

AN ASSESSMENT OF SMART FIREFIGHTING NEEDS IN NEW ZEALAND

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June 2026



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Executive summary

An Assessment of Smart Firefighting needs in New Zealand

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Smart firefighting encompasses the integration of data and technology into emergency fire management. Recognised internationally as an important component of future wildfire management, the use of smart firefighting tools is limited in New Zealand, providing an opportunity to improve the technology before it is most needed. During May – August 2022 work was undertaken to identify where improvements in smart firefighting can provide the greatest benefit, by engaging with stakeholders to identify critical gaps in current systems.

This report outlines the steps taken during this work and presents the findings, outlining the capability and requirements of smart firefighting in New Zealand. First, priority decision makers were identified through a workshop and survey involving representatives from key stakeholder organisations: Fire and Emergency New Zealand, Departments of Conservation, the forestry sector, and the Bioeconomy Science Institute (BSI; formally Scion). Interviews with those in decision maker roles were then conducted, to better understand the requirements and challenges.

Five primary areas of need were identified in New Zealand: data, tools, knowledge, training, and communication. Most of these needs could be addressed through improved smart firefighting technologies and tools. The findings provide a foundation for prioritising the research, development, and adoption of new tools. Since this work was completed stakeholder organisations have made progress in advancing smart firefighting capabilities, although there are still many needs which need to be met.

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1 Introduction

“Smart firefighting” encompasses the collection and integration of data from a wide range of databases, sensor networks (including sensors on firefighters and equipment), computational tools and communication systems. Smart firefighting ensures the flow of critical information when and where it is needed, and encompasses all four components of emergency management, namely reduction, readiness, response, and recovery (Casey Grant et al. 2015). Internationally it is considered of great significance for the future of wildfire management (Gabbert 2019; Wu et al. 2017).

New Zealand currently has limited smart firefighting tools (in terms of access to wildfire information, technology and decision-making tools) when compared to areas that experience frequent wildfire (such as the United States and Australia). This is due in part to the smaller scale of wildfires in New Zealand and prioritisation of other natural hazards, e.g. earthquakes, floods, over wildfire. It is widely accepted that the New Zealand wildfire regime is predicted to become more severe with future climate change (Melia et al. 2022) and New Zealand has a unique opportunity to improve technology prior to massive wildfire destruction, increasing future preparedness and hopefully reducing future impact.

The aim of this project was to engage with stakeholders to prioritise existing critical gaps where firefighting solutions are needed, and to develop prototype solutions to address these gaps. Similar to worker-centred innovation approaches in manufacturing (Kelmenson et al. 2025), frontline wildfire practitioners possess critical, experience-based insights shaped by their operational realities. Capturing these insights through structured engagement ensures that smart firefighting tools are designed to meet actual decision-making needs rather than assumptions driven by scientific or technological perspectives. This user-centred approach aligns technological development with practical constraints and priorities, fostering solutions that are both relevant and adoptable. This report summarises the identification of priority decision makers and information gathered about the pain points (areas which can cause problems or obstructions) and smart firefighting needs of those decision makers.

1.1 Wildfire in New Zealand

Historically New Zealand has had low levels of wildfire compared to many regions of the world. Frequent wildfire is not a natural part of New Zealand ecosystems and there is minimal fire history prior to human arrival (Perry et al. 2014). This is in part due to a lack of natural ignitions such as dry lightning – the most common natural wildfire cause (Perry et al. 2014). Natural ignitions have been found to be responsible for only 0.01% of total wildfires recorded in New Zealand (Anderson et al., 2016). Human influences, such as land cover changes and increased ignitions, have significantly increased wildfire occurrence in New Zealand (Baille et al., 2019), and wildfires have burnt around 5700 ha on average each year between 1998 to 2021 (Anderson et al. 2008; Gross et al. 2025).

Climate, topography, land cover type, and levels of human activity are all highly variable across New Zealand making some regions more susceptible to wildfire than others. New Zealand land cover is a unique combination of native and non-native vegetation, which can respond differently to fire. In New Zealand, fire behaviour models predominantly rely on data from exotic species, as the dynamics of fire in native vegetation is sparsely documented (Clifford et al. 2025). Currently, most wildfires in New Zealand start on grass or shrubland (Anderson et al. 2008; Gross et al. 2024).

