

Fire Research Report

Metadata Analysis of the NZFS Commission Contestable Research Fund

BERL

August 2010

BERL has used metadata analysis and economic methodology to undertake a review of the NZFS Commission contestable research fund. The stated purpose of the fund is to advance knowledge in fire prevention and fire management to meet the NZFS Commission's statutory interest. Between 1998 and 2010, the fund has commissioned research that has advanced fire prevention and fire management knowledge and resulted in over 100 research reports. The research assessment framework established to complete the metadata analysis incorporated economic methodology, principally benefit-cost analysis, with the strategic research framework established by CRESA in 2003. As well as cataloguing the data, the metadata analysis therefore considered the change (benefit) that has occurred as a result of the research.

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economics

Report to:

New Zealand Fire Service Commission

**METADATA ANALYSIS OF THE NZFS COMMISSION
CONTESTABLE RESEARCH FUND**

Prepared by

Dr Ganesh Nana

Fiona Stokes

Wilma Molano

August 2010

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1 Introduction

This report has been prepared by Business and Economic Research Limited (BERL) for the New Zealand Fire Service (NZFS) Commission.

BERL has used metadata analysis and economic methodology to undertake a review of the NZFS Commission contestable research fund. The stated purpose of the fund is to advance knowledge in fire prevention and fire management to meet the NZFS Commission's statutory interest. Between 1998 and 2010, the fund has commissioned research that has advanced fire prevention and fire management knowledge and resulted in over 100 research reports.

BERL has used metadata analysis to catalogue and analyse 34 projects that have been completed as part of the contestable research fund. For the purposes of this research, metadata analysis has been defined as data about data, or more accurately, as data used to describe other data. The 34 research reports were chosen on the basis of their representation of a subject area and strategic objective, their budget, and the period the research was completed in.

The research assessment framework established to complete the metadata analysis incorporated economic methodology, principally benefit-cost analysis, with the strategic research framework established by CRESA in 2003. As well as cataloguing the data, the metadata analysis therefore considered the change (benefit) that has occurred as a result of the research.

The following sections of this report provide a description of the research methods applied in the metadata analysis, definitions of the associated terms, and our findings and conclusions.

1.1 Summary

We assessed 34 research reports according to two overarching criteria, as follows:

- whether the research was associated with a strategic priority area or areas.
- whether the research outputs were applicable to the purpose of the NZFS, or there was a link between the outputs and the operational responsibilities of the NZFS, in terms of fire safety, fire prevention, and fire extinction.

Table 1.1 confirms that a large proportion of the research completed as part of the contestable research fund is associated with the NZFS strategic objectives of improving community fire outcomes, and contributing to enhanced community security.

We found no evidence of projects that were not related to at least one of the strategic objectives of the NZFS.

However, there was a clear lack of research associated with two of the five strategic objectives. To date, only a small amount of research has been completed that meets the strategic objectives to increase the integration between the urban and rural service delivery and develop and protect people, and promote internal stakeholder partnerships. This may be due to the internal focus of these strategic objectives. These two objectives are focused on the human aspects of the NZFS and their internal processes, policy and programmes.

Table 1.1 NZFS research by strategic objectives, sample population

NZFS strategic objectives	Frequency*	Percent
Improve community fire outcome	28	82.4
Increase integration of urban and rural service delivery	1	2.9
Contribute to enhanced community security	28	82.4
Improve service performance accountability and resource management	17	50.0
Develop and protect people and promote internal stakeholder partnership	8	23.5
*Multiple responses		

BERL calculations

If the NZFS was to undertake more internal monitoring and evaluation research, the amount of research that meet the strategic objectives to increase the integration between the urban and rural service delivery and develop and protect people, and promote internal stakeholder partnerships could potentially grow.

Table 1.2 NZFS research outputs by purpose, sample population

NZFS purpose	Frequency*	Percent
Fire safety	25	74
Fire prevention	30	88
Fire extinction	14	41
* Multiple responses		

BERL calculations

In terms of the NZFS purpose and operational responsibilities, our assessment is summarised in Table 1.2. It is clear that the majority of research outputs are associated with, or have links to, the fire safety and prevention purpose of the NZFS. However, we found relatively less linked to the fire extinction purpose.

