WHAKARATONGA IWI

FIRE EMERGENCY NEW ZEALAND

INQUIRY ON ALTERNATE WATER SOURCES FOR FIREFIGHTING

Morphum

July 2020

This report is aimed at identifying potential opportunities to improve the key issues highlighted in adopting non-reticulated water sources for firefighting in New Zealand.

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MORPHUM ENVIRONMENTAL LTD

Engineers & Consultants

Literature Review

Inquiry on Alternate Water Sources for Firefighting

Final

Prepared for Fire and Emergency New Zealand by Morphum Environmental Ltd.

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Executive Summary

Fire and Emergency New Zealand (FENZ) has engaged Morphum Environmental Ltd to prepare an inquiry report on alternative water sources for firefighting. The report is aimed at identifying potential opportunities to improve the key issues highlighted in adopting non-reticulated water sources for firefighting in New Zealand. This will assist FENZ develop a new Firefighting Water Supplies Code of Practice (CoP).

FENZ have the sole responsibility for emergency response to building fires and wildfires within rural and urban areas in New Zealand. Accordingly, this inquiry has involved a literature review of international examples and new technologies to identify options that could improve uptake of potential solutions, particularly in rural areas. The inquiry has addressed the current regulation and standards, key stakeholders, current implementation of the CoP, and information management and sharing, also setting out recommendations.

Effective firefighting is premised on the fact that the earlier the fire is suppressed; the smaller will be the consequences to people and property. Building regulation in New Zealand deals with fire protection and safety systems in building to safeguard life and prevent fire spreading to adjacent property but not to protect a building or its contents. Beyond the protection that these systems can offer, the level of risk that a fire incident poses to property and life can be affected the ability of fire emergency services to tun out and employ the necessary resources to respond to that fire. In New Zealand, there are high expectations for a prompt response from firefighting services, both for areas where there are reticulated water supplies and for areas without them.

Where there are reticulated water supplies, the Local Government Act requires councils to install fire hydrants in the water supply network at suitable locations for firefighting with the approval of FENZ. However, there is no basis in statutory instruments to secure adequate water supplies for firefighting in rural or urban areas where reticulated water supplies are not available or are insufficient. Therefore, supplementary sources of water in those areas are of strategic importance to fire service operations, property owners and communities.

We have considered technological, regulatory and FENZ's capability aspects at work in securing adequate firefighting water supplies. Nothing seems more essential in the short-term for emergency firefighting operations in existing communities with limited reticulated water supplies than identifying other suitable sources of water for fire brigades to access as quickly as possible. At the same time, improved implementation of the CoP must be achieved for new sources to be developed.

FENZ have a significant opportunity in the short-term helping operators in the development cycle understand local demands and how to implement CoP requirements. In particular, resource planners and local and regional authorities need guidance of when and how to take into account firefighting water supplies in relation to land use applications, particularly in rural areas.

Accordingly, initiatives that can help raise greater awareness where availability of firefighting water supplies are uncertain and improved guidance for the practical implementation of acceptable solutions should be prioritised to enable taking a risk-based approach. To this end, low-cost means for sharing information on local firefighting water sources and working collaboratively with councils should be considered with a focus on publishing guidance for key stakeholders and establishing availability of

suitable water supplies in three-yearly Local Fire Plans to highlight where greater security of supplies is most needed.

Notably, a common building block to enable progressing towards the publishing of a new CoP and improving its implementation hinges on developing a dedicated website for consultation and for accessing the relevant standards and guidance. In this regard, the benefits of deploying a geospatial platform for online collaboration and information sharing are highlighted. This supports FENZ's statutory responsibilities to consult changes to the CoP and to issue Local Fire Plans and relevant fire protection policy.

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1. Introduction: Problem Statements

Fire and Emergency New Zealand (FENZ) have sourced an inquiry on alternate water sources for firefighting to assist FENZ exercise their statutory duty to develop, consult with stakeholders and recommend the statutory publishing of a new Firefighting Water Supplies Code of Practice (CoP).

FENZ are particularly interested in a high-level literature review of international examples (where available). This is to identify potential opportunities to improve key issues highlighted within the current regulatory framework specific to promoting non-reticulated water sources for firefighting in New Zealand.

Initial guidance provided by FENZ has helped to outline relevant problem statements as follows:

- **Development of the new CoP must be widely consulted upon** and consensus gained before the Minister will publish it (s37 of Fire and Emergency New Zealand Act 2017).

- **FENZ indicate there is no explicit requirement in the current regulatory framework** to provide adequate water supplies for firefighting purposes concerning land development and buildings. FENZ have identified that enforcing this requirement is only implicit in obligations dispersedly stated for territorial authorities under existing legislation.

- **Current water supply and demand particularly in rural areas.** The current CoP precedes the FENZ Act 2017 and therefore does not recognise the remit of FENZ operations in rural settings where reticulated water supplies are not available or may be insufficient.

- **Understanding water supply demands and information sharing.** A review of the current research using theoretical estimates and actual water use fire incidents is required.

- **Innovation and new technology**. Notably, available research highlights also that having more water available does not necessarily reduce, better control or eliminate fire risks. There are other operational strategies, technology developments and controls that can optimise water requirements for firefighting.

Expansion to the problem statements above and the questions drawn to guide this inquiry are presented with relevant findings in the following sections.

2. Stakeholders

Development of the new CoP must be widely consulted upon and consensus gained before the Minister will publish it (s37 of Fire and Emergency New Zealand Act 2017). A clear understanding of the roles and responsibilities of stakeholders, and how the efforts required for this task could be coordinated, is needed.

- Who are the stakeholders and what are their roles and responsibilities in the context of providing adequate water supplies for firefighting, and in promoting and adopting practical solutions based on alternate water sources?
- How could efforts be coordinated for developing, consulting and recommending the statutory publishing of a new Firefighting Water Supplies Code of Practice (CoP)?

This section identifies stakeholders in the supply of firefighting water and building protection measures. The purpose of this is to identify parties to be consulted in the preparation of any new Code of Practice (CoP) and ways this could be streamlined.

Across territorial authorities, and by extension Council Controlled Organisations (CCO's) providing water supply, the extent of involvement in managing water supplies for firefighting is inconsistent, as is the level of their involvement.

Whilst there are some guidance documents, there is a lack of coordination and knowledge within the industry on how they should be taken into account. For this reason, future consultation should be assisted by general information on what the CoP is and its requirements.

Concerning consultation, it should be noted that the territorial authorities supplying water services, as well as network operator CCO's, tend to avoid taking over private water systems due to the costs involved in operating and maintaining small-scale systems. And therefore, with respect to infrastructure which the council had not taken over in relation to a new development (i.e. communal water systems, cisterns and rain tanks), maintenance responsibilities to be undertaken by private entities (e.g. a body corporate) can be poorly defined or limited to communal areas in a building and not external to the property boundary.

There is normally a division of functions within Councils between officers responsible for water supply, planning, and building consents. For this reason, when consulting with Councils, it will be necessary to ensure that consultation covers the scope of the matters covered by the CoP.

Planners and principal planners mentoring other staff in policy making and consenting functions, and policy and consenting managers, are all key operators, as are also staff and professionals involved in the delivery of capital works for public and private assets.

2.1 Stakeholders: Roles and Responsibilities

The relevant stakeholders, the role that they have in the provision of water supply for firefighting and the roles that each stakeholder has under relevant regulations is summarised below, in Table 1.

Table 1: Stakeholders with a Role Under Current Regulation

Stakeholder	Regulation	Role
Territorial Authorities **District Councils:** To enable democratic local decision-making and action by, and on behalf of, communities, and to promote sustainable district well-being. **Regional Councils:** To promote sustainable regional wellbeing	Local Government Act 2002 Building Act 2004 Resource Management Act 1991 Fire Emergency Act 2017	• The provision of local infrastructure, including water, sewerage, stormwater, roads. • Environmental safety and health, district emergency management and civil defence preparedness, building control, public health inspections and other environmental health matters. • To keep records about all the properties in their area, issue project information memoranda and certificates of acceptance, monitor compliance schedules and follow up notices to fix. They also have policies for certain buildings that are most vulnerable in an earthquake. • To provide fire hydrants on reticulated mains in places it determines are convenient for extinguishing fire. **Actions as a Resource Consenting Authority**: **District Council:** • Controlling the effects of land use (including hazardous substances, natural hazards and indigenous biodiversity), noise, and the effects of activities on the surface of lakes and rivers. **Regional Council:** • Managing the effects of using freshwater, land, air and coastal waters, by developing regional policy statements and the issuing of consents. • Managing rivers, mitigating soil erosion and flood control. • Regional emergency management and civil defence preparedness. **Actions as a Building Consent Authority**: To administer building consents and provide certain building consent applications to FENZ. Can issue infringement notices to address breaches of the Building Act or, in some circumstances, organise for remedial work to be done. • **Actions as a Policy Maker**. Issues bylaws and land use policy and undertakes monitoring.

Stakeholder	Regulation	Role
Council Controlled Water Supply Organisations		Council controlled water supply organisations have the same roles and responsibilities as territorial authorities as they act for Council in the supply of water.
Ministry of Business, Innovation and Employment	Building Act 2004	• Over-arching regulator of New Zealand's building system • Sets the performance standards that all building work must meet. (issues and administers Building Code) • Monitoring and evaluating the overall performance of New Zealand's building system • Monitor the performance of district and city councils. • Can investigate complaints and make determinations about disputes on certain building matters.
Building Consent Authorities	Building Act 2004	To undertake functions and duties under the Building Act including to issue building consents, inspecting building work.
Licensed Building Practitioners	Building Act 2004	Promote recognise and support professional skills and behaviour in the building industry.

2.2 Interested Parties

In addition, there are other interested parties that are actively involved in development of the three waters network and supporting territorial authorities in this role. These include:

- Local Government NZ
- Water 2050
- Water NZ

Relevant Ministers of the Crown should also be consulted including the Minister of Civil Defence, Minister for the Environment and Minister of Conservation. The subject should be of interest also to centralised governance team leading the Three Waters Review[1].

The Thee Water Review is particcularly concerned with how best to achieve safety and improved environmental outcomes in relation to drinking water, wastewater and stormwater systems, which are largely managed by council organisations but not exclusively. On 30 September 2019, the government agreed to establish the new drinking water regulator as an independent Crown entity. It is also investigating high-level options for service delivery as part of a longer conversation.

For example, a subject where there may be common interests in improved coordination between services providers and FENZ is with regard to establishing any minimum permanent works for taking

[1]The Three Waters Review was established in mid-2017 by government, alongside the Havelock North Drinking Water Inquiry, as a cross-agency initiative led by the Department of Internal Affairs (DIA) to look into the challenges facing our three waters system; and to develop recommendations for system-wide performance improvements.

water from identified non-potable sources to deal with, both, fire emergencies and water supply shortage emergencies.

For example, during the recent drought in Auckland that resulted in water use restrictions from 16 May 2020, Watercare Services Limited used emergency powers under the RMA to initiate a number of non-potable sources of water to enable supplying businesses relying on water, like waterblasting for building washing. Takes from lakes in Lake Pupuke, Western Springs and other sources were used to fill water tankers[2]. Long-term resilience discussions may mean the takes should remain available for future eventual use. FENZ have similar powers to take water during fire emergencies and could target those same sources. And, thus, any permanent improvements needed to establish access for water supply shortage events should also consider access relevant to firefighting operations where possible.

Within the private sector, developers play a role in both the provision of infrastructure to service development (infill, brownfield redevelopment and greenfield). Private developers (and their consultants) determine the style and type of development as well as measures taken to reduce fire risk or provide supplies of water for firefighting. Developers are heavily guided by regulation and what the requirements are, and costs for options that may be available.

Other interested parties may be Engineering New Zealand (ENZ), the New Zealand Planning Institute (NZPI) and the Institute of Public Works Engineering Australasia (IPWEA). Academic organisations with a specific program in fire engineering may also be interested parties, as would also be insurance brokers and community groups with expressed concerns with the security in provision of firefighting water.

FENZ must refer to S73 in the FENZ Act 2017, which describes the consultation and approval requirements for publishing and notifying a CoP for firefighting water supplies.

2.3 Guidance for Initial Discussions with Stakeholders

Matters highlighted in the current CoP implementation discussed further below raise the following talking points which may assist initial discussions with stakeholders:

- References made to the CoP in different statutory instruments, including bylaws, engineering standards and district plans, where there are any, do not seem to amount to helping communities secure the provision of firefighting water where supplies may be inadequate;
- Inconsistency in the consideration of firefighting water requirements in respect to development proposals may result from a combination of factors, including:
    - Whether rules in district plans adequately address water supplies for fire fighting
    - The nature and specificity of rules where firefighting water requirements are addressed in district plans, including whether they apply to rural zones

[2] Section 330 in the RMA gives powers to water providers and other lifeline utilities (telecommunications, power distribution, rail, etc) to undertake preventative or remedial works when affected, or likely to be affected by an adverse effect on the environment.

- Availability of relevant information for awareness of the significance of the problem (firefighting water stressed areas) and solutions available to be taken into account in decision-making by consent authorities
- Lack of common understanding by developers of when and how to provide adequate solutions, including a practical understanding of the CoP standards and when to require FENZ input.

The following regulatory and non-regulatory options to improve the situation outlined above have been identified and are detailed further in this report (Section 7):

Regulatory:

- Initiate plan changes to clarify rules in district plans to require firefighting water provision
- Establish current availability of suitable water supplies in three-yearly Local Fire Plans to assist community development planning decisions
- Investigate requiring automated fire alarms and sprinklers as necessary building fire protection measures under the Building Code in areas where firefighting water supplies are uncertain, including for residential buildings.

Non-regulatory:

- Publish guidance on how CoP requirements are expected to be addressed in district plans, bylaws and engineering standards.
- Education to enable taking a risk-based approach, including:
    - Information sharing via a dedicated website with geospatial data display capabilities
    - Developing Acceptable Solutions guidance

2.3.1 Stakeholder engagement

A plan to engage with relevant stakeholders should be prepared in respect of sharing and gathering feedback on proposed changes to the CoP. The post-Covid context should be taken into account when determining how this engagement can be done.

In hand with this, the deployment of a dedicated website with geospatial data display capability would assist with raising greater stakeholder awareness of firefighting water supplies uncertainties, as well as with gathering stakeholder feedback and publishing other related guidance over time.

This would be consistent with the statutory requirements in the FENZ Act 2017 for the eventual publishing of a new CoP.

Stakeholder engagement has not been undertaken in preparing this report.

3. The Regulatory Framework, Codes and Standards

FENZ have identified there is no explicit requirement in the current regulatory framework to provide adequate water supplies for firefighting purposes concerning land development and buildings. Enforcing this is only implicit in obligations dispersedly stated for local and territorial authorities under existing legislation. Developing a clear understanding of the roles and responsibilities of stakeholders, and how the efforts required for this task could be coordinated, is needed.

- What issues and opportunities are there in the current New Zealand framework concerning mechanisms to ensure the provision of adequate water supplies for firefighting and to promote the adoption of practical solutions based on alternate water sources?

Current regulation relevant to firefighting water in New Zealand can be split into;

1. **Regulation that controls fire protection measures**; these are measures that are incorporated into a building to slow the spread and severity of fire. These measures reduce water requirements.

2. **Regulation that controls water supplies**; these are regulations that guide the type, amount and characteristics of water that may be supplied for firefighting and how it may be taken.

This is expanded in the discussion of the current CoP implementation further below.

The biggest challenge in a regulatory sense is that there is no clear regulatory basis specific to firefighting water supplies.

Fire protection has a clearer regulatory basis in the Building Code (prepared under the building Act). The building code and building consent process focus on elements of the building itself, building protection measures and access to buildings. Requirements for buildings depend on the risk that their use and occupancy pose, and there is no distinction between buildings in rural and urban areas. There is flexibility in how the regulations are applied and the ability to increase water storage or construct multiple fire cells to lower fire protection measures (including by the installation of sprinklers). Some of the requirements do not apply to detached dwellings, which would exclude many rural buildings. Sprinklers are not mandatory for residential buildings, although the installation of sprinklers may change the type of building materials required and other performance requirements.

The current CoP recognises the risk on life and property are affected by delays in accessing available sources water and the adequacy of those supplies. Accordingly, it sets out standards for reticulated areas as well as for areas where there are is no water reticulation. However, as a New Zealand Standard, its adoption is not mandatory.

The current CoP is implemented, mainly, through bylaws and engineering standards under the Local Government Act, but also, through district plans prepared under the Resource Management Act.

These regulations may directly reference the CoP or indirectly implement some of its requirements, and therefore there is inconsistency of implementation across the country. There seems to be no geographic or water availability reasons for differences in the way councils currently implement the CoP.

Of note is the FENZ Act 2017 that provides for FENZ to publish a new CoP as a non-legislative instrument that is subject to approval by the Minister and, following, it can be amended or disallowed by the House of Representatives. This means the cost and benefits of measures promoted can be subject to debate in Parliament.

The following sections discuss how firefighting water supplies are taken account of at various parts of the development process to help understand potential gaps. Regulations relevant to firefighting in the current framework are set out below, in Figure 1.

The regulations on the left focus on fire protection and standards for buildings. The regulations on the right have a focus on water supply. A summary of relevant sections of the acts referred to below is contained in Appendix 1.