New Zealand's topography and weather result in varied microclimates across the country, ranging from semi-arid, to sub-tropical, leading to differences in wildfire risk and occurrence (Pearce & Clifford 2008). Typically, wildfires peak during the summer months (December – February), although extreme fire weather conditions can occur year-round. There is a much greater population density on the North Island with 76% of the population of New Zealand (StatsNZ 2025). The North Island typically experiences more fires (60% of the NZ total) while the South Island typically has a higher annual area burnt (70% of the NZ total) (Scion & FENZ 2020). Extreme fire weather conditions (those which are considered high fire danger) are predicted to occur with increasing frequency and in regions formally unaffected by wildfire conditions (Pearce et al., 2010; Melia et al., 2022). Vegetation rich regions with

the potential to dry out have been highlighted as some of the most dangerous future wildfire climates a description that applies to much of New Zealand (Melia et al., 2022).

Wildfires can have many negative impacts. They pose a danger to humans, natural areas and infrastructure, and also impose a significant economic cost (Wu et al. 2009). In regions of the world with fire adapted ecosystems and a history of natural wildfire ignition, there are often calls to let wildfires burn in a controlled way. However, NZ does not have such frequent wildfire regime ecosystems and therefore wildfire firefighting is focussed on suppression. Although many wildfires recorded in New Zealand are small, the time and resources required to manage them quickly add up. In fact, these smaller fires can cost as much as the large wildfires in terms of firefighting. Prescribed fire is still a commonly used land management tool used both in agriculture and conservation (Baille et al., 2019) and escaped fire has historically been a large source of wildfires in New Zealand (Anderson et al. 2008). One important part of wildfire firefighting in New Zealand, therefore, is monitoring conditions and determining when areas are safe for prescribed burns.

As wildfire is a growing concern in New Zealand, wildfire research is also a growing field. Many of the tools used for wildfire management are from other countries, such as Australia, Canada and the United States, and require adaptation to New Zealand's unique fire environment. (e.g. Fire Danger Rating System (Anderson 2005)).

2 Identification of priority decision makers

2.1 Methodology

A project initiation workshop was held on the 6th May 2022 with stakeholders. The objective of the workshop was to introduce smart firefighting, the collection and integration of data into firefighting, and to develop a pathway to prioritise smart firefighting prototypes. The workshop was hosted by Scion (now Bioeconomy Science Institute) and attended by representatives from Fire and Emergency New Zealand (FENZ), Department of Conservation (DOC), and the forestry sector. Directly following the workshop, a survey was circulated to attendees and forwarded to fire personnel throughout FENZ, DOC, and the forestry sector, to help identify decision makers and prioritise research needs. The survey was also sent to Scion staff who attended the workshop but were not involved in the development of the survey. Attendees of the workshop were kept involved throughout this research.

The survey focused on identifying key decision makers and those for whom smart firefighting could provide solutions to known problems. It also asked when during a wildfire (pre, during or post) tools were most needed and the importance of different types of tools. The questions asked in the survey can be found in the appendix. As attendees of the workshop, the survey was also completed by Scion researchers who were involved in the creation of the survey. To evaluate bias from Scion responses, results were analysed with and without Scion responses.

2.2 Survey results

Nine people completed the survey: three people from Scion, two people from DOC, and four people from FENZ. Answers to the question *'Vote for the four decision makers/roles for whom you believe smart firefighting solutions will provide the greatest value for wildfire planning, response, and recovery'* underwent two analyses. Figure 1 (a) shows the sum of answer scores where the 1st decision maker chosen was valued as highest (a score of 4) and last decision maker chosen was identified as lowest (a score of 1). Figure 1 (b) depicts the frequency of each answer chosen. Based on the survey responses, Fire Behaviour Analysts (FBANs) were identified as the top decision-makers most in need of, and likely to benefit from, smart firefighting tools. Public land managers were ranked second. Following this, incident controllers, private land managers, and firefighters ranked third to fifth, although the exact order of priority depends on whether frequency or summed value (i.e. rankings 1-4)

was used in the analysis (Figure 1). Public information officers, wildfire researchers, and GIS intelligence officers were ranked lowest in terms of need for smart firefighting solutions.

When looking at if a tool should be developed for use before, during or after a wildfire, the majority of the respondents (six) chose before a wildfire, and the rest (three) chose during a wildfire. No respondents prioritised a tool for use after a wildfire. Those who chose ‘before a wildfire’ unanimously identified public land managers as the priority decision maker, a role whose wildfire decision making would most likely occur before wildfires happen. Those who chose ‘during a wildfire’ identified Fire Behaviour Analysts (FBANs) and researchers as the priority decision makers, roles that occur during a wildfire.

Responses to the question ‘Where do you believe smart firefighting solution should focus? Please rank the options in order of importance, starting with the most important as 1’ were ranked by participants 1 to 7. The top-ranked option (1st) was scored 7, and the lowest-ranked (7th) was scored 1. The top prototype ideas identified in the survey were a prototype to predict and analyse fire behaviour and a prototype to understand fire risk across the landscape (Figure 2). These tasks fall under the FBAN and public land manager roles respectively, both of which were the two top decision maker roles prioritised as benefiting from smart firefighting.