Further, according to our sample analysis, neither the size¹ of projects nor the type of research organisation were determining factors in establishing the relationship between

¹ In terms of research funds invested.

research outputs and the NZFS purpose and strategic objectives. Consequently, we do not see a need to recommend any significant modification in investment criteria in favour of (or against) large (or small) scale projects, or directed at any particular organisation type.

Given the close alignment of funded projects and their outputs to the purposes and strategic objectives of the NZFS, we are comfortable in concluding that the Contestable Research Fund is a valuable investment.

2 NZFS contestable research fund

In the late 1990s, the NZFS Commission determined that the NZFS should make a greater investment in research. As such the contestable research fund was established. The fund now has a funding pool of \$550,000 per annum, which is static.

2.1 Background information about the fund

The stated purpose of the contestable research fund is to advance knowledge in fire prevention and fire management in New Zealand in order to meet the Commission's statutory interest as laid out in the Fire Service Act 1975 (Part II). A research advisory group was formed to administer the fund. This advisory group provides advice to the NZFS Commission regarding areas of research and research priorities that will assist the NZFS in meeting their mission of reducing the incidence and consequence of fire.

Longitudinal studies are not completed as part of the contestable research fund. Each research project must be completed within 12 months. This is to ensure the research informs the work of the NZFS Commission. To inform, the research needs to provide robust analysis for decision-making, and inform practice and procedure. It should allow the NZFS to act promptly in response to research findings, and in turn influence legislation such as submissions and changes to the Building Act, and align research activity to topical areas of interest nationally and internationally.

2.1.1 *Applying to the fund*

Each year between 25 and 35 expressions of interest are received by the NZFS Commission that encompass a wide variety of research topics. In the first year the fund was established 70 expressions of interest were received. The NZFS Commission annually receives expressions of interest from new companies, which indicates that the Commission is reaching a wide variety of people through the advertising mediums they employ.

The expressions of interest are judged according to the following criteria:

- relevance of the research to the Commission's strategic priority areas
- capability of the organisation and its staff
- track record of the organisation in carrying out research projects
- description of a sound methodology

- identification of applicable outputs
- cost.

A limited number of organisations are then invited to submit detailed proposals for scrutiny by the research advisory group.

The research round priority areas form part of the expression of interest documents. There are topics that remain central to the research fund each year but some topics are new or green field topics. These green field topics can come from members of the community, including research organisations, or from within the NZFS.

In the first round of contestable research in 1998/1999, the NZFS Commission identified the following as its research priorities:

- how people learn about the effects of fire in the urban and rural sectors
- how they respond in an emergency
- how strategies and actions may be identified to reduce the risk to people in a fire
- how strategies and actions may be identified to mitigate against the effects of vegetation fires
- identification of strategies to assess hazards of vegetation in the rural areas and to determine resource requirements accordingly
- how these strategies may be communicated to vulnerable groups
- research in relation to New Zealand Standards and Codes of Practice relevant to the Commission's strategic goals
- achievement of the Commission's goals in respect of reduction of false alarms.

Seventy applications were received from within and outside of the NZFS to complete research as part of this first round. Of this number 20 projects were selected to be developed into detailed proposals. This shortlist was based on the Commission's stated aims for the fund, an assessment of the track record of the organisations, and the perceived usefulness of the project outcomes. This shortlist also considered the best value for money and whether the research would meet the required standards.

The cost of the research is a consideration for the NZFS Commission, due to the fund having a set amount of money to distribute. However, the value of the work in terms of where and

how it can be used by the NZFS and their external stakeholders, and the ability of the research to inform, is also a serious consideration.

From 2004, the NZFS Commission aligned its research priorities to its strategic objectives. The following list illustrates this for the 2004-2005 research round:

- Identifying and influencing vulnerable communities
 - impact of targeted programmes on vulnerable groups
 - identifying intermediate outcomes for fire safety goals
- Cost-benefit studies to support legislative change to improve fire safety in buildings
 - analysis of the revised purposes of the Building Act 2004
 - measures of building fire risk
 - loss reduction in industrial buildings
- Incidence and control of vegetation fires in rural areas
 - projects in alignment with the Rural Fire Research Strategy
- Developing and supporting our people
 - validation of the recently introduced firefighter recruitment programme
- Techniques and technology for firefighting and reduction of fire impact
 - international approaches to reducing deliberately lit fires
 - impact of Fire Service activity in prevention of property loss
 - Fire Service impact on the environment.