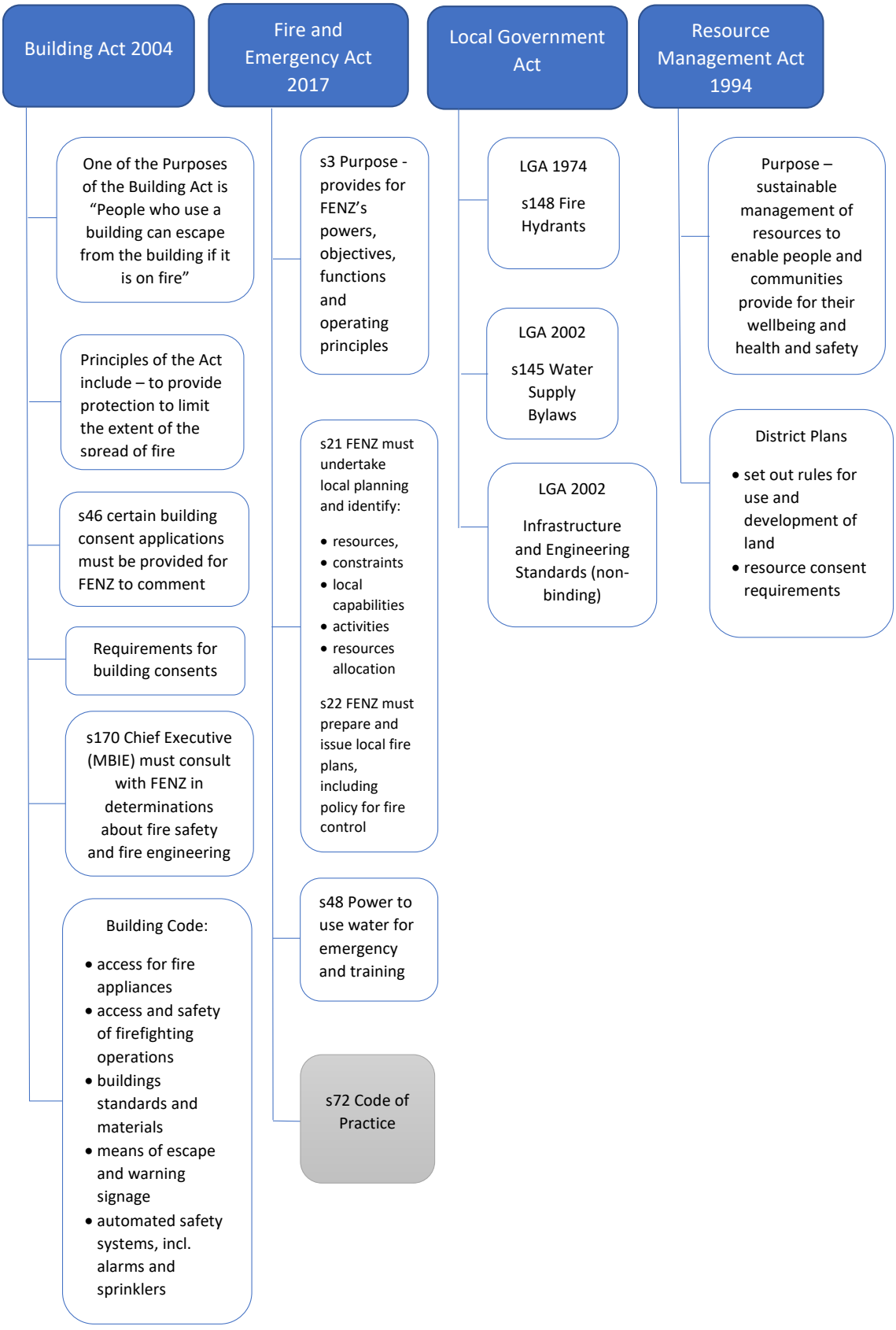

Figure 1: New Zealand Regulation Relevant to Firefighting Water Supplies.

In practice, the following regulatory and non-regulatory instruments influence the provision of water supplies for firefighting:

- Code of Practice for Freighting Water Supplies (NZS PAS 4509: 2008)
- Water supply bylaws
- Engineering standards
- District Plans and resource consents
- Building consents and the New Zealand Building Code
- Land development and subdivision infrastructure standards (NZS 4404: 2010)

These are discussed below and key matters highlighted in respect of the current CoP implementation are illustrated in Figure 2, further below.

3.1.1 Current Code of Practice for Firefighting Water Supplies[3]

The current CoP intends to give guidance to territorial authorities, developers, property owners and occupiers for determining firefighting water requirements. It sets out standards for water sources in terms of quantity requirements, flow rate, duration and access for fire service vehicles.

The CoP recognises the risk on life and property are affected by delays in accessing available sources water and the adequacy of those supplies. And therefore, it sets out standards for making provision for firefighting water from alternate water sources in areas where reticulated water supplies may be insufficient.

The approach of the CoP is to encourage flexibility - it is a New Zealand Standard. Local Authorities or developers may adopt more stringent regulations or measures. It is non-mandatory. When published, the Commissioner considered that outcomes for fire hydrants are better achieved through maintaining the CoP as a voluntary measure. However, a more current position in this respect is anticipated to be influenced upon consultation for publishing a new CoP.

3.1.2 Bylaws

S146 of the Local Government Act 2002 allows local government to make bylaws for water supply. Several Councils include firefighting requirements within water supply bylaws that almost exclusively cover water supply within urban areas. Whilst most bylaws define rural water supply, they do not cover firefighting water supply in rural areas.

The table in Appendix 2 lists all Councils that include water supply for firefighting in a bylaw and the general scope of the bylaw. These bylaws apply mainly to the use of water from the public water supply network.

Whilst it varies between Councils, bylaws also include requirements for protection elements such as sprinkler installation, hose reel fittings and the types of pipes connecting to hydrants as well as

[3] SNZ PAS 4509: 2008 New Zealand Fire Service. Firefighting Water Supplies Code of Practice.

standards for hydrants and standpipes. Typically, these are standards for those items when they are used rather than prescribing when they must be installed.

Concerning water supply, bylaws seem to be limited in scope to required pressure, although some bylaws do reference the CoP concerning water volumes. In some cases, bylaws specifically exclude water supply for firefighting from being metered. With regard to fire protection systems, some bylaws include provisions relating to sprinklers. However, this is more in relation to ensuring that they are maintained and have appropriate backflow control so as not to adversely impact on the wider water supply network.

An example of a typical provision with regard to sprinklers is contained in the Whangarei District Council bylaw, duplicated below;

> *Any fire sprinkler system shall be constructed, installed and maintained in good order, and shall be so designed and fixed that water cannot be drawn there from for any other purpose. All sprinkler systems shall have a Council approved backflow prevention device and meter installed at the point of supply. These systems shall be designed to operate at the minimum levels of service detailed in 1.3.5.*

Of interest to looking at alternative water supplies is that most bylaws refer to firefighting connections being able to be made to 'water supply' networks only. This is more restrictive than the Fire and Emergency Act that allows water to be taken for fire or emergencies (presumably from any water source).

Where bylaws are specific to firefighting water supplies being taken from a supply network only, if there were to be other permanent infrastructure (like the equivalent of hydrants), then changes to the bylaws may be required.

3.1.3 District Plans and Resource Consents

District plans are prepared by territorial authorities under the Resource Management Act 1991. District plans control the effects of development. If a development is not permitted or prohibited in a district plan, a resource consent is required. District plans state objectives and policies for development and matters that Council can consider when assessing the application.

District plans for Councils throughout the country have been reviewed and a summary of whether firefighting issues are contained in District Plans is contained in Appendix 2.

In most cases, rules that relate to firefighting water supplies are contained in the subdivision chapter and relate to urban subdivision and development.

One interesting example is the Central Otago District Plan 2008 which for residential and accommodation activities in the rural area require the provision of all services, explicitly, including firefighting water supply. Guidance notes for rural dwellings available online refer to a 30,000-litre tank with a static reserve of 20,000 litres as a standard requirement, acknowledging other alternatives may be available. Although the plan has been amended since it became operative in 2008, it does not reference the CoP.

About half of the district plans reviewed use firefighting water supplies as rules. Other plans refer to firefighting water supplies as only policies or assessment criteria. Most often, these relate to the distance of subdivided lots from a fire hydrant. At the time of resource consent for 6 or more lots, fire hydrants within 135m of the subdivision are tested, though this may not always be the case. Where new supplies are developed or testing occurs, the information on available supplies is unlikely to be systematically recorded. District plans also control access widths and gradients. Whilst it may not be the primary purpose of access rules, they also assist to ensure access is suitable for fire appliances.

There are several gaps in the way that district plans cover water supply issues. District plans are not prescriptive so a resource consent may allow deviations if an applicant can show effects are acceptable. Many district plans are inconsistent in the way firefighting water supply is addressed. A lot of plans apply only at the time of subdivision. This means that if developers chose only to build additional houses but not subdivide, water supply for firefighting may not be taken into account even though the fire risk is on the building and not on the underlying land parcel.

In some cases, district plan rules or assessment criteria refer to Council's engineering or infrastructure standards. Some engineering standards cross reference the CoP and some refer to directly to issues of firefighting water supplies. Engineering standards themselves are not mandatory to comply with. However, referring to them in a District Plan means they must be considered. Again, engineering standards are not consistent.

Resource consents must be publicly notified if the effects are more than minor. This means that anyone (aside from trade competitors) may make a submission on the application. If effects on a party are minor or more than minor, those parties must be notified.

For FENZ to be notified (unless they were a neighbouring landowner), firefighting water supply would have to be included in assessment criteria of a rule (unless the subdivision or land use application was discretionary) and the applicant would generally not have addressed it adequately.

Outside of formal notification under the RMA, Council officers (or applicants) may choose to consult with FENZ so they can understand effects specific to firefighting water supply and access for fire appliances. This would be determined by internal Council processes and, or the position of individual planners. It is noted that this is separate from the requirement to consult FENZ on certain building consent applications.

District Plans do not contain controls requiring fire safety mechanisms that are controlled under building regulations under the Building Act (e.g. installation of sprinklers, structural issues, escape routes, etc.). These matters will be considered at the time building consent is applied for. It is possible that this renders confusion as to which is the appropriate time to consider firefighting water resources in respect of development plans and projects.

3.1.4 Building Consents and the New Zealand Building Code

Councils implement building regulations in their role as building consent authorities. FENZ's Fire engineering unit advise councils on means of escape and firefighting safety aspects in building consent applications. Firefighting engineering designs for buildings are supplied by the industry. Developers and

designers can establish compliance with regulations assisted by Acceptable Solutions guidance issued by MBIE, with verification procedures and consideration of alternative designs on a case by case basis.

Building regulations set out specific objectives to provide for the protection of people from fire, to facilitate firefighting and rescue operations, and prevent fire spreading and affecting neighbouring property or buildings. All buildings over 30m^2 require building consent. Compliance with the building code is required.

The building code is a regulation to the Building Act. It is a performance-based code and in this manner is not prescriptive. Each clause has three aspects – objectives (the social outcomes the building must achieve), functional requirements (the functions the building must perform to meet the objective, and performance (the performance criteria the building must achieve).

For the installation of sprinklers there are further requirements as set out in New Zealand Standards:

- NZS 4515:2009 Fire sprinkler systems for life safety in sleeping occupancies (up to 200m^2)
- NZS 4517:2010 Fire sprinkler systems for houses, and
- NZS 4541:2013 Automatic fire sprinkler systems.

Performance against the standard must be demonstrated during the building consent process. A requirement for fire sprinklers depends on the compliance of designs with different matters in the Code. It is not explicit. Compliance paths using Acceptable Solutions only differentiate between buildings that are protected with an automatic fire sprinkler system and buildings that aren't. Sprinklers are one method that can be used to prevent fire spread. Sprinklers may also be required where other requirements of the Code are not met. For example, building insulation in a residential addition that is not in keeping with the Code may result in a requirement to install automated heat and smoke alarms.

3.1.5 Engineering and Infrastructure Standards

Territorial authorities have a range of engineering and Infrastructure standards. Concerning water supply, these regulations generally focus on the details of the type of connections to service new development. Most standards apply at the time of subdivision or when constructing infrastructure.

Standards not incorporated into any other regulatory document are not legally binding and are guidance to the industry. Some standards are incorporated into infrastructure or subdivision chapters of district plans that gives them some legal weight. When they are incorporated into district plans, they are primarily used as assessment criteria, rather than triggering a need to apply for consent.

3.1.6 Land development and subdivision infrastructure standards (NZS 4404: 2010)

A significant proportion of new infrastructure is created by land development and subdivisions projects.

In recognition of this, NZS 4404:2010 provides guidance to local authorities, developers and designers on standards for design and construction of roads, stormwater, water supply and wastewater networks. These standards are applicable to greenfield infill and brownfield development projects and can be used as means to comply with conditions of consent under the RMA.

As a Standard, it is not mandatory and seeks to provide as much consistency as possible while allowing flexibility to suit local circumstances. It is aimed at encouraging sustainable development and modern design, emphasising liveability and environmental quality and, thus, urban development is a key focus.

Some councils issue codes of practice for land development and subdivision which often incorporate these standards by reference in district plans.

Notably, NZS 4404: 2010 references the current CoP among other standards. It is unclear to what extent this Standard may influence CoP implementation, particularly in rural areas.

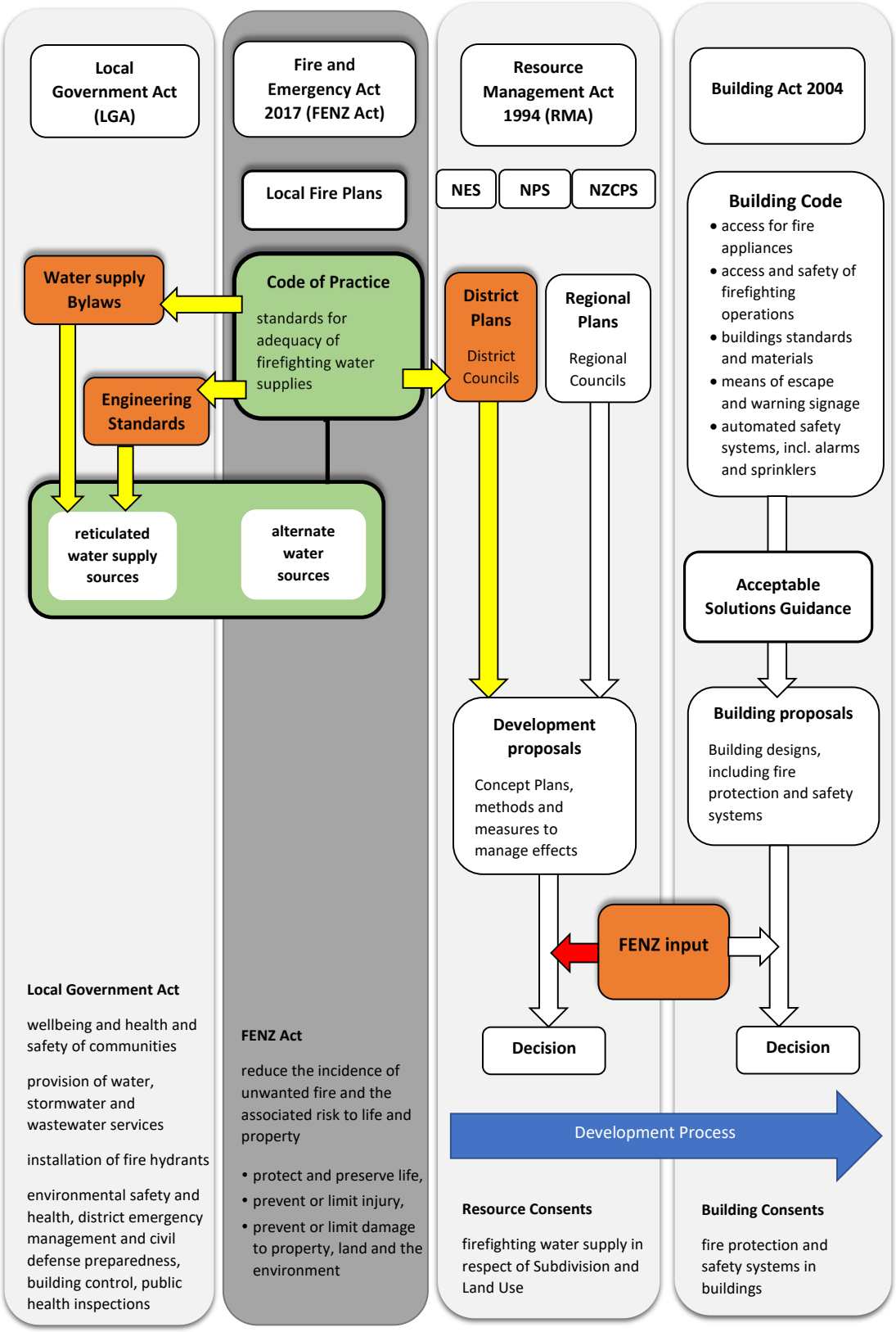

Figure 2: Matters Highlighted in The Discussion of The Current Cop Implementation

3.2 High-level regulatory considerations for using alternate firefighting water sources

The section below sets out broad considerations for using of non-potable water sources for firefighting in the context of the regulatory framework in New Zealand.

a. Use of Ponds, Streams, Lakes and Sea Water

Taking water for fire emergencies (drafting water), is exempt from restrictions on the take and use of water under the RMA. For this reason, there appears to be no regulatory barriers or changes necessary.

b. Use of Tank Farms in Rural Areas

In most cases, there are resource consent requirements to establish the tank farms. If they were to be owned by FENZ, consents would be required, depending on the location, zone and rules for that zone. There would also be likely building consent requirements for the tanks. To lessen requirements on an ongoing basis, FENZ could submit on district plan reviews to promote rules that encourage tank farms for alternative water supplies. FENZ could also undertake private plan changes to change rules of district plans or regional plans, where they were overly restrictive, to enable tank farms to be established. Regardless of what option is selected, amenity for properties surrounding the tank farm would be one of the main considerations. Selection of locations that are practical to supply water and mitigate any adverse effects would be important.

An alternative is to work collaboratively with Councils, improving the effectiveness of mechanisms for implementing the CoP. Allocation of maintenance responsibilities for any tank farms, including maintaining availability of water for firefighting, would require discussion. The CoP could include relevant agreement templates to assist with this aspect. Established agreements can then be required as part of the development process, and a compliance schedule included as a condition in a relevant consent. The justification for this is that they are means to ensure their ongoing operation and maintenance to manage the potential effects on firefighting supplies if such maintenance was not done.

c. Private Tanks that hold Firefighting Water in Rural Areas

An option is to require dedicated storage that provides firefighting water for each rural property. This would be determined at the time of subdivision and development of a house. It would require district plans to incorporate the specific requirements of the CoP or to have strong (clear) rules requiring tanks.