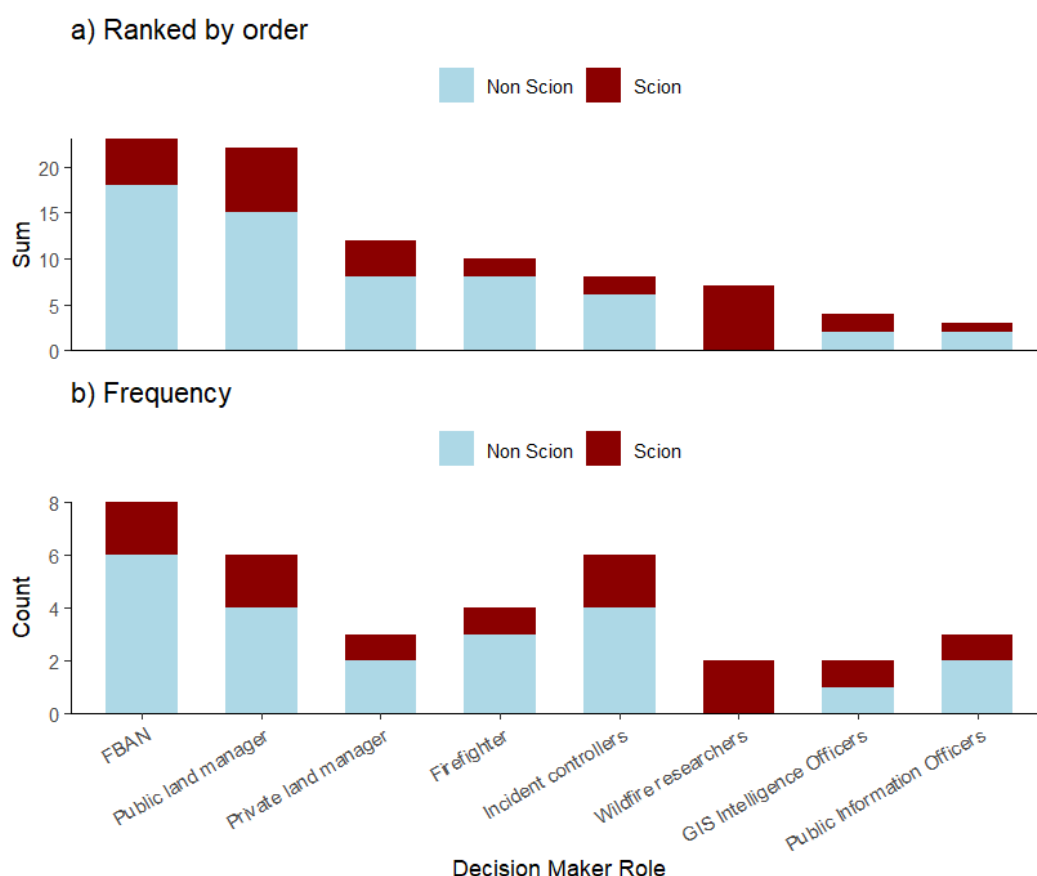


Figure 1: Survey results ranking decision makers by perceived value of smart firefighting solutions for wildfire planning, response, and recovery. (a) Summed scores (1–4, with 1st ranked highest) and (b) selection frequency. Scion responses (red) shown separately from others (blue) to assess bias. FBAN stands for Fire Behaviour Analyst.

