked in the past, but recent testing indicates that safety margins in sprinkler designs are less than we thought. This is particularly relevant where there are significant fire hazards, such as warehouses with high rack storage. It is also likely to be true for less challenging fire hazards since sprinkler system designs are often highly optimised for the water supplies available.

Occupancies, commodities and construction have changed over time to present greater fire loads in the built environment. Of particular concern is the increased use of various plastics in all areas of our lives.

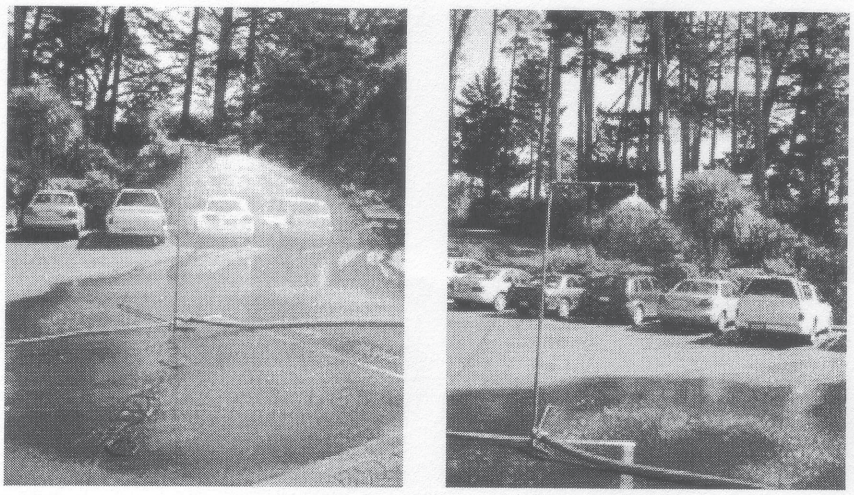
Sprinklers need water pressure

Effective sprinkler protection relies on adequate water supply. Each model of sprinkler head has a designated minimum operating pressure and cannot be expected to operate effectively below that pressure. The photos below show an automatic sprinkler head operating both at and below the listed minimum. The sprinkler discharge below the minimum pressure is pathetic. The spray distribution is uneven and does not provide effective coverage.

Water supplies can be adversely affected for several reasons, including partially or fully closed valves, equipment failure, shutting down of a sprinkler system before a fire has been suppressed, other water demands, and inadequate pressure due to changes in town mains supplies.

Reduction in town mains pressure is an increasingly common occurrence. Causes include:

- Pipe degradation through corrosion and ageing. In many places the infrastructure is nearly 100 years old and in dire need of maintenance and refurbishment.
- Sustained drought. New Zealand is second to Norway in the size of its fresh water reserves per head of population. →



Sprinkler head operating at minimum pressure on the left, and below minimum pressure on the right.

Yet summer water shortages and restrictions are a reality.

- Reduction in pressure imposed by water supply authorities to reduce leakage, water consumption and prevent infrastructure damage.
- Increased water demands as towns and cities grow.

In one recent case a town mains pressure reduced over 4 years, as a result of demands from a new subdivision, to become inadequate for a sprinkler system (see Figure 1). The sprinkler system demand point is in blue, representing the minimum pressure required to ensure effective sprinkler operation.

Although some sprinkler standards make specific allowances for hydrant and hose stream demands, the New Zealand Standard makes no such allowances for water from town mains. Under NZS 9201.7: 2007 *Model general bylaw – Water supply* there is no guarantee that town mains water supplies will meet the design criteria for sprinkler systems.

Outcome from fire more unpredictable

Even when water supplies are inadequate, an otherwise compliant sprinkler system can still be expected to detect a fire. Both commercial and residential sprinkler systems will automatically alert the fire brigade. However, the initial brigade response may be different responding to a fire in what they think is a fully sprinkler-protected building.

A sprinkler system without an adequate water supply might still control or suppress a fire. Loss statistics indicate that 65% of all fires in sprinkler-protected facilities are controlled by the operation of a single head, and 90% of fires by five heads or less. In industrial occupancies about 76% of fires are controlled by five heads or less, and 95% of fires by 25 heads or less. As the occupancy becomes a greater fire challenge, the number of sprinklers heads required to control the fire increases.