One of the issues identified is that not all tanks are suitable to draw water from, due to accessibility or design limitations (i.e shape of the top of the tank, cap on top of the tank and height above ground, or size to hold required water volume).

However, a known challenge is the split of consenting responsibilities between district and regional councils for different aspects of solutions that integrate water management considerations. District councils determine land use consents, whereas regional consents control stormwater diversion and discharges, and wastewater discharges, which consents can be obtained for separately from subdivision consents by developers.

Thus, the extent to which a multipurpose storage solution may appear feasible at the time of subdivision consents depends also on the extent to which district plans require dealing with water supply, stormwater or wastewater management aspects in land use consent requirements under s9 of the RMA. This, excluding considerations pursuant to s14 (surface water diversion) and s15 (contaminant discharges) of the RMA which concern regional plans.

Again, this would require clear rules requiring tanks, as well as assistance in the CoP standards with respect to providing guidance to consenting authorities on the feasibility of integrated solutions. Also allocating responsibilities for maintenance, including conflict resolution mechanisms.

The emergence of multipurpose storage solutions cannot be expected from changing the regulation status of the CoP alone, or from improving guidance for its implementation, given separation of decision-making responsibilities. Improving collaboration with and between district and regional councils should be expected. This implies information sharing tool and availability of suitable guidance to implement solutions.

Whether the CoP could have the same status as a National Environmental Standard is something to explore. District plans could not be inconsistent with the standard if it required the provision of on-site storage. This would not allow flexibility but would achieve consistency across the country. Similarly, for any multiple lot subdivisions, and plan changes zoning land for development, consideration of firefighting water requirements would be required.

At the other end of the scale, education of the community, designers and developers on the requirements of the CoP and expectations for its implementation would be needed. This includes raising greater awareness of water stressed areas and the benefits of including storage, so they can take this into account when also considering other water management measures, such as on-site detention and reuse.

d. Use of Urban Stormwater Networks

The FENZ Act allows water to be taken. As discussed in previous sections, each individual Council supply bylaw would need to be analysed to determine whether changes are required. This would best be done by working with Councils.

Figure 3: Firefighting Water Drafting from a Pond[4]

[4] sourced from https://en.wikipedia.org/wiki/Drafting_water, on 15/05/2020

4. International Examples of Alternate Water Sources

Under the FENZ Act 2017, the remit of FENZ fire service operations extends to rural settings where reticulated water supplies are not available or may be insufficient.

Where reticulated water supplies are available, potable water for domestic, commercial and industrial use is a scarce and valuable resource. Water demand for these uses is relatively small compared to the estimate requirements to supply water for firefighting purposes which will generally determine the overall demand and sizing of pipes for water supply. This imposes high water installations cost on water infrastructure and developments.

Large fire hydrants connected to large diameter water pipes deliver the necessary flowrate for fighting fires in large cities. The water stored in reservoirs in the distribution network is often adequate without disrupting service. In turn, water supplies in small communities is often inadequate for fighting fires. Using potable water sources to fight a fire will likely disrupt customer service in a small community.

FENZ have considered that more sustainable solutions could be available and, to that end, the most recent update to the current CoP incorporated guidance on the use of alternative firefighting water sources (Appendix B), defining relevant key criteria that such sources should meet (access, security, visibility, adequacy of supply).

FENZ consider that defined criteria remain a relevant starting point for investigating options for using alternate water sources and that a literature review of international examples could help develop evidence to support a wider adoption in New Zealand.

- Are there examples documented in the international literature of practical solutions based on alternate water sources for firefighting, for example, non-reticulated water, multipurpose water storage and water reuse options?
- What key issues or criteria should be considered when evaluating the adoption of practical solutions based on alternate water sources?
- Are there options available that could fit the New Zealand context?

International literature was investigated to determine what alternative water sources are used for firefighting, and to identify examples of practical solutions that could fit the New Zealand context. Documents from a range of sources, including regulatory agencies and professional organisations in America, Australia, Canada and the UK were reviewed. Journals from the American Society of Civil Engineers (ASCE), and publications from the Cooperative Research Centre for Water Sensitive Cities (CRCWSC), Australia were also reviewed.

We found evidence that alternate firefighting water sources are used and specified in standards to supplement available supplies both in urban and rural areas. However, a focus on using reticulated sources of firefighting water in urban areas prevails in practice and the literature.

Options for water supply for firefighting are outlined in Table 2, below. Further details on more innovative options are provided in the sections following the table.

Table 2: Options for Water Supply for Fire Fighting.

Source type	Referenced examples
Bores	In Western Australia, Department of Fire & Emergency Services (2017), recommend that bores should no longer be considered an acceptable primary water supply source for firefighting but may be used to fill water storage tanks. If taking water from a bore, then discounting unwanted interferences with any neighbouring bores and the quality of water are relevant considerations requiring hydrogeology investigations. In New Zealand, legislation allows taking water from bores without the need for a resource consent in emergency situations.
Dams	In Western Australia, for private dams to be considered acceptable for use, the water storage and run-off area must be on the building lot under consideration and under the direct control of the building owner (Department of Fire & Emergency Services, 2017).
Rivers, lakes and the sea	In the United Kingdom, a spring, river, canal, loch or pond with capacity to provide 45m^3 of water at all times of the year, to which access, space and a hard standing are available for a pumping appliance may be used (Scottish Building Standards Agency, 2013). In Canada, the auxiliary water supply can include water from any natural source such as well, lake, spring, stream or harbour provided it meets requirements for potability. Some non-potable sources also include storm retention ponds as secondary supplies. In Western Australia, rivers, lakes and the sea may be used to provide water for firefighting. However, they require consent from the department with regulatory powers over the water body prior to use (Department of Fire & Emergency Services, 2017). A limitation of using seawater with good vehicle access is required such as a boat ramp and in shallow areas this option can be restricted to high tide only. As previously noted, New Zealand legislation allows all these sources to be used. The RMA specifically excludes emergencies from water take rules.
Rainwater tanks	A large tank filled from the roof of a home or outbuilding can provide storage for fire protection. In Victoria, Australia, a static water supply required for fire protection can be stored in a separate water tank or as a reserve supply in a larger water tank providing domestic water, or stock drinking water, with the required minimum volume stored between the two outlets, as required according to property size.

Source type	Referenced examples
Flexible tanks (bladders)	Self-supporting flexible tanks, (pillow-tanks or bladders), that expand up to 1.5m high are supplied throughout Europe by Lebarrone-Citaf as a solution for uses in mining, agriculture and fire protection. They are made of a polyester mesh coated with UV treated PVC and UV treated, and requiring simply rolling out on top of a 100mm horizontal bed of sand[5]. Storage capacities vary from 1,000 litres to 2,000m^3. A 180m^3 bladder requires an area of approximately 150m^2 (approx. 10 x 15m). There are other flexible tank manufacturers and suppliers in other countries, including Australia[6], China, France, UK and New Zealand[7], for example. As the design life of 10 years is advertised by some manufacturers, likely suiting less permanent applications.
Rural fire protection tanks	A range of water storage solutions made of plastic, fiberglass and steel are available in the market and offer target emergency water storage specifically by providing standard fire-hose outlet kits. In New Zealand, Greentank supplies a fiberglass underground water supply storage tank and promotes applications in fire protection, including commercial fire sprinkler systems[8]. Devan[9] manufactures plastic fire tanks with capacities between 15m^3 and 30m^3. In Australia, Kingspan[10] supplies steel tanks for fire protection with capacities between 26m^3 and 360m^3.
Cisterns	Cisterns generally refer to a publicly stored underground water tanks for the provision of fighting fires, especially in areas with water scarcity or where water supplies may be impacted by natural disasters. For example, in the Imperial National Wildlife refuge in Arizona, there is an underground cistern with a capacity of 100,000 litres and, similarly, in Maryland. In Missouri local firefighting services house large underground cisterns to provide water for firefighting. Cisterns can provide emergency water storage from rain water and greywater.

[5] https://www.labaronne-citaf.com/storage-applications/fire-fighting-storage/

[6] https://www.flexibladder.com.au/

[7] https://www.flexitanksnz.com/page/water/

[8] https://www.greentank.co.nz/fire-protection-water-tanks/

[9] https://www.devan.co.nz/product-category/tanks/fire-tanks/

[10] https://www.kingspan.com/au/en-au/products-brands/water-management-solutions/water-tanks/fire-water-tanks/rhino-rural-fire-tanks

Source type	Referenced examples
Grey water/recovered water	An example of the use of grey water is in Hong Kong. The Government has developed pilot schemes to explore the possible uses of reclaimed water for applications including: • Cleaning roads and vehicles • Irrigating parks and sport fields • Flushing toilets • Fire fighting • Industrial production • Urban development and landscaping where there is provision within the current codes for use and reuse of grey water to fight fires, provided it has undergone sufficient treatment.

4.1 Alternate Water Sources in Urban Areas

A paradigmatic example in urban areas is San Francisco's 19th century cistern system which was designed to store firefighting water in response to a series of large fires in the early 1850's. It was supplemented over the years and currently there are some 170 cisterns around the city operated by the municipal utilities company[11]. Of particular note are three large cisterns built after the 1906 earthquake after which resulting fire burnt a large part of the town. They are interconnected, operated by gravity and independent from the domestic water supply system. They provide a combined emergency storage of 4.5million litres available in the event breakages of the reticulated mains, such as during earthquakes Feeding pump stations can draw saltwater from the San Francisco Bay, for an 'unlimited supply' of water.

4.2 Alternate water sources in rural and peri-urban areas

Of note is that this review found no evidence of references in literature to multipurpose water storage solutions for large multi-lot urban or peri-urban developments. For rural areas, there are products in the market advertised online as solutions for permanent storage of water for protecting forests and properties from bush fires.

In bushfire prone areas of Australia, it is mandatory for homeowners to have a supply of water dedicated for fire-fighting purposes. The amount of water required varies between local council jurisdictions. For example, in Victoria, a static water supply must be provided on the property for fire-fighting purposes for any single new dwelling or renovations associated with an existing single dwelling located in a Bushfire Management Overlay.[12]

Every property needs to have either a fire hydrant attached to a reticulated water system serving the property, and/or an alternative static water supply dedicated to fire-fighting purposes, and this needs to be clearly marked as such so that fire-fighters can find it quickly in an emergency.

[11] http://www.waterworks.io/cistern_map/

Water storage requirements are based on property size and range from a minimum of 2.5m^3 for a small property (less than 500 square metres) to a minimum of 20m^3 litres for rural properties exceeding 1 hectare in size. For large and high hazard sites, elevated water storage tanks connected to a pressurised hydrant system are recommended.

Ideally a fire tanker can quickly drive up to a water source, fill its tank, then return to the fire. Access to nearby streams, ponds, wells or even swimming pools can allow firefighters to quickly refill the tanks and get back to fighting the fire.

Fire tankers range from pickup trucks with 350 to 550 litre tanks, with pumps and hoses, to fire engines or water tenders that carry from 900 to 4,500 litres or more. A hard, durable-surface road that can get the tanker close enough to the water source to reach it with a 4m long drafting hose is preferred. Some trucks carry portable pumps, allowing them to pump from a water source up to 50 m away, but that is much more time-consuming and less desirable.

Chandler (2017)[13] addresses shuttle operations in detail noting this is a necessary tactical response to firefighting in remote locations but demands significant resources between training, risk management, crew and fire services vehicles required .

Chandler's discussion highlights remotely powered Floating Source Pumps (FSP's) can provide high flowrates and allow use of difficult to access water sources such as rivers or lower elevation ponds to reduce the manpower and service vehicle requirements. It states:

> *The use of composite materials and modern designs mean an FSP can weigh less than 34kg and can provide fireflows of 7,500 lpm, which means they can be carried and placed into a water source by a single firefighter within 3-5 minutes, resembling a floating hydrant.*

A minimum water depth of 500 mm is required to achieve buoyancy and maintain proper operation of FSP's. Besides their primary benefit of allowing true access to natural water sources, Chandler notes employing FSP's can significantly reduce firefighting man-power required when used in in conjunction with primary response appliances and in shuttle operations.

4.3 Suitability Considerations of Non-Potable Water Sources

References cited discuss feasibility considerations, access and other requirements for using natural and man-made sources of water for firefighting aside from potable water supply sources.

Security required in firefighting water supplies means there are chief considerations required around the practicalities of the use of non-potable sources. This includes consideration of the capacity of the source to supply flow requirements all year round, and how it will be accessed, as well as water quality.

When considering the use of alternative water supplies, a hierarchy of preferred sources should be formed. For example, in Western Australia, fire districts may have a range of water supply systems; reticulated system, rural supply tank, or a stand-alone tank using rainwater or a bore. (Water Corporation, 2014). Guidance issued for property owners in rural areas by the University of Ohio, for

[13] Chandler, K. (2017). The rural supply challenge. International Firefighter (06/12/2017) https://iffmag.mdmpublishing.com/the-rural-water-supply-challenge/ (last accessed 30 June 2020).

example, set out minimum flow rate requirements from non-reticulated sources and specifications for access.

Specifications for the maximum distance to the source from a hardstand suitable for firefighting vehicles and descriptions of permanent suction pipeline works and hydrant and hose couplings required for connecting pumps (fixed pumpsets) are also common.

Other aspects to consider include:

- All-weather road access within 20-50 m of the water source.
- Provision for vehicle turnaround area close to the water source.
- Road grades
- Signage indicating the location of the water source.

Davis (2002) addresses the factoring of accessibility and reliability aspects when assessing the suitability of sources by considering:

- The provision of fire service couplings on tanked supplies, preferable flooded;
- Fixed draughting pipes for ponds, lakes and dam supplies; and,
- The avoidance of turn around or time delaying manoeuvres for vehicular access.

Water quality is an important decider of whether to use non potable water sources. The health and safety of firefighters and any contamination that could affect the effective capabilities of a firefighting brigade are key considerations.

For example, in guidelines issued by the Department of Fire & Emergency Services for Western Australia, water quality governs the selection of pump materials and strainers to protect equipment including from corrosive material. Other factors noted as affecting usability of water for firefighting include: pH, iron bacteria, biofouling, biofilm, effluent, E.coli and enterococci, amoebae and surface litter[14].

Managing the discharge of firefighting water is also important. In Utah, fire fighters are not allowed to discharge firefighting water that is from non-potable water systems, has added chemicals or materials, and the water must be retained[15]. In Canada, firefighting activities should be performed in a manner that minimises or avoids discharges to the storm drain system.

Compared with other guidance specifications and standards reviewed, it is noted the current CoP addresses firefighting water requirements and criteria for non-potable water sources comprehensively and in sufficient detail.

For example, in addition to the above considerations, other items specifically addressed in the current CoP include:

[14] Department of Fire & Emergency Services. (2017). Acceptable sources of water supply for fire hydrant / Sprinkler systems. (Bores, Dams, Rivers, Lakes and Seawater). Perth: Manager Built Environment Branch.

[15] City of St. George. (2015). STORMWATER BMPS: FIREFIGHTING, FIRE TRAINING, AND FIRE SUPPRESSION SYSTEM TESTING ACTIVITIES. St. George: City of St. George.

- Security – this refers to the protection of the water supply from vandalism and tampering, for example by having a locked off valve on the outlet pipe that can be cut with bolt cutters to access
- Visibility – this refers to sources being readily identifiable by responding firefighters by using signs or marker posts.
- Suction limitations for pumps – this refers to the maximum lift that pumps can deliver. It directs to consider establishing fixed static pumps for depths requiring a lift greater than 3m, which is the normal rating of Fire Service pumps.
- Unacceptable quality – this sets a maximum particle size for dispersed solids and unwanted chemical and biological contamination risks.

Other recommendations found in consulted guidance are directed for communities that plan to use alternate sources for fire protection, and include:

- Mapping the location and volume for type of each water supply, describing its accessibility and making this information accessible to the fire alarm dispatcher
- Directing property owners and developers to find detailed requirements for connection fittings that match local fire equipment
- Inspecting water sources regularly, including changes in water level or access to correct any problems.
- providing agreement templates for access water sources located on private property, including inspections.

4.4 Water Volume and Flow Requirements

FENZ funded research recently undertaken by University of Canterbury explored different methods for estimating water requirements for firefighting[16]. This, and prior research available online about approaches for estimating flow and storage requirements shows there is marked variability between the results of relevant methods and direct comparison is difficult[17].

The Fire Protection Research Foundation published a research study that compared different international methods for determining water flow requirements for firefighting, including New

[16] University of Canterbury, Department of Civil and Natural Resources Engineering (2020). Estimating energy release rate from real fires for use in Assessing Firefighting Water Supplies (Report No. 175). University of Canterbury, Christchurch, NZ: Fire and Emergency New Zealand. Last accessed online on 9/03/2020 https://fireandemergency.nz/assets/Documents/Files/Report_175_Assessing_Firefighting_Water_Supplies.pdf

[17] Halabi, B. – GHD Limited (2009) Firefighting innovations and technology – how we can leverage the new technology to improve the efficiency of the firefighting service. Paper presented at the 2009 Water New Zealand Conference. Last accessed online on 9/03/2020 https://www.waternz.org.nz/Article?Action=View&Article_id=930

Zealand's. [18] Nineteen existing firefighting water flow calculation methods were comprared, including methods from US, UK, France, Germany, the Netherlands, New Zealand, and Canada.

Two types of methods were differentiated in the study:

- on-scene calculation methods
- building planning methods

Building planning methods in building or fire code requirements account for a range of variables in determining fire flow (i.e., building construction, occupancy, fire size, etc.). They allow building and community planners to assess developments against the existing or planned water supply and adjust accordingly. The on-scene calculation methods are used by firefighting services and consist of one equation with one variable. This allows the firefighters on scene to assess, on arrival, whether they need more hose lines or appliances to fight the fire.

Both are based on theoretical approaches.

A comparison of flow requirements by country and types of method for sprinklered and non-sprinklered single-family dwellings of 325m^2 and 140m^2 are shown in the figures below.

Examples of flow and storage volume requirements under different methods are discussed in more detail further below.