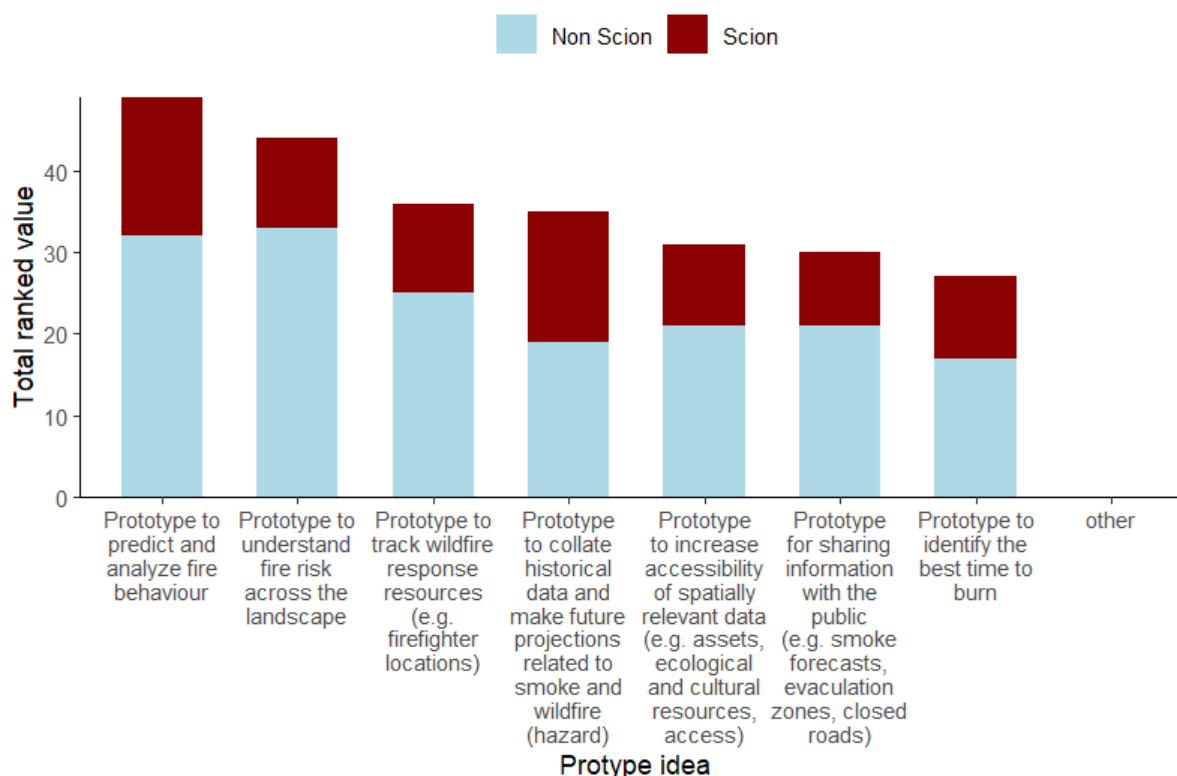


Figure 2: Survey results ranking areas of focus for smart firefighting solutions. Responses were scored from 7 (highest importance) to 1 (lowest). Scion responses (red) are shown separately from others (blue) to assess bias.

Without the Scion responses, all results were similar with two exceptions:

1. The priority for prototypes flipped so that the prototype to understand fire risk across the landscape had a higher priority than the prototype to predict and analyse fire behaviour.
2. Wildfire researcher was no longer identified as a priority role for the value of smart firefighting solutions.

This shows the potential contrasts between the focus and priorities of researchers compared to users of tools and highlights the importance of working together during tool development.

Based on the survey results, the following decision-making roles were chosen for further interviews:

- FBANS
- Incident Controllers (IC)
- Incident Management Team (IMT) leaders for planning and intelligence
- Public land managers
- Large private land managers (Forestry sector)

3 Identification of smart firefighting needs

3.1 Methodology

Seventeen individuals from the five decision maker roles were interviewed by Scion wildfire researchers, during June - August 2022. The interviewers had expertise in human performance, wildfire behaviour, modelling, wildfire operations, and translational ecology. Decision makers were

questioned about their work environments, tools they use, and their pain points and needs. Those who were interviewed reviewed summaries of the interviews and provided their consent for the information to be included in this report. A summary of the findings from these interviews is presented in this report.

The information gained in these interviews with key representatives in wildland firefighting provides a picture of the current state of smart firefighting in New Zealand. Of the five roles interviewed, FBANS, ICs and IMT planning and intelligence leaders are all present on the fire ground, gathering information, forming plans, and making decisions during a wildfire event. The FBAN is an advisory role called upon during complex or large wildfires and works within the intelligence section. The role of the IC is to establish and lead the IMT and to be a final decision maker, with other roles in the IMT being Planning Manager and Intelligence Manager. The remaining two roles interviewed were public and private land managers, and those interviewed were DOC land managers and forestry managers respectively. These roles are involved in wildfire risk reduction and recovery, typically making decisions before and after a fire event. Across the decision makers interviewed there are a wide range of key responsibilities, including resource and personnel management, risk assessment, fire behaviour advice and post fire recovery. Each of these responsibilities encompasses different priorities, requirements, and operational challenges.

3.2 Current smart firefighting tools

During the interviews with decisions makers, tools and datasets currently used in wildfire firefighting in New Zealand were identified. Any new tools should fit into and work well with this existing toolkit without too much overlap, since a choice of two tools for the same task can lead to unnecessary duplicated effort and/or confusion. This is likely not a complete list of tools used, only those that were identified in the interviews.