There are some facilities where fire control cannot be reasonably expected in the first few minutes with only a few sprinklers operating. Examples include high rack storage, flammable liquids, combustible dusts, process risks and plastics in construction.

When the water supply cannot meet the sprinkler system demands, the outcome of a fire event cannot be predicted. A fire might be suppressed or controlled until the arrival of the brigade. Or a fire might deplete the available water supply and spread unchecked throughout the building, perhaps even to neighbouring buildings.

Because fires do not always behave predictably, no fire protection system is infallible. But knowingly reducing water supply for fire-fighting purposes is courting disaster.

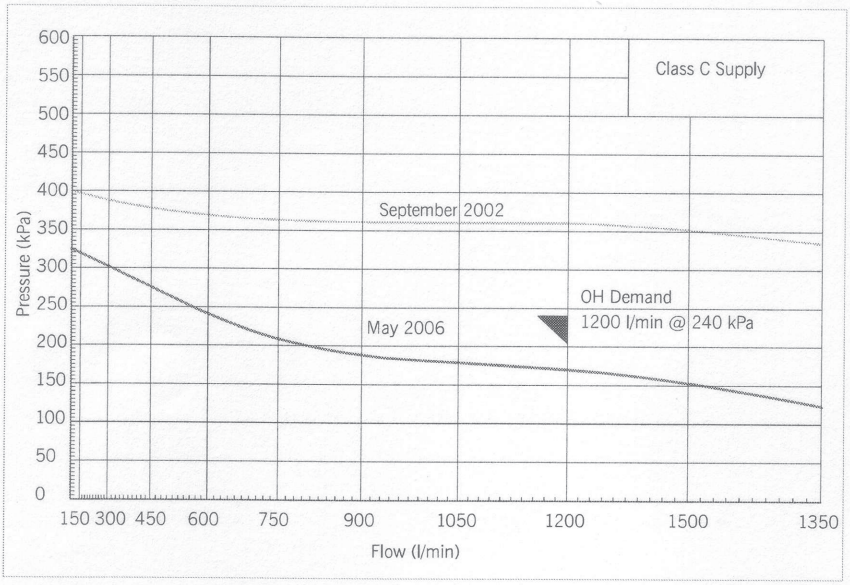
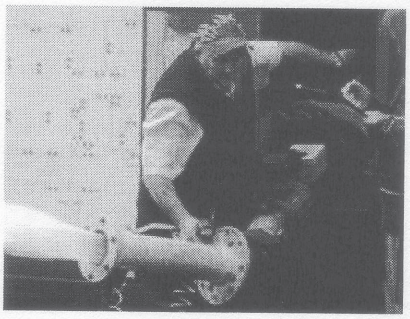


Figure 1: Water supply case study.



Testing water supply equipment.

No data yet on problem

Because fires are relatively rare events, and reduction of water supply pressure is a recent phenomenon, there is no fire loss data yet that shows decreasing town mains pressures are a problem. Further, water supplies in certified commercial and residential sprinkler systems are periodically tested so changes in water supply should be identified before protection is compromised. However, there is no mandated maintenance or testing for fire sprinkler systems in houses.

As water becomes an increasingly precious resource we need to be vigilant. There is little comfort after a fire in identifying that a town mains water supply was inadequate.

Future strategy to address problem

The Fire Protection Association of New Zealand (FPANZ) is collaborating on this problem with other industry bodies including BRANZ, the New Zealand Fire Service, and the Insurance Council of New Zealand.

To quantify the problem, historical town mains water supply test data will be collated from a number of sources. Regions where town mains pressures are reducing can then be identified. This will give an indication of how many sprinkler systems have been, or are likely to be, affected.

A strategy can then be developed to address the problem in a cohesive and effective manner. It will take some time to develop a workable solution that will ensure satisfactory fire protection while addressing issues such as town mains infrastructure and water supply conservation. After all, the problems we have begun to experience in the last decade have been a century in the making.