[18] The Fire Research Foundation, 2014. Evaluation of Fire Flow Methodologies. Quincy, MA. USA

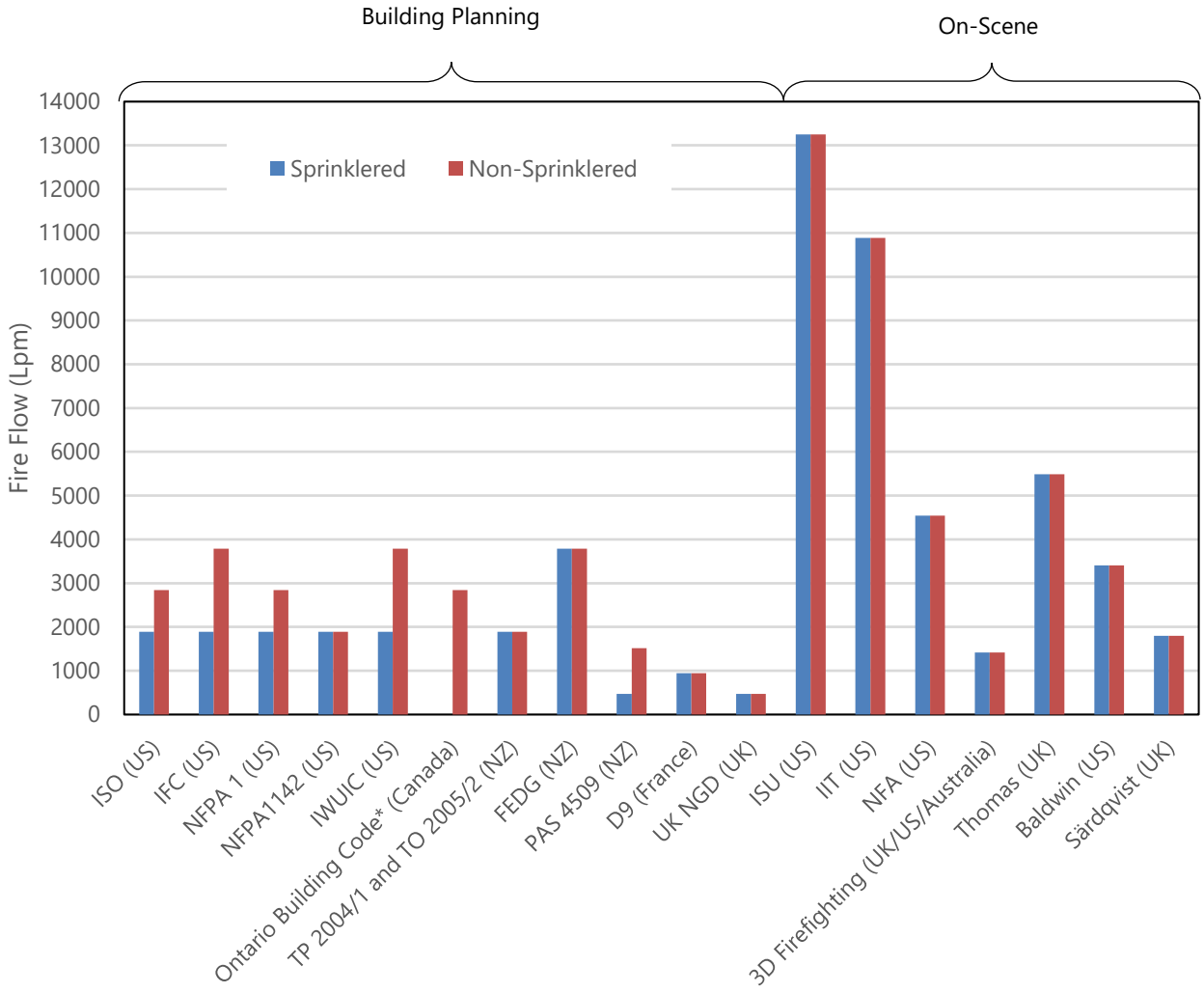

Figure 4: Comparison of flow requirements by different methods for a 325m² single-family dwelling, sprinklered and non-sprinklered (modified from The Fire Protection Research Foundation, 2014)

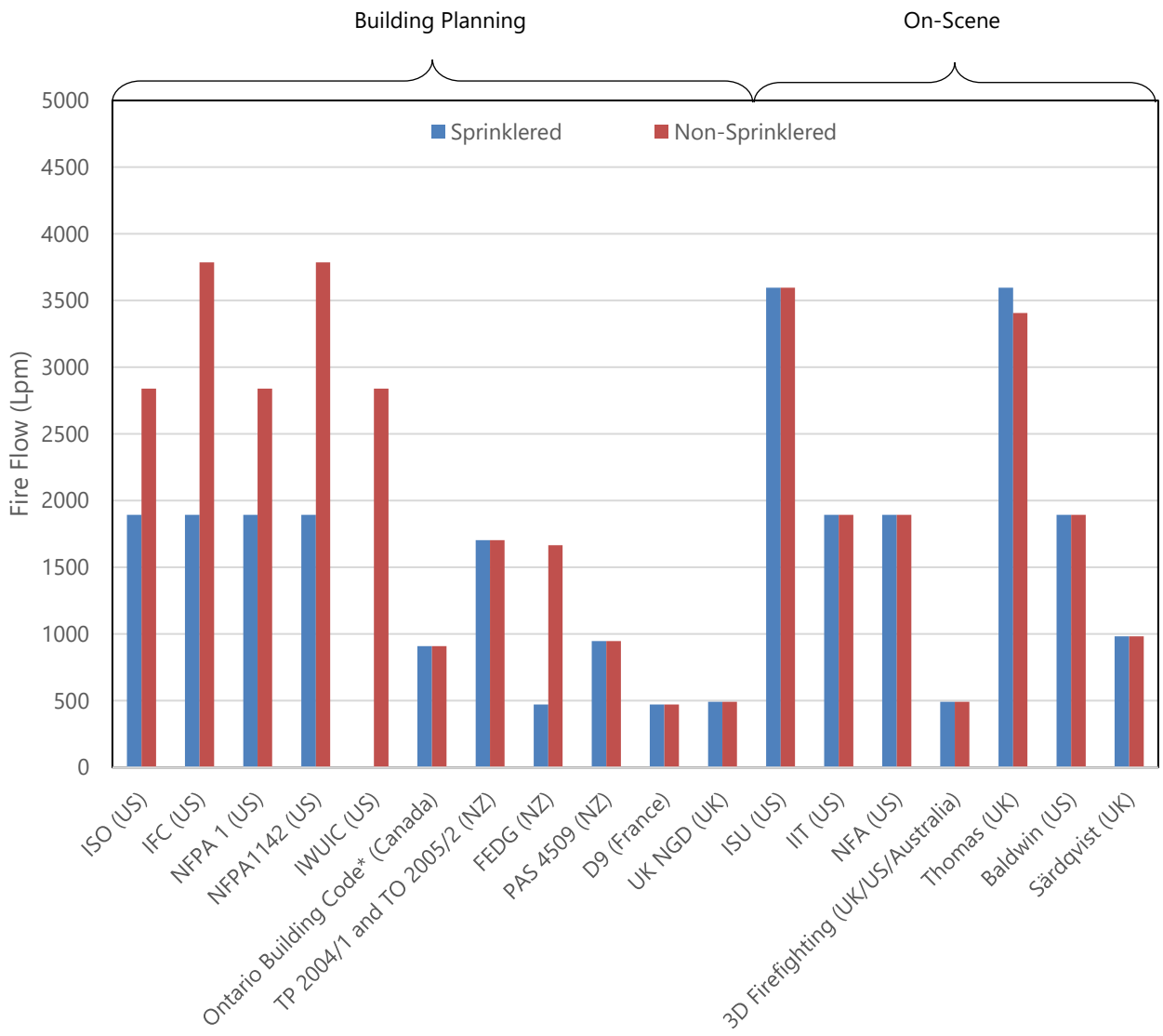

Figure 5: Comparison of flow requirements by different methods for a 140m2 single-family dwelling, sprinklered and non-sprinklered (modified from The Fire Protection Research Foundation, 2014)

As stated on the International Wildland-Urban Interface Code (IWUIC) method, the purpose of the water supply is to provide for initial structural fire attack and exterior flame front control in the Wildland-urban interface zone. The water flow is based on the type of building and floor area and can be reduced for sprinklered buildings by 50%. The water supply required for buildings other than residential must be approved by the authority having jurisdiction, but can be no less than 5,678 lpm for a duration of two-hours.

The figures for residential buildings are shown in Table 3, below.

Table 3: Example of water flow requirements for residential buildings based on the Wildland-Urban Interface Code (IWUIC) method

Type of building	Floor area	Minimum water flow – sprinklered	Minimum water flow – non sprinklered	Minimum duration [min]
Residential dwelling	Up to 335m^2	1895 L/m	3785 L/m	30
Residential dwelling	Greater than 335m^2	2840 L/m	5680 L/m	30

In the United States, minimum water volumes and flowrates are recommended in the National Fire Code published by the National Fire Protection Association (NFPA)[19].

The approach is described in Guidance published by the Ohio State University[20].

Minimum volume and flowrates for adequate fire protection are calculated from an assessment of the structure, activities and occupancies of buildings and construction materials for each community. Local fire companies survey the number, type, construction material, contents, and proximity of structures in a community.

The minimum water supply is calculated from:

- the volume of each structure (in cubic feet),
- its occupancy hazard classification, and
- its construction classification.

Minimum water supply values increase as the buildings are closer together as, the risk of a fire spreading increases. The values increase by 1.5 times if structures are closer than 15m apart.

[19] National Fire Protection Association, 2012. NFPA 1, Fire Code. Quincy, MA. USA

[20] Nye, T., Mancl. K., Water Sources for Fire Protection in Small Communities. Extension Fact Sheet Food, Agricultural and Biological Engineering Ohio State University Extension. Columbus, OH. USA

Table 4, below, shows an example of the resulting storage volumes for recommended water flows relative to structure separation distance.

Table 4: Storage Volumes for Recommended Water Flows Relative to Structure Separation Distance (NFPA method)

Structure Separation	Minimum Water Flow (per stream)	Minimum Duration (min)	Equivalent Storage Volume (m^3)
more than 30 m	1890 L/min (32L/s)	60	113m^3
10 to 30 m	2840 L/min (47 L/s)	60	170m^3
less than 10 m	3780 L/min (63 L/s)	60	227m^3

The San Diego County Fire Authority sets out different flows and durations according to the size of the building and separation distance from adjacent property in standards for "Minimum water storage to provide protection for dwellings and other structures where adequate public or private water supply is not available"[21].

Similarly, flow requirements increase as structure separation distances decrease. For example, Table 5, below, shows storage volumes and water flows specified for structure separation over 30 metres.

Table 5: Storage Volumes and Water Flows for Structure Separation Over 30m[22]

Building Footprint	Structure Separation	Minimum Water Flow	Minimum Duration (min)	Equivalent Storage Volume (m^3)
up to 140m^2	Over 30m	950 L/min (15.8L/s)	20	19m^3
Greater than 140m^2	Over 30m	950 L/min (15.8L/s)	40	38m^3

In 2017, NFPA published a method for estimating water requirements in a Standard on Water Supplies for Suburban and Rural Firefighting (NFPA 1142)[23]. This is referenced in the International Fire Code

[21] http://www.wrighttank.com/userfiles/files/water-tank-standards.pdf

[22] modified from San Diego County Fire Authority.

[23] National Fire Protection Association 2017, NFPA 1142: Standard on Water Supplies for Suburban and Rural Fire Fighting. Quincy, MA. USA

(IFC) for areas where adequate and reliable water supply systems do not exist. According to the method in NFPA 1142, the minimum volume required for any structure larger than $9m^2$ must not be less than $7.6m^3$ if located more than 15 metres away from other buildings, and otherwise shall not be less than $11,4m^3$.

NFPA 1142 does not contain the historical basis for the development of the calculation methodology. Burnham discusses the minimum fireflow and volume calculations using the NFPA 1142 in the context of rural supplies[24]. Burnham notes the type of structures most fire departments operations deal with in the United States are single-family dwellings for which their occupational hazard classification and average size result in minimum fireflows between 950 and 1,900 lpm and minimum volumes between 9.5 to $35m^3$.

In New Zealand, the current CoP specifies flow requirements that depend on the fire cell size and a fire hazard category that takes account of the building purpose or activity.

For example, practical water requirements set out in the CoP for reticulated and non-reticulated supplies are summarised in Table 6, below:

Table 6: Practical Water Requirements in Current CoP (NZ)
(modified from Table 2 of SNZ PAS 4509:2008)

	Reticulated water supply	**Non-reticulated water supply**	
	Required water flow within 135 m and maximum number of flow streams (hydrants)	**Minimum water storage within 90 m**	
		Duration (min)	**Volume [m^3]**
Dwellings with sprinklers	450 L/min (7.5 L/s), up to 1 stream	15	7
Residential and other low risk structures	750 L/min (12.5 L/s), up to 2 streams	30	45
Low risk buildings with automated sprinklers	1500L/min (25 L/s), up to 3 streams	60	180
Low - medium risk fire hazards	3000 L/min (50 L/s), up to 4 streams	90	540

[24] James Burnham, J. 2018. Rethinking Rural Water Supplies. Fire Apparatus**,** Vol 23 (6), 6.1.18

Med – high risk fire hazards	4500 L/min (75 L/s), up to 6 streams	120	1080
High risk fire hazards	6000 L/min (100L/s), up to 8 streams	180	2160

Of note is that NZS 4541:2013 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[25].

Notably, identified research highlights there is no available data of actual water use during fire incidents and that anecdotal evidence suggests that a markedly lesser flowrate than that which is made provision for by using theoretical estimates could be needed to fight actual fires, which is acknowledged internationally[26].

We did not find references to studies on actual firefighting water use.

FENZ have taken steps to begin gathering information on actual water use during fire incidents to enable determining water requirements based on this evidence.

As a trial, water meters were installed in six firefighting appliances and have collected data over several years. However, FENZ roughly estimate requiring data from at least 60 vehicles. FENZ acknowledge this as a long-term strategy given the long timeframe over which data can become meaningful for developing a solid evidence-based approach to determine water requirements. At this stage, there are no initial inferences that can be made from this data logging trial and no decision to expand this has been made.

4.5 Wildfire planning and protection in Australia and United States

Wildfire risk is a critical issue. In Australia, 2019 was the warmest and driest year on record. Excacerbating drought conditions that began in the eastern states in early 2017 spread across the country and contributed to one of the worst bushfire seasons on record.

In February 2020, the Reserve Bank of Australia estimated the direct effects of the recent bushfires could to reduce GDP growth by around 0.2 percentage points between December 2019 and March 2020[27].

[25] NZS 4541:2013– Automatic fire sprinkler systems.

[26] Davis, S. (2000). Fire Fighting Water: A Review of Fire Fighting Water Requirements A New Zealand Perspective. Master of Engineering dissertation, University of Canterbury, Fire Engineering Programme. Last accessed online on 11/03/2020 https://ir.canterbury.ac.nz/bitstream/handle/10092/8346/davis_fire_research-00-3.pdf?sequence=1&isAllowed=y

[27] Reserve Bank of Australia. 2020. Statement on Monetary Policy – February 2020 https://www.rba.gov.au/publications/smp/2020/feb/box-b-macroeconomic-effects-of-the-drought-and-bushfires.html#:~:text=Macroeconomic%20Effects%20of%20the%20Drought%20and%20Bushfires,-

Discussing community wildfire planning and design policies and practices in the Western United States, Klein (2017)[28] establishes that community decisions allowing development adjacent to wildfire prone areas affect larger economic, social and environmental risks as managing these areas is complex and costly.

Klein raises that planners and designers have a key role to play in managing the risks of development in wildfire prone areas by incorporating fire protection into land-use plans and guiding new community construction using best practices and development standards. This, in recognition that household preparedness, fuel treatments and fire prevention methods only go so far. Klein highlights also that landscape architects can contribute to community resilience to wildfire and, citing others, promotes policies and design that can reduce sprawl and fragmentation in favour of compact development with fire-resistant landscapes and building materials as some of the strategies that can be employed.

4.5.1 guidance for property owners and developers

In addition to fire code, standards and building legislation requirements, guidance is provided in wildfire prone areas to assist residents in preparing for bushfire is available through bushfire survival plan booklets and planning templates.

For example, in Australia, although importance authorities place on water in household preparedness is inconsistent, they are consistent on the importance of residents preparing to stay and defend or to leave early.

Wilkinson and Eriksen (2015) [29] cite that emergency services in Victoria, Western Australia and Tasmania provide comprehensive advice in relation to water and preparedness with clear explanations of:

1. Why residents need an independent water supply,
2. What constitutes an independent water supply,
3. How water can be accessed, and
4. What measures can improve the integrity of the water supply during a bushfire.

The provision of a dedicated or static water supply is essential in areas that are not serviced by reticulated water supplies. The stipulated amount of water required is determined on the basis of lot sizes and density of development.

Most%20of%20Australia&text=The%20direct%20effects%20of%20the,is%20uncertainty%20around%20this%20estimate. (last accessed 30 June 2020).

[28] C. Klein, Carlene 2017. Community Wildfire Planning and Design: A Review and Evaluation of Current Policies and Practices in the Western United States. Utah State University. Masters Thesis 12-2017.

[29] Wilkinson, C. & Eriksen, C. (2015). Fire, water and everyday life: bushfire and household defence in a changing climate. Fire Safety Journal, 78 102-110.

While installing an independent water supply is a legislative requirement for new development, there is different criteria authorities apply on the actual quantity of water deemed necessary for a household to be considered well-prepared for bushfire (Wilkinson and Ericksen, 2015).

In Victoria, for example, planning regulations mean properties between 500m^2 and 1000m^2 in bushfire prone areas must provide a volume of 5m^3 litres of water if a hydrant within 120 m of the rear of the building is available. Otherwise, a volume of 10m^3 litres and suitable access to fire fighting vehicles must be provided. Fittings required to connect local fire authority equipment must be installed.