FireMapper

FireMapper is a tool developed by Fire Front Solutions to track fire ground operations. It is the current operational mapping tool within FENZ, used to track resources and operational logistics. It is designed to produce simple maps fast and has been built with flexibility to evolve with user needs. It provides real time data that is viewable via a portal and links into ArcGIS online, meaning it can be easily accessed on individual's devices and combined with other data. FireMapper is able to share up to date incident information with ministers and stakeholders – providing a real time tool mapping the fire perimeter, fire suppression actions taken, and the fire ground characteristics.

FireMapper was specifically mentioned during interviews with the IC. It was suggested that other, similar, tools are more complicated to use and could overload frontline workers and IMT members.

Land Cover Database (LCDB)

The New Zealand Land Cover Database from Landcare Research is a classification of New Zealand's land cover. It contains 35 land cover classifications detailing vegetation type, such as 'Exotic Grassland' or 'Broadleaved Indigenous Hardwoods'. This dataset has been linked to the NZ fire behaviour and fuel type models to provide fire behaviour predictions. This dataset currently provides the best available information on the spatial location of fuels for New Zealand.

The LCDB was raised in the interviews with the FBANs and public land managers. Both roles had concerns over the LCDBs suitability for fire behaviour modelling. The database is periodically updated, with landcover types given for 1996, 2001, 2008, 2012, and 2018 (at the time of writing), and this means it can quickly become outdated at specific fire locations. Furthermore, some vegetation classes are not suitable for fire behaviour modelling as it classes non-flammable and flammable fuels together (e.g. 'Gorse and Broom').

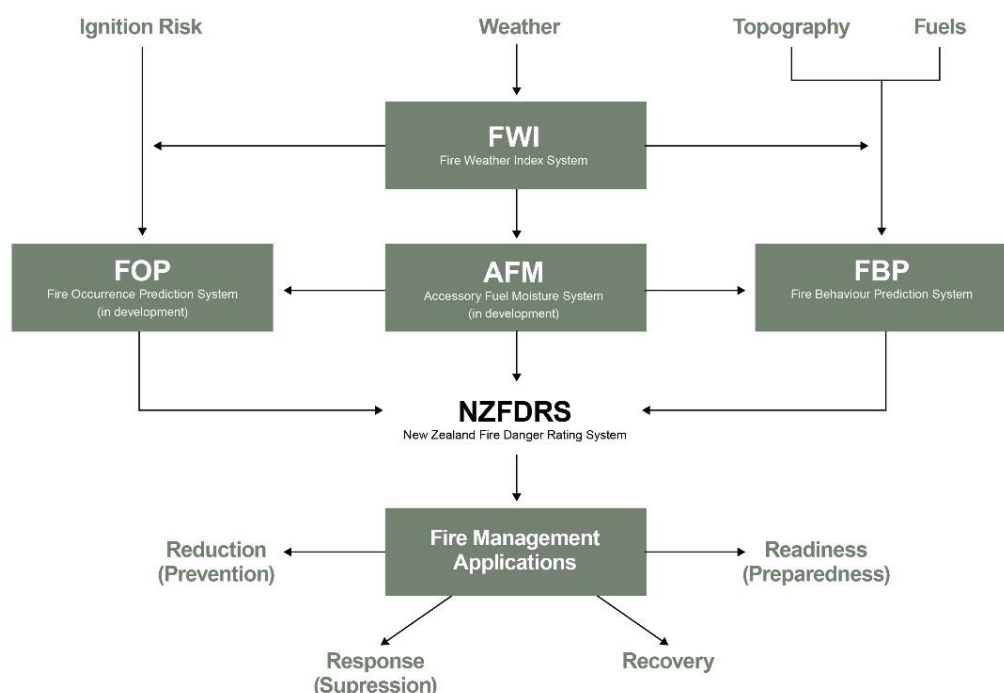


Figure 3: The NZ Fire Danger Rating System (Bioeconomy Science Institute 2026)

Fire Weather Indices (FWI)

In New Zealand, wildfire risk is assessed using the NZ Fire Danger Rating System (NZFDRS; Figure 3), which is based on the Canadian Fire Danger System (CFFDRS). The NZFDRS combines the Fire Weather Index (FWI) with fire behaviour predictions to determine the risk of forest fire. The FWI is a subsystem within the NZFDRS incorporating fuel moisture and weather conditions to determine fire behaviour and fire danger. New Zealand adopted the methodologies of the Canadian FWI system and the Rural Fire Research Team adopted, added and modified it for the New Zealand's unique fire environments. The fire indices are used before and during wildfire incidents to better understand the fire behaviour and risk.

Within the system weather observations of temperature, rain, relative humidity and wind are used to determine three fuel moisture codes: Fine Fuel Moisture Code (FFCM), Duff Moisture Code (DMC), and Drought Code (DC). These metrics then determine the fire behaviour indices: Initial Spread Index (ISI), Build-up Index (BUI), and finally the Fire Weather Index (FWI). Each of the metrics within the FWI system is a numeric rating with a higher value as the fire danger increases.