The New South Wales Fire Service has published guidance on planning for bush fire protection setting out minimum requirements to be met by static water supplies for non-reticulated developments or where reticulated water cannot be guaranteed[30].

The requirements according to lot area for single dwelling and multi-dwelling residential lots are reproduced in Table 7, below.

Table 7: Water supply requirements for non-reticulated developments or where reticulated water supply cannot be guaranteed (NSW Fire Services 2019)

Development type (Area)	Water volume required
Residential lots (<1,000m^2)	5,000L/lot
Rural-residential lots (1,000-10,000m^2)	10,000L/lot
Large rural/lifestyle lots (>10,000m^2)	20,000L/lot
Multi-dwelling housing (including dual occupancies)	5,000L/dwelling

[30] NSW Rural Fire Service, 2019. Planning for Bush Fire Protection : A guide for councils, planners, fire authorities and developers. https://www.rfs.nsw.gov.au/plan-and-prepare/building-in-a-bush-fire-area/planning-for-bush-fire-protection (last accessed 30 June 2020)

5. Information Management and Sharing

Research findings indicate that better gathering and sharing information would help develop an evidence-based approach to better determine water supply requirements, as well as to consider supplementary fire control strategies in conjunction with key stakeholders.

Exploring approaches and tools for systemising data capture from actual operations and sharing this information with other key stakeholders is needed to develop evidence-based approaches to determine water requirements for firefighting.

- What approaches and tools are being used or could be used to improve and share information with stakeholders to develop evidence-based approaches to determine water requirements for firefighting?

Information management and sharing is essential to FENZ's functions and goals.

FENZ have a strategic priority '*to make intelligence-led, evidence-based decisions and manage our readiness, reduction, response and recovery activities*' [31].

Attending calls as quickly and efficiently as possible is central to FENZ functions. Mobilisation procedures are critical for FENZ to achieve its goals and manage risks to life, property and the environment.

To effectively mobilise to respond to an emergency, readily accessible and reliable information is required.

FENZ main goals are:

- Reducing the incidence of unwanted fires and the associated risk to life and property, and
- Protecting and preserving life, and preventing or limiting injury, damage to property, land and the environment

FENZ main functions include:

- Promoting fire safety
- Providing fire prevention, response and suppression services
- Providing safety during hazardous substances incidents
- Assisting transport accidents
- Urban search and rescue

FENZ also have capability to respond to medical emergencies, maritime incidents, natural hazard events and disasters, and other incidents, including performing rescues.

[31] Fire and Emergency New Zealand 2019. Our National Strategy 2019–2045 Te rautaki matua ā-tari 2019–2045

There are multiple benefits of using a low-cost GIS portal to share and maintain updated information online to work collaboratively with consent authorities. These include:

- Publishing fire safety systems information, including to promote the benefits of installing fire-sprinklers
- Allowing fire services and communities to locate, categorise and publish non-potable water sources of firefighting water, in addition to identifying reticulated sources i.e. fire-hydrants.
- Enabling consent authorities update records where water sources for firefighting are provided through new development (for example raintanks),
- Sharing fire hydrant test results with when undertaken as part of a resource consent application or other capacity verifications.
- Enabling to publish and maintain updated Local Fire Plans to strengthen direction in the CoP implementation.

5.1.1 FENZ's GIS System

FENZ have in place a spatial database and GIS system that enables them to record calls, follow up incident reports and update incidents from the field. FENZ share information with NZ Police. All commercial buildings with sprinkler systems must include detection systems connected directly to a fire service communications centre, and many buildings with only smoke/heat detection systems are connected also. New Zealand is covered by three communications centres operating seamlessly as a single system[32].

As a key feature, the system shows natural drainage catchments to help fire brigades to proactively manage firefighting water runoff during emergency incidents. Other information that FENZ manage specific to mobilising fire brigades includes equipment inventories, personnel rosters, the status of appliances and incident reports.

Currently, access to the GIS system is provided at relevant firefighting stations and command centres, and command trucks. This means local fire-brigades must undertake a desktop consultation of the system at their departing facility when responding to incidents. The mobilisation to incident sites is steered with support of a mobile phone with standard GIS navigation software, such as Google Maps. However, FENZ's ongoing Mobility program is expected to provide firefighting appliances (trucks) with online access to their system within the next 2 to 3 years, via a portable device (such as a tablet) and a GIS application.

5.1.2 Incident Data

FENZ's fire services have the sole responsibility for emergency response to building fires in New Zealand. Incident reports record ex-post data about the location, timing and nature of the incident that triggered

[32] Neil Challands, N. (2009) New Zealand Fire Service, Wellington, New Zealand. Fire Technology, 46, 665–676, 2010 Springer Science+Business Media, LLC. USA

a response and can be updated with information by mobilised teams attending relevant incidents. Data fields include: Incident number; Date and time; Location; Duration; Station; and, Result.

FENZ routinely collects data on the apparent state of the fire at the time of arrival of the first pump capable fire appliance. Structure fires are classified as either: Out on arrival; No fire or smoke; Smoke only; Small fire; Large fire; Totally involved fire; Not known. FENZ publish online the incident records for the last seven days by geographic area.

5.1.3 Building Fire Data

Challands (2009), records that New Zealand experiences about 5,500 building fires each year, based on data for approximately 27,500 fires in structures over the period from July 2003 to June 2008[33].

A review of FENZ's national summaries of incident data for the period 2010 to 2020 shows a declining trend in building fire incidents to an average under 5,000 building fires per year. About 16% of building fires are Rural.

The 2010-2020 data is shown in **Figure 7**, below.

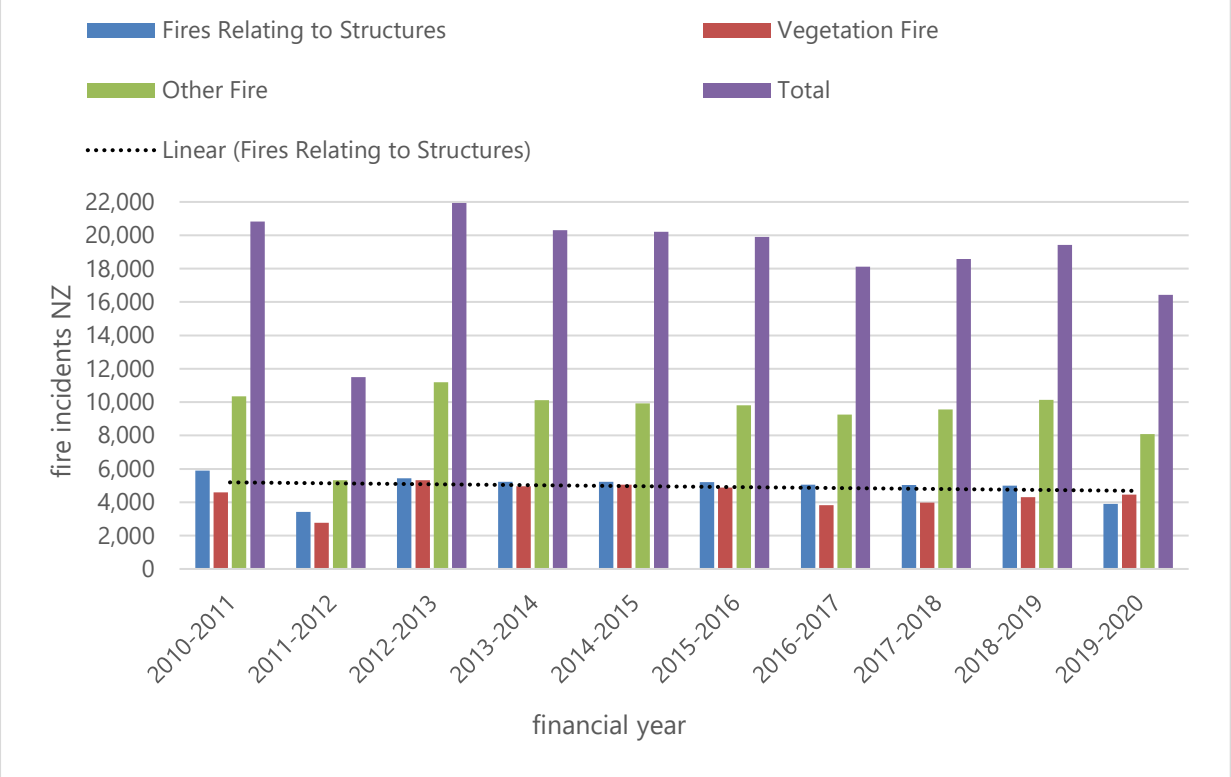

Figure 6: All Fires Distribution by Type for the period 2010 – 2020 showing a declining trend for building fire incidents

[33] Neil Challands, N. (2009) New Zealand Fire Service, Wellington, New Zealand. Fire Technology, 46, 665–676, 2010 Springer Science+Business Media, LLC. USA

Based on data of 205,822 fires in the period 2009-2020, the average annual distribution of Fires per Type in Rural and Urban Fire Incidents is shown in Figure 8, below.

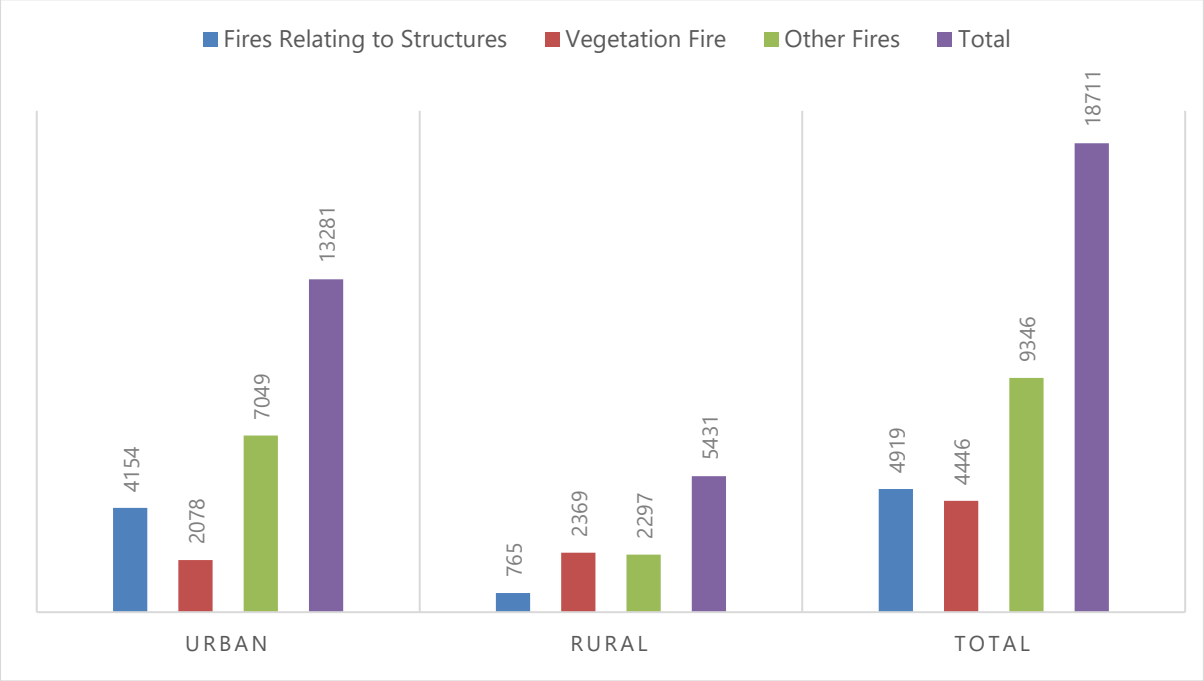

Figure 7: Average Distribution of All Fires Per Type in Rural and Urban Fire Incident data 2009 - 2020

Figure 9 below, shows fires relating to structures with or without damage for the 2009-2020 period, using annual averages.

Notably, the data shows there are between 1.9 to 2.3 building fires with damage for every building fire without damage in Rural incidents any year.

In turn, for Urban incidents, this relationship markedly lower, ranging between 0.76 to 1 building fires with damage for every building fire without damage any year.

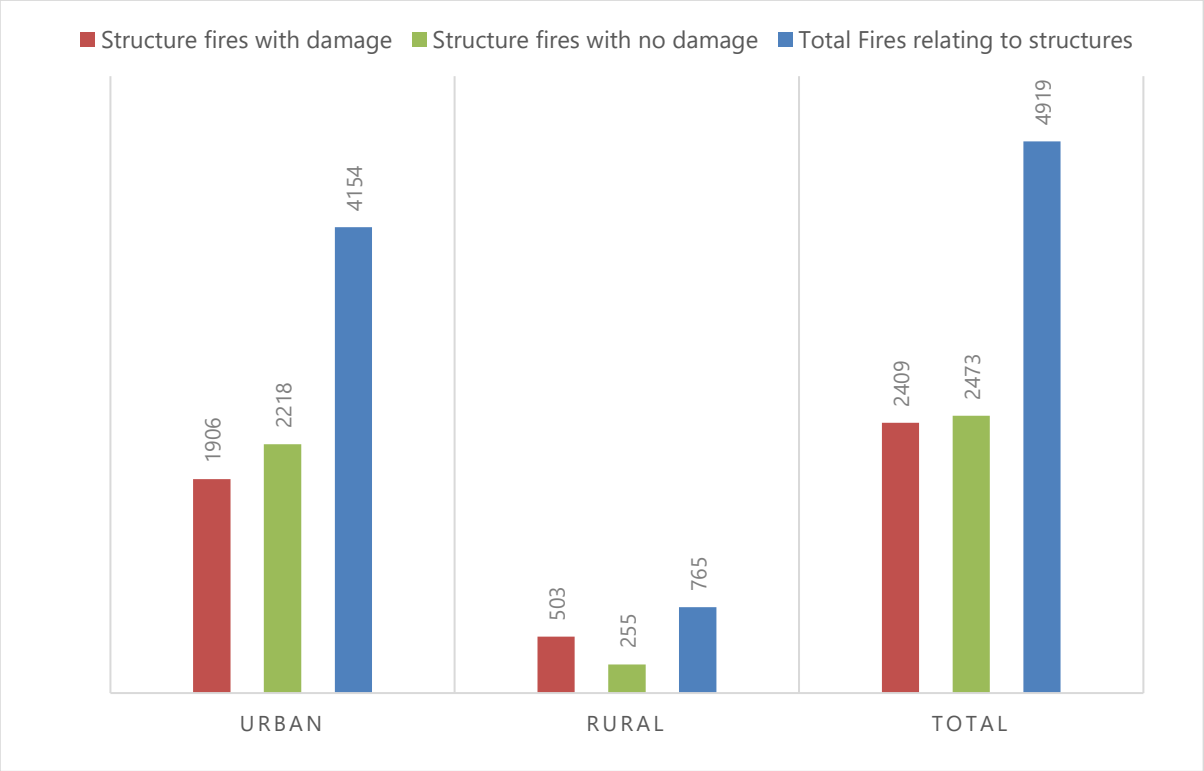

Figure 8: Average Distribution of Fires Relating to Structures in Rural, Urban Fire Incidents (2009 - 2020)

5.1.4 Firefighting Water Sources Geospatial Information

To access water sources quickly and efficiently, they must be documented so that responding units can locate the sources and know how to draw from them. FENZ keep up to date information about water supply networks and receive regular updates to their GIS maps from councils' asset management systems.

In reticulated areas, the asset id number for each hydrant is supplied so fire brigades can identify them in the network. Fire brigade personnel can also log maintenance calls according to established protocols with water services providers. Current service level agreements in place mean that councils supply updated information to FENZ every 6 months.

FENZ have done some investigative work into alternate water sources available for firefighting. Fire brigades assessed the availability of non-potable sources of firefighting water in a coastal settlement with limited reticulated supplies at the north of Auckland[34]. There are only two hydrant locations from reticulated water supplies in Mangawhai. A pilot study in 2014 identified 200 possible water sources for firefighting in and around Mangawhai.

Fire-brigade personnel identified other local water supplies that could be used in an emergency and classified these by type, volume and access. FENZ identified tanks between 15m^3– 50m^3 fed by rainwater

[34] Zeidler, B., Geiger, M. 2014. Fire Engineering Unit, New Zealand Fire Service, February 2014 (Draft). Report on fire-fighting water supply in Mangawhai, NZ

located in private properties, provided a tanker truck could be filled at a close distance from the tank using a pump since access was assessed unsuitable for firefighting appliances.

Other alternate sources identified where access for firefighting appliances could allow drawing water, were streams and locations by the sea (such as boat ramps). A handbook to locate those identified firefighting water sources with maps and a spreadsheet was produced for the local fire brigades.

The study highlighted potential delays in operations relying on filling and transporting water in tanker trucks due to the time and manpower anticipated to be involved. It raised the need to consider a suitable pump equipment noting portable pumps FENZ commonly use, as many other portable pumps, are unsuitable for drawing from a tank or elevated water source. Also, the report notes as the survey was undertaken in summer, most tanks had little water.

A more comprehensive identification of non-potable firefighting water sources using means to keep updated and share this information online seems warranted given their strategic importance to communities, fire service and property owners.

Figure 9, below, shows sample images of maps produced with non-potable water sources surveyed.

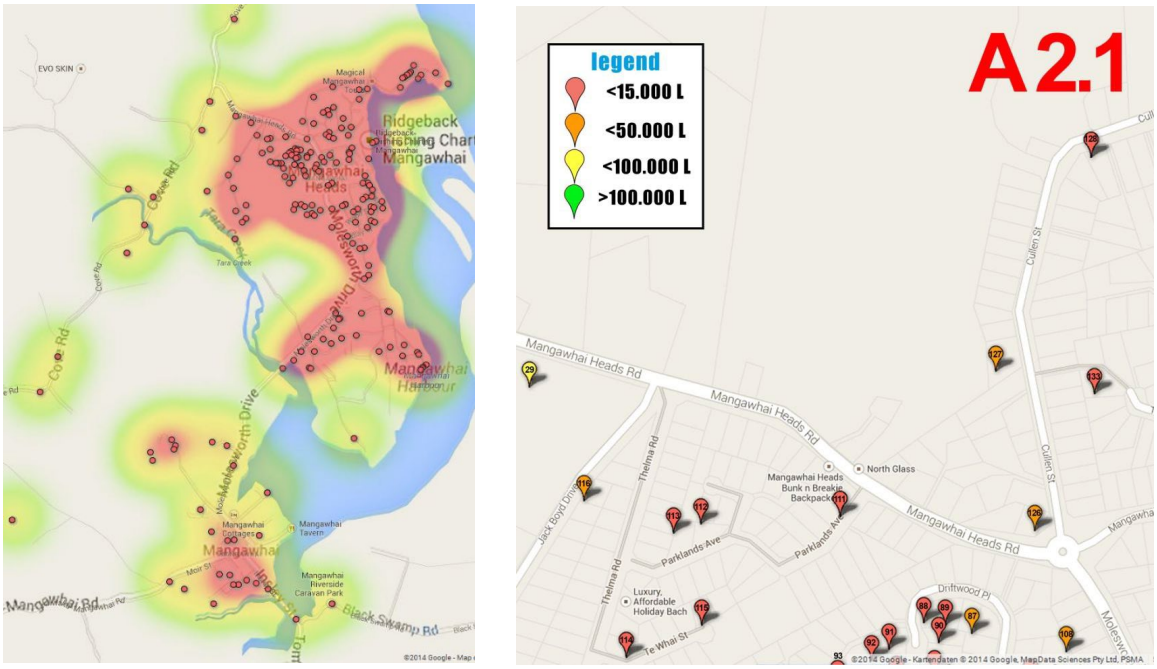

Figure 9: Images of Maps Produced with Non-Potable Water Sources Surveyed in Mangawhai (Zeidler, B., Geiger, M. 2014).

6. Other technology developments

It is important to note that available research also highlights that having more water available does not necessarily reduce, better control or eliminate fire risks[35]. There are other operational strategies, technology developments and controls that can optimise water requirements for firefighting.

- What innovation in fire safety systems, firefighting technologies, planning controls or building design warrant wider recognition by relevant stakeholders in terms of their benefits in optimising the use of water for firefighting.

6.1 The Case for Monitored Alarms and Automated Sprinklers

Sprinklers and alarm systems are the primary way to improve the effectiveness of firefighting. Challands (2009) studied the relationships between fire service response time and fire outcomes in New Zealand, measuring the influence of fire service response on building fire development[36]. He found a clear correlation between response time of fire services and the amount of structural damage. The study highlighted the benefits of monitored fire alarms and sprinklers. It established the cost of structural damage increases at the rate of approximately NZ$4 thousand per fire per minute of response time and concluded monitored fire detection systems reduce the damage by two-thirds when there is a quick fire service response.

A study prepared for The Fire Protection Research Foundation (2012)[37] considered standard estimates of the amount of water expected to be used in various building types with and without automatic sprinkler protection during a fire. It also estimated the water used per year for commissioning, inspection, testing and maintenance of buildings with systems for each building type.

It showed that in all scenarios studied, the calculated water used during a fire when a building has a sprinkler system is less than that of a building without sprinklers. For example, it found in typical single and duplex dwellings, the fire water used for sprinklered buildings is between 4 and 10% of the fire water used for unsprinklered buildings.

Sprinklered apartment buildings were estimated to use approximately 30% of the fire water used by unsprinklered apartment buildings.

[35] Halabi, B. – GHD Limited (2009) Firefighting innovations and technology – how we can leverage the new technology to improve the efficiency of the fire fighting service. Paper presented at the 2009 Water New Zealand Conference. Last accessed online on 9/03/2020 https://www.waternz.org.nz/Article?Action=View&Article_id=930

[36] Neil Challands, N. (2009) New Zealand Fire Service, Wellington, New Zealand. Fire Technology, 46, 665–676, 2010 Springer Science+Business Media, LLC. USA

[37] Code Consultants Inc. (2012) Fire Flow Water Consumption in Sprinklered and Unsprinklered Buildings: An Assessment of Community Impacts

Further, the study indicates that, in most scenarios, water used during a fire in a building without sprinklers exceeded the total water used in an otherwise similar building with sprinklers for, both, commissioning-inspection-testing-maintenance and a fire condition.

This was based on estimates to code standards based on the IFC[38] and NFPA 1[39] flow requirements for both sprinklered and unsprinklered buildings, and not on actual firefighting water used.

According to this study, the required flow for a building protected with a sprinkler system is typically permitted to be reduced by 50% for single and duplex dwellings. This is a key assumption.

6.2 Geospatial platforms for online collaboration and information sharing

Of note concerning information sharing and are the features of online GIS portals that plug with existing back-end databases including asset-management software. Users can consult and edit information and view related maps simultaneously thereby minimising written content and maximising visual content.

Public publishing and managing editing permissions is possible. Visualisation features and integration with mobile data collection products enable to quickly share and communicate information and enhance coordinated efforts.

Given these capabilities, online geospatial platforms are seen as a helpful tool to enhance collaboration with councils in the CoP implementation and identifying firefighting water sources, enabling FENZ and councils to exchange and maintain updated information on new sources and assessments.

There is evidence of such geospatial tools being used in this context also for developing regional strategies and policy, preparing tactical fire plans, improving response, developing mitigation procedures, for example[40].

Noting these benefits is of relevance to FENZ's requirement to issue Local Fire Plans and relevant fire protection policy. For example, the ability to show available sources, access and seasonal restrictions for use by firefighting brigades when responding to incidents, as well by consenting planners and communities.

As an example of their display capabilities, a StoryMap is an interactive web-based application designed to display text and maps or graphics side by side. Scrolling through the text automatically updates the maps or media content which provides enriched information. The user is also able to interrogate the maps by zooming in and out and bringing up attribute information by clicking on map features. StoryMaps has proven to be an effective communication tool for online access, information sharing and for use in workshops.

An example is the Richmond Catchment Management Plan prepared by Morphum Environmental Ltd for Tasman District Council and illustrated in Figure 10.

[38] International Code Council, International Fire Code. Country Club Hills, IL: International Code Council, Inc., 2012.

[39] National Fire Protection Association, NFPA 1, Fire Code. Quincy, MA: National Fire Protection Association, 2012.

[40] https://www.esri.com/news/arcuser/0100/firetools.html

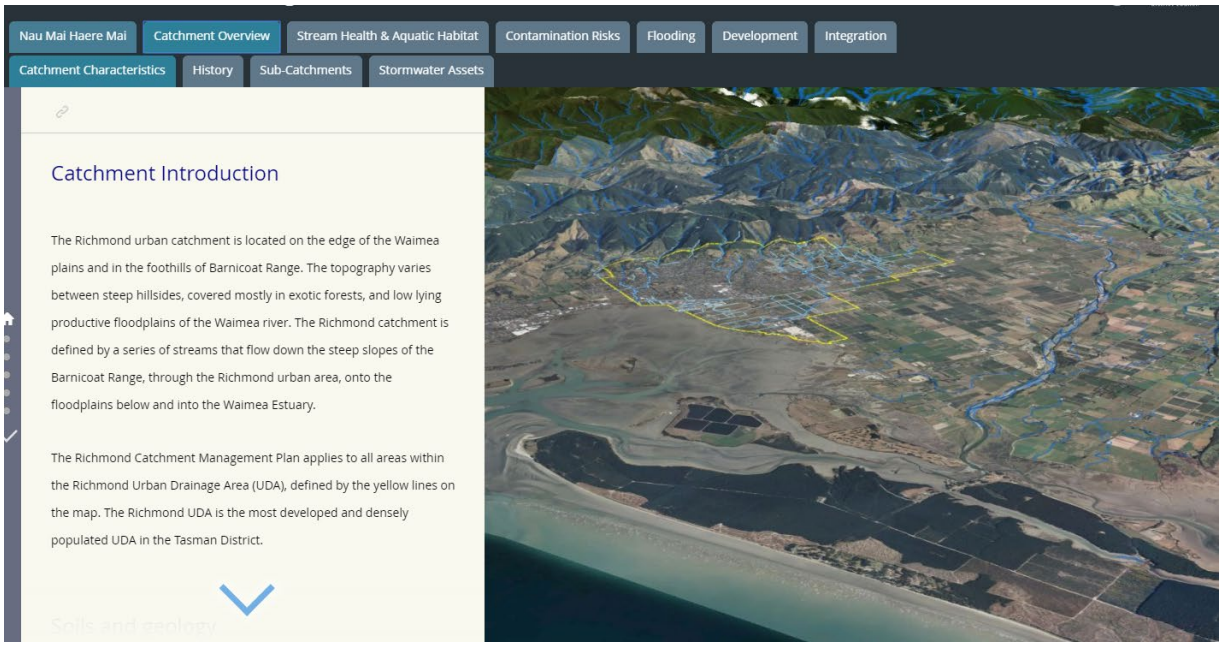

Figure 10: ESRI StoryMap Created by Morphum Environmental for Tasman District Council.[41]

This StoryMap can be accessed here:
https://tdc.maps.arcgis.com/apps/MapSeries/index.html?appid=ea92237d9c8446caa391e55061cc879d.

[41] https://tdc.maps.arcgis.com/apps/MapSeries/index.html?appid=ea92237d9c8446caa391e55061cc879d.

6.3 Firefighting technologies

Table 7 below, outlines firefighting technology developments that can assist with efficient and effective firefighting.

Table 8: Other Developments in Firefighting Technology

Innovations	Description
Compressed Air Foam	Compressed air foam combines an agent which reduces the surface tension of water (surfactant) and compressed air to produce an expanded volume of extinguishing agent. CAFS are often used in conditions where firefighting water is not readily available, such as on ships that cannot use seawater to fight fire or in warehouse storage This has shown promise in regions where water is scarce in an urban environment. In United States – the US Fire Administration have investigated the applicability of compressed air foam for fighting interior fires in Massachusetts. Studies of environmental conditions at Whidbey Island, Washington where a Navy base had used a CAFS showed high groundwater levels of contaminants such as PFOS at levels more than 54 times the safety standard of the USEPA and the environmental contamination is one of the potential disadvantages of compressed air foam.
Water Additives	Similar to compressed air foam, water additives such as surfactants can be used to reduce the surface tension of water, forming an aqueous film which can form a barrier between fire and its fuel source. They can also generate less effective foams, aqueous film-forming foams (AFFF). Whilst it performs well in reducing requirements and the decrease in surface tension can allow water to flow faster, it is less effective than adding a surfactant to a foam producing mixture. In some cases, where water additives have been used, groundwater levels of fluorinated surfactants have increased. However, little is known about the occurrence, transport, biodegradation and toxicity of fluorinated surfactants in the environment, from both surfactant water sources and compressed air foam sources.
Thermal Imaging Cameras	Thermal imaging cameras are used to locate people in smoky environments or where visibility is low. Potential victims can be located based on their thermal signature and rescued from places where they cannot be seen.
Positive Pressure Ventilation	Positive pressure ventilation uses fans to create a flow throughout a building which removes the smoke in order to support firefighting operations. This does not affect the amount of water required to fight fires but similar to thermal imaging cameras, may increase safety during firefighting.

Innovations	Description
Drones	The ability of drones to quickly reach a vantage point where humans cannot easily get access to allow assessing and monitoring dangerous fires. Drones are sent to fire locations as scouts, using cameras with thermal imaging technology to help first responders in their rescue efforts. Equipment modifications include also: • extinguishing agent takes, including powder, foam, water, or specialized liquids; • mist distributors that spray a cooling mist to let drones and firefighters get closer to a fire; French firefighters used DJI drones to survey the Notre Dame cathedral when it burned in 2019. Currently, approximately 910 state and local police, sheriff, fire, and emergency service agencies in the U.S. have acquired drones, according to a May 2018 report by the Center for the Study of the Drone at Bard College[42]. In China, drones fitted with a water hose from a fire truck, and controlled by a pilot on the ground remotely are being tested in firefighting. In 2020, A firefighting trial for high-rise firefighting drones was held in Dazu, Chongqing[43]. Low battery life and payload limits have meant this application is still in development. However, drones that are fed water and electricity from the ground are already in use in the cleaning of buildings and de-icing of wind turbines, for example[44]. As drone batteries get better allowing them to fly for longer and have heavier payloads their adoption is expected to rise in the next few years.

[42] https://www.roboticsbusinessreview.com/unmanned/firefighting-drones-aim-to-fly-higher-save-lives/
[43] https://www.youtube.com/watch?v=WFqThcMIN7A
[44] https://www.aerones.com/

7. High-level Regulatory and Non-Regulatory Options to Improve CoP Implementation

From a regulatory perspective, it would seem more efficient to have a clear and single origin for regulation about firefighting water supplies. In particular, establishing current availability of suitable water supplies in three-yearly Local Fire Plans to assist community development planning decisions should be considered before investigating further regulatory options.

Nonetheless, any initiative, including the publishing a new CoP only, should involve an education component. At a high level, this would enable understanding the availability and coverage of identified firefighting water sources to raise greater awareness of the problem and help provide adequate solutions in areas where firefighting water supplies are uncertain. At an operational level, this would provide practice guidance and tools for territorial authorities to implement solutions at the right stage in the development process.

The options outlined in Table 8: Regulatory Options to Improve CoP Implementation, below, need further investigation to determine how they could be achieved but initially seem viable.

Table 9: Regulatory Options to Improve CoP Implementation

	Option	Description
1R	**Initiate plan changes to clarify rules in district plans to require firefighting water provision.**	The emphasis in current regulations is on urban water supplies. This gap could be addressed through specific rules in district plans to ensure adequate firefighting measures are implemented when new subdivisions and buildings are developed, including in rural zoned land. A risk-based approach could be taken to encourage fire protection measures to be used. However, rules would not apply to existing areas or sites where no new development or redevelopment is occurring.
2R	**Establish current availability of suitable water supplies in three-yearly Local Fire Plans to assist community development planning decisions**	Under S21 and s22 of FENZ Act 2017, FENZ must undertake local planning and prepare and issue local fire (protection) plans. Local Fire Plans must set out how FENZ will exercise its powers relating to fire control, setting out policy, describing the particular fire risk conditions that exist or are likely to exist in the local area. Establishing the availability or uncertainty of supplies in Local Fire Plans is relevant to establishing risks and doing so would be beneficial also for the role that these can have in improving implementation of the CoP in close collaboration with councils. For example, if Local Fire Plans can be referred to by planners to determine water supply requirements for new developments in areas where reticulated supplies cannot be guaranteed. That is, with an adequate understanding of water sources available locally and water stressed areas. This implies information sharing and, geospatial information potentially, as well as building a common understanding of the legal basis for fire protection policy and its enforcement. Issuing of Local Fire Plans is subject to community consultation, including the public notification of plans and consideration of public submissions. Following the issuing a Local Fire Plan, it must be reviewed every 3 years.
3R	**Investigate requiring automated fire alarms and sprinklers as necessary building**	Currently, for residential buildings and other buildings low on the importance level, sprinklers are not mandatory. Literature findings support the installation of sprinklers in both urban and rural buildings would assist

Option	Description
fire protection measures in areas where firefighting water supplies are uncertain.	to reduce water required for firefighting. With a greater awareness of firefighting water stressed areas, guidance documentation MBIE issue to assist establishing compliance with the Building Code could better promote fire protection measures that apply when firefighting water supplies are uncertain. For example, clarifying requirements for installing automated sprinkler systems where this is warranted to reduce local firefighting water demands.

Non-regulatory options identified are outlined in Table 8 Non-Regulatory Options to Improve CoP Implementation.

Further below, all high-level options discussed are illustrated in Figure 11: Matters Highlighted in The Discussion of High-Level Options**.**

Table 8: Non-Regulatory Options to Improve CoP Implementation

1NR	**Publish guidance for Councils, including:**	
	a. How CoP standards are expected to be adopted in Engineering Standards.	Councils can adopt directly into any engineering standards any section within the new CoP. This would avoid the need for each Council to adopt their own standards with varying degree of consistency with the CoP and with each other.
	b. How firefighting water supplies are expected to be addressed in relevant water supply bylaws.	Since bylaws cannot be inconsistent with regulation issued under the FENZ Act 2017, which the CoP is, then alterations to the CoP trigger a review of relevant bylaws. The CoP would require setting expectations as to the enforcement of the CoP through bylaws. However, further research is recommended on the benefits, or otherwise, of including water supply considerations in bylaws where councils have these, and if relevant considerations can be required by other regulation that may be more effective.
	c. How firefighting water supplies are expected to be addressed in clearer rules in district plans.	The emphasis in current regulations is on urban water supplies. This gap could be addressed through specific rules in district plans to ensure adequate firefighting measures are implemented when new subdivisions and buildings are developed, including in rural zoned land. A risk-based approach could be taken to encourage fire protection measures to be able to be used.
2NR	**Education to take a risk-based approach**	Either way, an education component must accompany current CoP implementation, and any changes in the future. For a risk-based approach, there are two broad components required:
	a. Information Sharing via a dedicated website with geospatial data display capabilities	At a high level, raising awareness of firefighting water stressed areas is needed so requirements are considered where it matters. This implies making available information on the known availability and coverage of firefighting supplies to consent authorities and planners. To this end, it will be important to consider this in the context of Local Fire Plans and fire control policy anticipated under the FENZ Act, as well as the role that these will have in securing adequate water supplies. In particular, deploying a geospatial platform for online collaboration is seen as a building block to assist working collaboratively with local and regional councils to develop maps that show available reticulated and alternate water supply options, access and seasonal restrictions. Importantly, a dedicated website would

	also assist with required consultation for changes to the CoP, for example setting out the expected path and timeline for its adoption and gathering stakeholder feedback.
b. Develop Acceptable Solutions Guidance	At operational level, it would be helpful for processing officers to, similarly, have access to information online about firefighting water stressed areas along with improved guidance material, enabling a practical understanding of the requirements of solutions available for different development scenarios. The emphasis on early consideration is important to avoid projects stalling in the face of additional costs related to water supplies. When proposals fit the scenarios, then no further input from FENZ would be required. Otherwise council would be required to determine adequate firefighting water supplies with FENZ approval on a case by case basis. Development scenarios should include: • Redevelopment within water supply reticulated area – brownfield / change of use • Additional building on lot with existing building – infill /rural • Single lot subdivision – intensification / rural • Multiple lot subdivision – greenfield Should consider at least the following options and their combinations: • Extension to reticulated supplies, • Provision of a static water supply, either, on-site, or, from a remote site • Alternate water sources Where anticipating the use of automated fire sprinklers, then reducing firefighting water requirements is provided for in the current CoP. Comprehensiveness and detail in the current CoP and its appendices mean that this information can be synthesised in schematic diagrams, and supplemented where required, to be presented in a more accessible way for wider audiences.