The FWI was mentioned in the interviews with the IC, IMT and public land managers.

Wildfire Threat Analysis (WTA)

The Wildfire Threat Analysis (WTA; Majorhazi & Hansford 20011) is a planning tool developed by the National Rural Fire Authority for identifying wildfire threat based on risk, hazard, and values. In the interviews with public land managers, it was identified as a useful tool but noted that, while good for broad regional scale planning, it did not provide information on site specific planning. It also lacked regular updates.

Prometheus / WISE

Prometheus is a Canadian wildfire growth model that simulates fire spread based on the fuel, topography and weather conditions (https://firegrowthmodel.ca/#/prometheus_overview). It has been adapted for New Zealand FWI inputs, fuel type and fire behaviour and has been used in New Zealand for over a decade.

Prometheus can be more complex to use than other tools and therefore is difficult to use during a wildfire event; although historically Intelligence has used data produced by this model to understand wildfire risk for road closures and evacuations. The model requires intensive training in how to use it. Currently, Prometheus is run by FENZ and DOC by trained staff and sometimes BSI researchers are called upon during a wildfire event. Prometheus has reached end of life, and while the programme still runs, there is no further development or support. This means that as computer software is upgraded, the Prometheus programme will eventually become obsolete.

The Wildfire Intelligence Simulation Engine (W.I.S.E. https://firegrowthmodel.ca/#/wise_overview) has replaced the Prometheus model. It is an open-sourced simulation engine that offers additional capacity over the desktop version of Prometheus. However, W.I.S.E. does not include a user interface and requires increased technical skills compared to Prometheus, requiring the user to have an understanding or experience with both fire behaviour modelling and programming languages.

This tool was specifically mentioned during interviews with FBANs, public land managers, and forestry managers, although the latter specified that the capability of using this modelling is decreasing.

Fire Registry and Smoke Forecasts

The Fire Registry (<https://www.ruralfireresearch.co.nz/resources/tools/fire-registry>) is a tool developed by Scion (now Bioeconomy Science Institute; BSI) that uses satellite detections of hotspots, the WISE fire growth model, and the BlueSky smoke modelling framework (Larkin et al. 2009) to produce real-time fire growth and smoke dispersion forecasts. While the smoke forecast is publicly available, the fire growth forecast has access limited to specific users, mostly amongst BSI researchers, FENZ and DOC. Since the forecasts are dependent on a satellite fire detection, the information can be delayed due to cloud cover and satellite overpass times. The model has a ready-made input stream for ground detected fires for such a time when FENZ is ready to feed the information into the modelling framework. The Fire Registry and smoke forecast tools were mentioned in the interview with the FBANs.

Rural Fire Pamphlet

In the interview with the forestry managers, it was identified that small forestry owners have fewer tools available to them and are largely reliant on a rural fire pamphlet created by FENZ, farming associations, and forestry associations. The rural fire pamphlet (<https://www.nzfoa.org.nz/resources/file-libraries-resources/fire/831-rural-fire-guidelines-managing-the-risks/file>) focuses on prevention and identifies actions to take before a wildfire starts.

Other pamphlets around rural fire and wildfire prevention have also been produced for landowners and managers, such as the Practical Guide to Rural Fire (<https://www.fireandemergency.nz/assets/Documents/Files/NZFS3278-Practical-Guide-to-Rural-Fire-FA-LR.pdf>). These pamphlets give advice on the most common wildfire causes and how to reduce them, on vegetation types and fuels management, and on protecting resources.

Fire Behaviour Calculator

The Fire Behaviour Calculator is a part of the NZ fire behaviour toolkit developed by Scion, now BSI (<https://www.ruralfireresearch.co.nz/resources/tools/fire-behaviour-toolkit>). The calculator (and the associated apps) quantifies fire potential of New Zealand fuels using information on

fuels, topography, and weather conditions. It is designed for producing quick estimates on the fire ground as well as helping landowners to determine fire behaviour potential to reduce escapes from burn-offs.

This tool was specifically mentioned during interviews with FBANs.

3.3 Needs of decision makers

From the interviews several areas were identified where smart firefighting could help decision makers prior to and during wildfires, including needs in science, communications, and personnel. Many of the pain points and needs were common across the different roles which is not surprising given many of these roles work closely together. These needs could generally be split into the themes of data, tools, knowledge, training and communication.

Data

The data-based needs generally came from the fire ground during a fire. Data on fuels and weather are all vital to smart firefighting tools, but accessing or collecting this data can be difficult. The FBANs and DOC raised concerns with available fuel maps as these often have low spatial accuracy and can quickly become outdated. Forestry managers noted that good fuel data is available for many large forestry blocks, but it is not easily sharable with firefighters. The FBANs also raised concerns around accessing weather data, as data for specific locations can be difficult to find and extract. Even when data is accessible, the models and tools used by the FBANs require it to be in specific formats. The need for a tool that could join large scale weather data with observations from the fire ground, and create model ready input, was suggested here.

It was noted during the interviews with the IMT and IC that there can be a lack of information about the fire ground, including land and property owners and relevant points of contact. This makes it difficult to ascertain information about the location and accessibility of any values or assets. Forestry managers also raised this need, noting that firefighters may not know the different values on a forestry block in order to prioritize them.

Both the IC and IMT interviews highlighted the need for data or information about the fireground before first responders arrive at the fire. This can include data on access, landowners, fuels, topography, weather, and site-specific hazards. A tool that could store this information and quickly provide it based on a location was suggested. IMT and forestry managers thought that a summary of the potential fire environment, and particularly the forest fire environment, would help any firefighters not familiar with the area.

Tools

In the interviews with the FBANs, IMT, and IC, there were many instances of pain points caused by the current smart firefighting tools missing important features. The FBANs raised the issue that fire behaviour models do not include the spread of fires through spot fires, possibly underestimating fire spread. The current fire behaviour tools also do not include rate of spread for specific fuel models, and there is no easy way to incorporate adjusted inputs, such as the fine fuel moisture code affected by slope or aspect. The FBANs also expressed the need for building materials to be incorporated into fuel models to aid the understanding of fire behaviour in mixed environments. There is also the need for a conversion between fire intensity and heat flux to understand the fire rating of different building materials. The IC expressed the need for a quick way to run fire growth simulations as the current models can be difficult or timely to run. The IMT raised the issues around the dependence on digital tools, as it can be problematic to transfer and communicate any data collected in remote areas, leading to delays.

Knowledge

During the interviews many areas were identified where pain points are caused when knowledge or understanding is lacking, especially for those who don't often work in readiness and response to wildfires. Much of this was around the understanding of fire hazard reduction. In the interviews with DOC, it was raised that there is little advice on how to prioritise different reduction activities, which is important for cases with few resources and multiple threats. It was also difficult to determine how to monitor the success of different methods for prioritisation and/or enhancement in the future. Part of this uncertainty was due to a lack of understanding on the extent different wildfire prevention activities influence wildfire. In the interviews with forestry personnel, uncertainty was expressed around the wildfire hazard of different tree species and densities. There was a lack of understanding on how wildfire hazards change across a landscape, and the effectiveness of different forestry land management techniques on reducing wildfire hazard was not known.

Both DOC and forestry managers acknowledged a degree of uncertainty around how well current smart firefighting tools are understood. It was unclear how the fire weather system indices should be prioritised in decision making or what the threshold values were. This gap in understanding could limit managers' ability to take proactive measures to prevent fires, such as closing areas to the public (DOC), or stopping high risk operations (forestry). Concerns were also raised around the language used in firefighting guides, with a suggestion that small forestry owners lacking wildfire experience may struggle to interpret technical terms.

During interviews with forestry managers, another pain point emerged that firefighters may not fully grasp the different values within a forestry block. The absence of a quick way to weigh these values against suppression costs could hinder effective protection and prioritisation of values.

Additional uncertainties around wildfire knowledge included a lack of understanding on where ignitions are most likely to start (raised by the forestry managers) and a lack of understanding on the interactions between climate change, disease, and wildfire (raised by DOC). These are both areas where more research is needed.

Training

Within the FENZ roles common pain points centred around training and capability gaps. The ICs and the IMTs highlighted the need for a tool to track resources and training qualifications. This would help ensure the correct people in the right positions on the fire ground and help with identifying training needs. ICs also noted challenges regarding tracking resources onsite during burns as it can be difficult to track and keep up-to-date records on people arriving and leaving a site. Another issue raised was the lack of mapping capability required to produce accurate maps of the fire ground, resulting in this job often being outsourced. This could be addressed by a simpler mapping tool.

Several pain points related to a lack of standardised procedures. The FBANs raised the need for a consistent way to make and document decisions on the fire ground, including how their information is shared with other decision makers. This would support both real-time decisions and with justifying decisions post-fire. The FBANs and the IMT also called for a standardised approach to collecting fire ground data, suggesting that tools could streamline data collection and record keeping. The FBANs further raised concerns about validating their predictions, as no process exists for comparison with the observed fire behaviour. Finally, the IMTs highlighted uncertainty around demobilisation following an event.