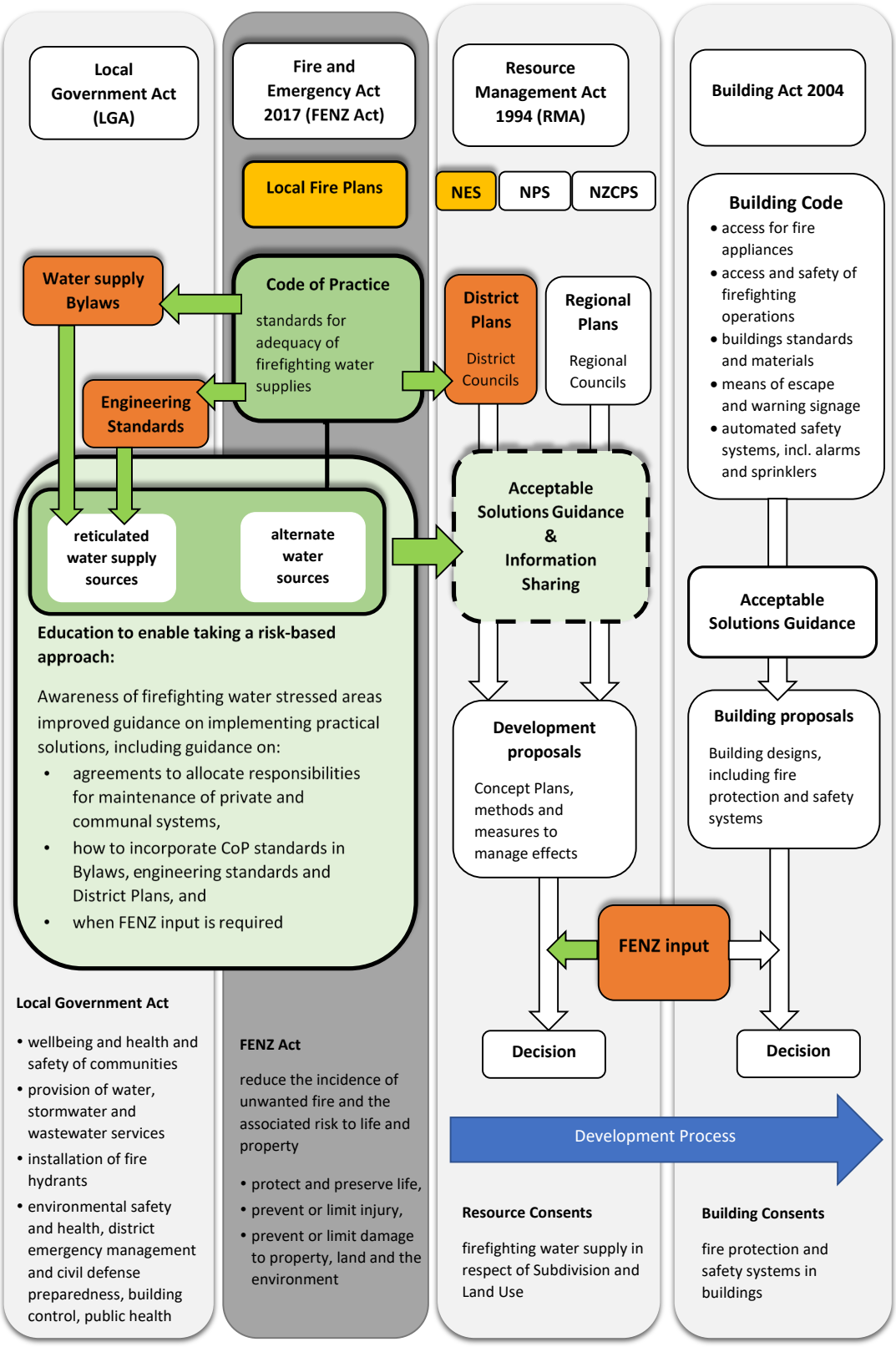

Figure 11: Matters Highlighted in The Discussion of High-Level Options

8. Recommendations

As an inquiry report, the problem statements and relevant findings from the literature review commissioned by FENZ are presented in the above sections of this report, including high-level options identified to improve the uptake of solutions using alternate water sources.

We have considered technology advances, current regulations, and the capability that FENZ has to secure adequate firefighting water supplies.

Nothing seems more essential in the short-term for emergency firefighting operations in existing communities with limited reticulated water supplies, than identifying other suitable sources of water for fire brigades to access as quickly as possible.

At the same time, improved implementation of the CoP must be achieved for new sources to be identified and developed where required. Importantly, there is scope for taking account of firefighting water requirements in the resource consent process where applications are discretionary, as is often the case for rural development. Also, FENZ have ability to draft water in emergencies from natural sources, such as ponds, lakes, rivers and the sea, without a resource consent.

We consider FENZ have a significant opportunity in the short-term to help understand local demands and availability and raise stakeholder awareness on CoP requirements, as well as any changes. Resource planners, developers and property owners need guidance of when and how to take account concerning firefighting water supplies in relation to land use applications,

Thus, aside from consideration that FENZ should give to other options previously outlined, we consider FENZ should progress the combination of regulatory and non-regulatory options set out in the Table 10, below.

Once decided, consideration should be given to how stakeholders will be engaged by developing a relevant plan that considers timing and the material that should be available for this to be effective.

A new CoP must be widely consulted before it can be published and publishing it in a dedicated website is a statutory requirement. Therefore, developing such a website alongside a stakeholder engagement plan is a reasonable first step for FENZ to embark on this path.

In this regard, the benefits offered by geospatial platform for online collaboration and information sharing should be weighted for their relevance not only to consultation efforts needed and raising awareness of available supplies, but also, for developing strategies and tactical fire plans and mitigation procedures.

Finally, recording actual water use data during fire incidents would allow improving predictive on-scene methods used by fire brigades at the same time that the evidential basis is accrued for improving theoretical methods and, thus, for improving relevant planning and regulatory requirements.

Advantages of geospatial data and satellite imagery analysis for high-order estimation of requirements for areas based on case data, for example, using machine learning, may also justify expanding relevant efforts.

Table 10: Morphum Environmental Limited Recommendations		
2NR	**Education to take a risk-based approach**	An education component must accompany current CoP implementation, and any changes in the future. For a risk-based approach, there are two broad components required:
	c. Information Sharing via a dedicated website with geospatial data display capabilities	At a high level, raising awareness of firefighting water stressed areas is needed so requirements are considered where it matters. This implies making information on the known availability and coverage of firefighting supplies to consent authorities and planners. To this end, it will be important to consider this in the context of Local Fire Plans and fire control policy anticipated under the FENZ Act, as well as the role that these will have in securing adequate water supplies. In particular, deploying a geospatial platform for online collaboration is seen as a building block to assist working collaboratively with local and regional councils to develop maps that show available reticulated and alternate water supply options, access and seasonal restrictions. Importantly, a dedicated website would also assist with required consultation for changes to the CoP, for example setting out the expected path and timeline for its adoption and gathering stakeholder feedback.
	d. Develop Acceptable Solutions Guidance	At operational level, it would be helpful for processing officers to, similarly, have access to information online about firefighting water stressed areas along with improved guidance material, enabling a practical understanding of the requirements of solutions available for different development scenarios. The emphasis on early consideration is important to avoid projects stalling in the face of additional costs related to water supplies. When proposals fit the scenarios, then no further input from FENZ would be required. Otherwise council would be required to determine adequate firefighting water supplies with FENZ approval on a case by case basis. Development scenarios should include: • Redevelopment within water supply reticulated area – brownfield / change of use • Additional building on lot with existing building – infill /rural • Single lot subdivision – intensification / rural • Multiple lot subdivision – greenfield Should consider at least the following options and their combinations: • Extension to reticulated supplies, • Provision of a static water supply, either, on-site, or, from a remote site • Alternate water sources Where anticipating the use of automated fire sprinklers, then reducing firefighting water requirements is provided for in the current CoP. Comprehensiveness and detail in the current CoP and its appendices mean that this information can be synthesised in schematic diagrams, and supplemented where required, to be presented in a more accessible way for wider audiences.

2R	**Establish current availability of suitable water supplies in three-yearly Local Fire Plans to assist community development planning decisions**	Under S21 and s22 of FENZ Act 2017, FENZ must undertake local planning and prepare and issue local fire (protection) plans. Local Fire Plans must set out how FENZ will exercise its powers relating to fire control, setting out policy, describing the particular fire risk conditions that exist or are likely to exist in the local area. Establishing the availability or uncertainty of supplies in Local Fire Plans is relevant to establishing risks and doing so would be beneficial also for the role that these can have in improving implementation of the CoP in close collaboration with councils. For example, if Local Fire Plans can be referred to by planners to determine water supply requirements for new developments in areas where reticulated supplies cannot be guaranteed. That is, with an adequate understanding of water sources available locally and water stressed areas. This implies information sharing and, geospatial information potentially, as well as building a common understanding of the legal basis for fire protection policy and its enforcement. Issuing of Local Fire Plans is subject to community consultation, including the public notification of plans and consideration of public submissions. Following the issuing a Local Fire Plan, it must be reviewed every 3 years.
	Recording the results of on-scene methods used by fire brigades for estimating firefighting water requirements and actual water use data during fire incidents.	This would allow improving predictive on-scene methods used by fire brigades at the same time that the evidential basis is accrued for improving theoretical methods and relevant planning and regulatory requirements. FENZ have taken steps to begin gathering information on actual water use during fire incidents to enable determining water requirements based on this evidence. As a trial, water meters were installed in six firefighting appliances and have collected data over several years. However, FENZ roughly estimate requiring data from at least 60 vehicles. FENZ acknowledge this as a long-term strategy given the long timeframe over which data can become meaningful for developing a solid evidence-based approach to determine water requirements. At this stage, there are no initial inferences that can be made from this data logging trial and no decision to expand this has been made. Advantages of potential uses of relevant geospatial data and satellite imagery analysis for high-order estimation of firefighting water requirements for key areas based on case data, for example, using machine learning, may also justify expanding relevant efforts.

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Appendix 1 Relevant Legislation

Building Act 2004

The Building Act and Building Code that is regulation to the Building Act control the standard of Buildings. In relation to firefighting water supply, they relate almost solely to limiting the spread of fire, ensuring the means of escape from fire and protection of buildings and neighbouring properties from fire. The most relevant sections of the Building Act are summarised below and full text of the provisions is included in Appendix 1.

- One of the purposes of the Building Act is (a) to provide for the regulation of building work, the establishment of a licensing regime for building practitioners, and the setting of performance standards for buildings to ensure that - (iii) people who use a building can escape from the building if it is on fire.
- In performing functions under the Act several principals must be taken into account. One of these is s4(2)(i) the need to provide protection to limit the extent and effects of the spread of fire, particularly with regard to (i) household units (whether on the same land or on other property); and (ii) other property.
- S46 states that certain building consent applications must be provided to Fire and Emergency New Zealand. For these applications, s47 states that Fire and Emergency New Zealand may provide advice on provisions for means of escape from fire and the needs of persons who are authorised by law to enter the building to undertake firefighting.
- There are a number of regulations prepared under the Building Act. The most relevant of these is the Building Code (that is schedule 1 of the Building Regulations 1992).
- S170 is also relevant. It states that *The chief executive must, in performing his or her functions, consult with, - (a) in the case of functions that involve advice, approval, and determinations about fire safety and fire-engineering practice, Fire and Emergency New Zealand.*
- The building code is a regulation to the Building Act. It is a performance-based code and in this manner is not prescriptive. Each clause has three aspects – objectives (the social outcomes the building must achieve), functional requirements (the functions the building must perform to meet the objective, and performance (the performance criteria the building must achieve). The Building Code is discussed in greater detail in the following section.

Building Code

> For reference in this section, firecell is defined as *Firecell: Any space including a group of contiguous spaces on the same or different levels within a building, which is enclosed by any combination of fire separations, external walls, roofs, and floors.*

Objective C1 of Clause C2 to C6 of the building code is to (a) safeguard people from an unacceptable risk of injury or illness caused by fire, (b) protect other property from damage caused by fire, and (c) facilitate firefighting and rescue operations.

Clause C2 relates to fixed appliances using controlled combustion and states they must be designed, constructed or installed in buildings in a way that reduces the likelihood of illness or injury due to fire.

Clause C3 is fire affecting areas beyond the fire source. It requires that buildings be designed and constructed so there is low probability of fire spread vertically or horizontally to other property, across a boundary, fire spread to upper floors of a building greater than 10m and low probability of illness or injury to persons not in close proximity to a fire source. This clause specifies the required performance of building materials.

Clause C4 is movement to a place of safety. This includes that buildings must have a means of escape and must be provided with effective means of giving warning of fire and visibility in escape routes. The requirements of the clause generally vary depending on the occupancy of the building.

Clause C5 relates to access and safety for firefighting operations. As it is most relevant to fire fighting water supplies it is duplicated in full, below.

Clause C5 states

C5.1 Buildings must be designed and constructed so that there is a low probability of firefighters or other emergency services personnel being delayed in or impeded from assisting in rescue operations and performing firefighting operations.

C5.2 Buildings must be designed and constructed so that there is a low probability of illness or injury to firefighters or other emergency services personnel during rescue and firefighting operations.

C5.3 Buildings must be provided with access for fire service vehicles to a hard-standing from which there is an unobstructed path to the building within 20 m of: (a) the firefighter access into the building, and (b) the inlets to automatic fire sprinkler systems or fire hydrant systems, where these are installed.

C5.4 Access for fire service vehicles in accordance with clause C5.3 must be provided to more than 1 side of firecells greater than 5,000 m2 in floor area that are not protected by an automatic fire sprinkler system.

C5.5 Buildings must be provided with the means to deliver water for firefighting to all parts of the building.

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.

C5.7 Buildings must be provided with means of giving clear information to enable firefighters to: (a) establish the general location of the fire, (b) identify the fire safety systems available in the building, and (c)establish the presence of hazardous substances or process in the building.

C5.8 Means to provide access for and safety of firefighters in buildings must be designed and constructed with regard to the likelihood and consequence of failure of any fire safety systems

Clause C6 relates to structural stability during fire.

Resource Management Act

Relevant parts of the Resource Management Act are set out below;

- Part 2 of the RMA states the purposes and principles of the Act.
- The purpose of the RMA is sustainable management. ***sustainable management*** *means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety*
- The definition of natural hazard within the RMA includes fire (but this seems to be limited to fire started by natural means).
- S14 of the RMA sets out restrictions on the use of water. Water that is required to be taken or used for emergency or training purposes in accordance with section 48 of the Fire and Emergency Act 2017 is exempt from the restrictions imposed on the use of water (or the need to obtain consent).

- S75 sets out the contents of District Plans. The scope is wide enough to include firefighting water supplies.

- s330 in the RMA gives powers to water providers and other lifeline utilities (telecommunications, power distribution, rail, etc) to undertake preventative or remedial works when affected, or likely to be affected by an adverse effect on the environment. S330A provides for notifying a consent obtaining retrospective resource consents for any permanent change resulting from emergency works undertaken under s330.

Fire and Emergency New Zealand Act 2017

Of relevance to the supply of water for fire fighting are the following sections of the Fire and Emergency New Zealand Act (FENZ Act)

- S6 is the interpretation section.

  Code of practice for firefighting water supplies *means a code of practice—(a) that is approved by the Minister under section 72; and(b) that relates to firefighting water supplies, including standards of water supply and access to, and volume and pressure of, water supply.*

- S14 and S15 requires the board to establish Local Advisory Committees to provide advice, from a local perspective, to FENZ. This requires FENZ to establish their geographic boundaries taking account of risks and FENZ's operational capabilities in each local area, and to ensure a Local Advisory Committee for every local area.

  The functions of the local advisory committee are, among other:

  - to undertake local engagement for the board
  - to provide advice to FENZ on national strategy, local issues and local planning
  - to consider and promote the interests of FENZ volunteers in the area
  - to consider the interest of the industry brigades operating in the area
  - to consider provisions in service agreements with other organisations, including DoC, NZDF or the Ministry of Education

- S21 requires FENZ to undertake planning for each local area identifying specific needs, resources, constraints and capabilities in the local area that are relevant to FENZ's functions. This planning must identify resources allocation and activities that address those needs (avoiding duplication with activities of other relevant organisations). In preparing plans, FENZ must take into account a number of matters, including national strategy, designated services for the area, the fire plan for the area, operational service agreements with NZDF, DoC and MoE.

- S22 requires FENZ to prepare and issue a fire plan for each local area, including policies and procedures for fire control.

- S48 provides FENZ with the power to use water for emergency and training purposes

- Sections 52 to 58, and 62 to 68, of the Act set out FENZ's fire control powers.

  Powers include issuing prohibitions and restrictions in relation to open air fires, including seasonal restrictions, as well powers to issue notices for the removal or destruction of

vegetation or other source of danger. Also, powers ae given to FENZ to make and clear any firebreak, and to remove from any firebreak vegetation or other thing, by issuing notice on any relevant landholder.

- S72 states the Minister may approve a code of practice for firefighting water supplies
- Under s73 FENZ is required to develop, consult on, recommend the approval of, and publish and notify the code of practice for firefighting water supplies.
- S189 provides the Governor-General to make regulations relating to fire plans, including the content and the consultation that FENZ must undertake in relation to the content of fire plans.

Fire and Emergency New Zealand (Fire Plans) Regulations 2018

The Fire Plan regulations came into force on 13 December 2018 and set out the purpose, content and scope, consultation requirements and review provisions for fire plans.

Section 5 sets out that the purpose of a fire plan is to

(a) set out how FENZ's will exercise its fire control powers in each local area and

(b) ensure that the particular fire risk conditions in each local area are considered by FENZ when it establishes policies and procedures for that local area.

Section 7 requires local fire plans are issued by FENZ within 2 years of the boundaries of the Local Advisory Committee in respect of the local area having been set.

Section 8 sets out the content of fire plans prepared and issued by FENZ must:

- describe the particular fire risk conditions that exist or are likely to exist in the local area; and
- set out the policy for fire control in the local area; and
- set out fire control procedures in the local area, including and the factors that FENZ will consider, when deciding to—
  i. issue notices of prohibitions or restrictions for fire control
  ii. declare a prohibited or restricted fire season in relation any part of a local area
  iii. issue notices in relation to firebreaks, and
- issue notices to remove or destroy vegetation or other things on land

A fire plan must cover the entire local area to which it relates, may include provisions that deal differently with different areas within that local area, and must be consistent with:

- the national strategy; and
- any local planning by FENZ in respect of the local area; and
- operational service agreements; and
- any relevant FENZ policies.

Consultation requirements include publishing a public notice and considering submissions received from the public.

FENZ may amend a fire plan at any time. However, at least every 3 years, or when changes to the boundaries of a local area require so, FENZ must review the fire plan for each local area.

FENZ must amend or confirm a fire plan as appropriate for each local area.

Local Government Act 2002 and Local Government Act 1974

- S146 allows Local Government to make bylaws for water supply. Under s152B(4) a bylaw can't be inconsistent with the Fire and Emergency NZ Act and regulations under that Act.
- S647 Local Government Act 1974 Fire Hydrants has not been repealed. It requires Council to install hydrants on Mains pipes in location that are the most convenient for extinguishing fire. Section 647 (3) is that fire hydrants shall be distanced as Council decides, with the approval of Fire and Emergency New Zealand. Council must mark where fire hydrants are. If Council is dissatisfied with the decision of Fire and Emergency New Zealand they have a right of appeal to the District Court.
- S648 of the Local Government Act 1974 (not repealed) requires pipes where fire hydrants are installed to be kept charged with water. There are exceptions in cases of unusual drought, accident shortage of any cause of the water supply, during necessary repairs, connections or inspections or in the case of a state of emergency declared under the Civil Defence Emergency Management Act 2002. Councils must allow all persons to take and use water from any waterworks or water race for extinguishing fire without payment. This is subject to the requirements of any controller.
- S130 prescribes Councils with an obligation to maintain water services.

Appendix 2 Council Bylaws and District Plan rules that relate to water supply

District Council Name	Water Supply Bylaw?	Does it mention 'Fire Fighting Water Supply'?	Fire Fighting Water Supply Rules (Subdivision/Residential)	Fire Fighting Water Supply Rules (Engineering/Infrastructure)
Carterton District Council South Wairarapa District Council Masterton District Council Note: All three councils share the Wairarapa Combined District Plan and Wairarapa Water Supply Bylaw	Yes (all three councils share the same one)	Yes (Section 3.1.3 Fire Hydrants, 4.4.5 Extraordinary Use, 4.9 Fire Protection Connection)	Subdivision: Yes (20.1.1 (a)(xiv) Matters of Control) Residential: No	Network Utilities and Energy: No
Central Hawkes Bay District Council	Yes	Yes (Section 707.1.3 Fire Hydrants, 708.9 Fire Protection Connection, Figures 2 and 3, 708.4.89 Rural and/or Individual On-Site Water Storage)	Subdivision: Yes (Policy 9.2.2 (4), 9.9.3 ((f) Water Supply (Controlled Subdivision Activities, 14.6 (5) Water Supply - Subdivision Matters) Residential: No	Utilities: No
Hastings District Council	Yes	Yes (Section 7.5.1 Offences in Relation to Water Supply)	Subdivision and Land Development Chapter: Yes (Outcome SDLAO10, 30.1.8.1 (4)(iii) Water Supply (Controlled, Restricted Discretionary and Discretionary Activities) 30.1.8.2 (12)(g) Specific Assessment Criteria (Sites within the Coastal Residential Zone at Tangoio)	Network Utilities: No
Horowhenua District Council	Yes	Yes (Sections 11 (Fire Hydrants) and 14 (Fire protection connections))	Residential Zone: No Subdivision and Development: No	Utilities and Energy: No

District Council Name	Water Supply Bylaw?	Does it mention 'Fire Fighting Water Supply'?	Fire Fighting Water Supply Rules (Subdivision/Residential)	Fire Fighting Water Supply Rules (Engineering/Infrastructure)
Hutt City Council	Yes	Yes (Section 9 (Fire Protection Connection))	Residential: Yes (General Residential Activity Area, Rule 4A 5.2.2.1 Activities (Housing for the Elderly) - Matter of Discretion (vii)(5) Subdivision: Yes (11.2.2.1 Controlled Activities - Standards and Terms (b) Engineering Design (vi) Water Supply)	Network Utilities, Incl. National Grid: No
Kapiti Coast District Council	Yes	Yes (Section 8.1.3 Fire Hydrants, 9.2.3 Location of point supply (d) and (e), 9.7 Fire connection)	Living Zone (includes subdivision provisions): No	Infrastructure, Services, and Associated Resource Use: Policy 11.19(2)(1) Water Supply
Manawatu District Council	Yes	Yes (Part 5)	Residential Zone: Yes (15.4.2 Permitted Activities - Residential Units and Accessory Buildings (Guidance Note 2), 15.4.8 Restricted Discretionary Activities - Retirement Living and Multi-Unit Residential Development (Guidance Note)) Subdivision: Yes (Policy 3.5 (Guidance Note))	District Wide Rules (Network Utilities): No
New Plymouth District Council	Yes	Yes (Section 4.1.7 Extraordinary Use, 9.2.2 Fire Hydrants, 9.5 Fire Protection Connection)	Residential Environmental Area (includes subdivision provisions): No	Couldn't find an infrastructure chapter
Palmerston North District Council	Yes	Yes (Section 8 Water System)	Subdivision: Yes (Policies 2.8, 3.1(2), and 7.7; R7.6.1.1 (g) Performance Standards for Controlled Activities (Pacific Drive Extension Area), R7.8.2.1	Network Utilities: No

District Council Name	Water Supply Bylaw?	Does it mention 'Fire Fighting Water Supply'?	Fire Fighting Water Supply Rules (Subdivision/Residential)	Fire Fighting Water Supply Rules (Engineering/Infrastructure)
			(3)(a)(iii)(k) Performance Standards (Restricted Discretionary), North East Industrial Zone)) Residential: Yes (R10.6.1.1 (j) Performance Standards (Permitted Activities - Pacific Drive Extension Area Water Supply Requirements)	
Porirua City Council	Yes	Yes (Section 17.1, 18 Water for Extinguishing Fires, 22.4(g) Protection of Water Supply and Other Property - Offences and Penalties	Suburban Zone (includes subdivision/infrastructure provisions): No Subdivision: No (note that there is no subdivision rules chapter)	No infrastructure chapter
Rangitikei District Council	Yes	Yes (Sections 5.4, 5.7, and 5.8)	General Rules (includes subdivision, utility, and residential rules): No	No infrastructure chapter
Ruapehu District Council	Yes	Yes (Section 10.1.3, 11.2.3, 11.7)	Residential: No Subdivision: Yes (Subdivision - Rural (General)(SU3.3.2 Servicing), Assessment Criteria: Rural (SU3.4.1 (b) Controlled Activities) Subdivision - General Conditions (SU3.6.3 (d) Servicing), Assessment Criteria: Residential (SU3.7.1 (b) Controlled Activities), Subdivision - General Conditions (Commercial) (SU3.9.2 Servicing), Assessment Criteria: Commercial (SU3.10.1 (b) Controlled Activities), General Conditions - Industrial (SU3.12.2 (c) Servicing), Assessment Criteria - Industrial (SU3.13.1 (b) Controlled Activities),	Infrastructure: No

District Council Name	Water Supply Bylaw?	Does it mention 'Fire Fighting Water Supply'?	Fire Fighting Water Supply Rules (Subdivision/Residential)	Fire Fighting Water Supply Rules (Engineering/Infrastructure)
			Assessment Criteria - Urban Settlement Zone (SU3.15.1 (b) Controlled Activities), Assessment Criteria - Protected Areas and Active Reserve Zone (SU3.17.1 (b) Controlled Activities)	
South Taranaki District Council	Yes	Yes (Section 8.1.3 - 8.1.4, Figure 1, 12.5.1(h), 12.6.1, 15)	Residential: No Subdivision: Yes (Section 9.1.2 (a)(ii) Controlled Activities (incl. advice note), 9.2.2 (2) Performance Standards (Utilities and Services) and 9.2.3 Performance Standards (Roads and Access))	Network Utilities: No
Stratford District Council	Yes	Yes (Sections 9.1.3, 13.4.1, 13.5.1,17)	General Rules (includes subdivision, utility, and residential rules): Yes (B2.1.14 Lot/Site Design and Land Development)	No infrastructure chapter
Tararua District Council	Yes	Yes (Section 15, Part 6)	Residential (Residential Management Area): No Land Subdivision: No	Water Supply (General Rules): Yes (5.1.3.2 (c)(i))
Upper Hutt City Council	Yes	Yes (Section 8.1.3, and 9.8)	Subdivision and Earthworks: No Residential (includes subdivision provisions): No	Utilities: No
Whanganui District Council	Yes	Yes (Section 15 and 24)	Subdivision and Infrastructure: Yes (Policy 13.3.25; 13.5.7 (d), 13.5.9 (f), and 13.5.16 (b) Performance Standards - Site Serviceability, Site Access, and Water (respectively)) Residential: No	See Subdivision and Infrastructure chapter
Wellington City Council	Yes	Yes (Section 9, 10.2)	Residential (includes subdivision provisions): No	No infrastructure chapter

District Council Name	Water Supply Bylaw?	Does it mention 'Fire Fighting Water Supply'?	Fire Fighting Water Supply Rules (Subdivision/Residential)	Fire Fighting Water Supply Rules (Engineering/Infrastructure)
Ashburton District Council	Yes	Yes Section 6.1 and 9.3	Residential chapter: No Subdivision chapter: Yes - Policy 9.2C, Section 9.4 Anticipated Environmental Results, Sections 9.7.3 Controlled Activities, 9.7.4 Restricted Discretionary Activities, 9.7.7 Notification, 9.10.7 Water Supply	Utilities, Energy, and Designations Chapter: No
Buller District Council	Yes	Yes Sections 9.9 Schedule 1	Residential chapter (includes subdivision activities): No	Infrastructure and Services chapter: No
Central Otago District Council	Yes	Yes Sections 9.3, 9.5, 9.10	Residential (resource) chapter: No Subdivision chapter: Yes (Policy 16.4.4) Rural Chapter 4: Yes (Rule 4.7.2 (i) CONTROLLED ACTIVITIES Residential Activity, Outstanding Natural Landscapes, Outstanding Natural Features and Land in the Upper Manorburn/Lake Onslow Landscape Management Area; (vii) Accommodation Facilities; Matters of control require provision of services, including firefighting water supply	Infrastructure, Energy, and Utilities chapter: No
Christchurch City Council	Yes	Yes Sections 5(4)(h), 7, 17, 19(2)	Residential chapter: Yes (all residential zone chapters have a rule relating to fire fighting water supply) Subdivision chapter: Yes (Standard 8.6.7 Water Supply)	Utilities and Energy chapter: No

District Council Name	Water Supply Bylaw?	Does it mention 'Fire Fighting Water Supply'?	Fire Fighting Water Supply Rules (Subdivision/Residential)	Fire Fighting Water Supply Rules (Engineering/Infrastructure)
Clutha District Council	Yes	Yes Part 2, Sections 7, 14, and 22	Residential (Urban Resource) chapter: Yes (listed as reason behind yard requirements rule) Subdivision chapter: Yes (Section 3, Water Supply)	Water chapter: No Infrastructure chapter: No
Dunedin City Council	Yes	Yes Sections 7.8 Figure 5	DCDP Residential Chapter: No DCDP Subdivision Chapter: Yes (Section 18.6.1 Assessment Matters for Subdivision Activities) 2nd Gen District Plan Residential Chapter (Management Zones: Standards 15.6.3 (relates to buildings and subdivision)	DCDP Utilities Chapter: No Couldn't find an infrastructure chapter for the 2nd Gen District Plan but under the City-Wide Provisions: Public Health and Safety chapter, Standard 9.3.3 talks about fire fighting
Gore District Council	Yes	No, but includes the Fire Service Act 1975 and the NZ Fire Service Fire Fighting Water Supplies Code of Practice	Land Use Activities Chapter: No	Utilities Chapter: No
Grey District Council	No https://www.greydc.govt.nz/our-services/sewerage-water-stormwater/water/Pages/default.aspx	N/A	Residential Environmental Area Chapter: No Subdivision Rules Chapter: Yes (Assessment Matters (25.5.4 (2) and (3))	Utilities Chapter: No
Hurunui District Council	Yes	Yes (Section 2.7)	Subdivision Chapter: Yes (5.4.3 (3) Matters for Control, 5.5.9 (3) Standards for Controlled Activities, 5.6.5.1 (1)(h) Controlled Activities (Buxton Valley Management Area) Residential	Utilities Chapter: No

District Council Name	Water Supply Bylaw?	Does it mention 'Fire Fighting Water Supply'?	Fire Fighting Water Supply Rules (Subdivision/Residential)	Fire Fighting Water Supply Rules (Engineering/Infrastructure)
			(Settlements) Chapter: No	
Invercargill City Council	Yes	Yes (Section 8.9)	Residential Rules: Yes (Residential 2 (Bluff and Omaui Zone), Residential 3 (Large Lot Zone), Residential 4 (Residential Transition Zone) all have rules relating to firefighting water supply)	Utilities and Subdivision Rules: No
Kaikoura District Council	Yes	Yes (Sections 5.6 and 5.7)	Subdivision Chapter: Yes (Policy 13.3.2 (1), Section 13.9 (2), Standard 13.11.1 Water Supply Residential Chapter: No	Utilities Chapter: No
Mackenzie District Council	Yes	Yes (Section 5.4 and 11.6 - 11.7)	Subdivision Chapter: Yes (Section 3a Controlled Activities, 10.2(g) Water Supply) Residential Chapter: No	Utilities Chapter: No
Marlborough District Council	No https://www.marlborough.govt.nz/services/utilities/water-supplies	N/A	Urban Residential Zone Chapter: None Township Residential Zone Chapter: None Chapter 29: Subdivision - Yes (Standard 29.2.15 - Water Supply - Subdivision Requirements	Utilities Chapter: No
Nelson City Council	Yes	Yes (Section 5.2 to 5.3, 11)	Subdivision and development rules (DO14): Yes (Policy DO14.3.2 (a) - Subdivision/Residential) Residential Zone (includes subdivision): No	Residential Zone (includes utilities rules): No
Queenstown Lakes District Council	Yes	Yes (Subpart 1 (9), Subpart 6)	Operative District Plan: Residential Zone Chapter: Section 7.7.2 (vii) Discretionary	Operative District Plan: Utilities Chapter: No

District Council Name	Water Supply Bylaw?	Does it mention 'Fire Fighting Water Supply'?	Fire Fighting Water Supply Rules (Subdivision/Residential)	Fire Fighting Water Supply Rules (Engineering/Infrastructure)
			Activity - Visitor Accommodation Subdivision/Development/Financial Contributions Chapter: Section 15.2.11.1 Controlled Subdivision Activities - Water Supply, Section 15.2.11.3 Zone Subdivision Standards - Water Supply, Section 15.2.11.4 (iv) Assessment Matters for Resource Consents	
Selwyn District Council	Yes	Yes (Section 22)	Subdivision Chapter: Yes (Rule 12.1.4.3 Water, Section 12.1.4 Matters of Discretion (12.1.4.96 Rural Residential Areas Living 3: Zoning) Living Zone Rules - Buildings Chapter: None	Buildings and Water Supply Section: No Living Zone - Utilities Chapter: No
Southland District Council	Yes	Yes (Section 3.1.2 and 4.6)	Subdivision Chapter: Yes (Rule SUB.2A(3) Subdivision - Eweburn Zone) Urban Zone Chapter: No	Energy, Minerals, and Infrastructure Chapter: No
Tasman District Council	Yes	Yes (Section 28, Phases E and F of the Water Restriction Protocol)	Residential Chapter: No Subdivision chapter: Yes (16.3.8.1 Controlled Subdivision (Rural Residential Zone - Matters of Control (6), Schedule 16.3A Assessment Criteria for Subdivision (11)	Network Utilities and Public Works Chapter: No
Timaru District Council	Yes	Yes (Section 1518.5, 1520, and 1527 Fire Fighting)	Residential chapter: No Subdivision chapter: No	Services and Infrastructure Chapter: No

District Council Name	Water Supply Bylaw?	Does it mention 'Fire Fighting Water Supply'?	Fire Fighting Water Supply Rules (Subdivision/Residential)	Fire Fighting Water Supply Rules (Engineering/Infrastructure)
Waimakariri District Council	Yes	Yes (Sections 13 and 16)	Residential chapter: No Subdivision chapter: No	Utilities and Traffic Management Chapter: No
Waimate District Council	Yes	Yes (Sections 1418, 1420, and 1427)	Residential chapter: No Subdivision chapter: Yes (Section 4.5, 11.7 (a) and (b))	Utilities Chapter: No
Waitaki District Council	Yes	Yes (Section 8.1.3 - 8.1.4, 9.10.5)	Residential chapter: No Subdivision chapter: Yes (Section 14.3.3 (6) Controlled Subdivision Activities, 14.7.2 (6) Assessment Matters)	Utilities Chapter: No
Westland District Council	Yes	Yes (Section 8.1.3 - 8.1.4, 9.9)	Small Settlement Policy Unit Chapter: None Subdivision Chapter: None	