Communication

Many of the needs listed above relate to communication - both on and off the fire ground. Examples include sharing data during operations and communicating decisions from the fire ground to stakeholders. Continuing this theme, interviews revealed additional pain points around interagency communication, especially when critical data and information is available but not shared. IMTs noted that data sharing is often dependent on pre-existing relationships, making collaboration inconsistent. Another challenge is map sharing, as different stakeholders often use incompatible mapping systems.

A system or tool to improve interagency communication and ensure compatibility was suggested. Forestry managers also proposed a platform for directly sharing fire ground information with firefighters during incidents on forestry land.

3.4 Meeting the needs

Several of the needs and pain points raised during the interviews with decision makers could be mitigated through further development and use of smart firefighting tools. Other needs might require further research, training, or procedural change. Tools, such as a weather interface or interagency data sharing platform, could improve the accessibility and usability of data. Improvements or add-ons to fire behaviour modelling tools could simplify and enhance these tools, and potentially reduce the training needs to use them. In areas where understanding or knowledge is lacking, decision-support tools could guide informed decision making, provided users understand the purpose, assumptions, and limitations of any tools they rely on. Smart tools also have the potential to reduce the training burden by simplifying tasks such as resource tracking, map production, and data collection.

Since the interviews, progress has been made on several of the needs identified. At the Bioeconomy Science Institute (BSI) an ignition probability map has been created to improve understanding of ignition likelihood across different environments. BSI has also calculated wildfire hazard potential which can answer many questions regarding wildfire hazard and risk (Kiely, Gross, & Schou 2026). To aid with better understanding of wildfires in New Zealand, the New Zealand Wildfire Occurrence Database has also been created through a collaboration of the BSI, FENZ, and DOC (Kiely, Gross, Woods, et al. 2026). This database makes historic wildfire records, and data on the conditions wildfires occurred under, easily accessible to the public.

4 Conclusions and future work

This roadmap identifies the needs of key decision makers for smart firefighting in New Zealand and suggests ideas for smart fire-fighting tools to meet those needs.

The roadmap began by bringing together stakeholders of New Zealand firefighting: FENZ, DOC, forestry representatives, and Scion (now BSI). Through a workshop and survey, it was discovered what is considered most important for smart firefighting. Solutions were viewed as highly valuable across multiple decision maker roles, with tools for pre-fire planning preferred over those for active wildfire response. Tools that improve understanding of fire behaviour and risk emerged as the top priority.

Interviews with the identified key decision makers revealed specific needs and pain points, as well as the current smart firefighting tools in use. It was found that although many smart firefighting tools are already used, there is a need for new and improved tools in many areas. The needs were mainly focused across five categories: data, tools, knowledge, training, and communication. Most of these needs could be addressed through new or improved smart firefighting tools.

The needs identified in this report were identified in 2022, and aspects could have changed in the past 4 years. Since this roadmap began, significant progress has been made, and new tools are already helping to mitigate some of these needs. However, as with all tools, regular updates and maintenance are essential for keeping the tools effective. There are several needs that could still be aided by additional smart firefighting tools. The ideas suggested here could provide a starting point for this, but is not intended to be an exhaustive list, and many other solutions may be needed.

As wildfire in New Zealand evolves under a changing climate, the needs for smart firefighting will also change. New tools may be needed, and existing tools will likely need to adapt. Maintaining strong connections between tool users and the researchers and developers who create them will be critical to success.

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6 Appendix: Survey of priorities in smart firefighting

The questions asked in the survey sent to workshop attendees were:

- Vote for the four decision makers/roles for whom you believe smart firefighting solutions will provide the greatest value for wildfire planning, response, and recovery
 - Private land managers
 - Public land managers
 - Wildfire researchers
 - Fire Behaviour Analysts
 - Firefighters
 - Incident Controllers
 - GIS Intelligence
 - Public Information
 - Other
- Do you think the main priority for smart firefighting tools to be implemented is:
 - Prior to a wildfire
 - During a wildfire
 - Following a wildfire
- Where do you believe smart firefighting solutions should focus? Please rank the options in the order of importance, starting with the most important as 1.
 - Prototype to identify the best time to burn
 - Prototype to collate historical data and make future projections related to smoke and wildfire (hazard)
 - Prototype to predict and analyse fire behaviour
 - Prototype to understand fire risk across the landscape
 - Prototype to increase accessibility of spatially relevant data (e.g. assets, ecological and cultural resources, access)
 - Prototype to track wildfire response resources (e.g. firefighter locations)
 - Prototype for sharing information with the public (e.g. smoke forecasts, evacuation ones, closed roads)
 - Other
- Is there a need for the above prototypes to provide:
 - Additional capacity to be used as a training tool
 - A tool to improve collaboration (e.g. to enable data sharing across organizations, provide a platform to share decisions)