2.2 Commissioned research projects

Between 1998 and 2009, the NZFS Commission has commissioned over 100 research projects.

The return on investment in these research projects for the NZFS Commission is to meet their strategic objectives and national goals. The strategic objectives are:

1. Improve community fire outcomes
2. Increase integration of urban and rural service delivery
3. Contribute to enhanced community security
4. Improve service performance accountability and resource management
5. Develop and protect people and promote internal stakeholder partnerships.

Their national goals are to decrease the total number of fires, the avoidable fire fatality rate, and the number of life threatening and moderate injuries per 100,000 population.

2.3 Published research

Research completed as part of the NZFS contestable research fund is predominantly presented as published research reports. Currently, these published reports are publicly available on the NZFS website.

To make the research and their published reports readily accessible to the public, the reports are grouped into the following key research areas: built environment; earthquake; environmental; rural; volunteer/people; epidemiological; fatal; social; and Māori. A research report is not unique to a key research area. For example, a report completed in 2005 by Heimdall Consulting Ltd appears in the social and fatal research areas. This report is entitled *Human Behaviour Contributing to Unintentional Residential Fire Deaths 1997-2003*. Within each of these research areas, topics are researched within the context of fire safety, fire prevention, and fire extinction.

2.3.1 Primary audience of the contestable research fund

The primary audience of the research completed as part of the contestable research fund is the NZFS. However, the reports and data can be used by other audiences who have an interest in fire prevention and fire management practices, and human behaviour towards and interaction with fire. These audiences can include central and local government, Crown Research Institutes, land and forest owners, engineers, researchers, third party advertisers, firefighters in the United States, United Kingdom and Australia, and others with a concern in the prevention and extinction of fires.

2.4 Who uses the published research

The research is used by the NZFS to build capability and capacity to reduce the incidence and consequence of fire, and to provide a professional response to other emergencies.

Internally, the research findings and recommendations are communicated to firefighters through presentations, training sessions, and resources. These resources can include resources used in fire prevention and fire reduction work in the community. Internal stakeholders are also informed of the research that supports education programmes, advertising campaigns, and fire prevention and fire reduction work.

The research may be referred to by NZFS staff such as operational crews, fire safety/fire risk management officers, volunteer support officers, or iwi liaison officers when they work with groups in the community. These staff members could refer to the research findings as part of their presentations, as supporting research, or as part of a demonstration.

Some research areas are more relevant to particular sections of the NZFS. For example, research into the economic costs of wildfires or the impact of climate variability and seasons on fire danger may be of more interest to the National Rural Fire Authority or volunteer firefighters working in rural areas. While reviewing the recruitment programme to select trainee firefighters may be of more relevance to members of the NZFS involved in training, development and strategic planning. Other research, such as that which considers the role of human behaviour in regards to fire ignition and unintentional death, may be relevant across all sections of the NZFS, and impact on the work the NZFS does with the community to positively influence and change behaviour. This research could be used in firefighter and operational staff education and training.

2.5 How is the published research used

Research completed as part of the contestable research fund can be used in fire safety or fire prevention advertising campaigns or education programmes, and in improving fire extinction procedure and practise. It can also be used to promote fire safety and prevention systems to builders, building contractors, and building associations; building owners such as property developers and landlords; and home owners.

The NZFS has several educational programmes that they invest in. These programmes are designed to teach basic through to progressively more complex fire safety messages. They are supported by research completed as part of the contestable research fund.

Much of the research that underpins the advertising campaigns and education programmes the NZFS invests in was completed during the establishment of the fund. This research is considered fundamental as it underpins much of the work completed by the NZFS now.

2.5.1 Fire prevention and suppression research

Research has assisted the NZFS to anticipate and plan for fire events or high risk fire seasons, and resource allocation and management. This planning includes the NZFS working with external stakeholders to manage the risk of fires, and anticipating when trained people will need to be available. It can also include training in fire risk management, incident control, decreasing the impact of the fire on the environment, and decreasing the spread of the fire.

In urban centres, fire extinction procedures and practises can also draw on modelling that maps fire spread in and around urban centres. This modelling was completed as part of research that determined the dominant fire-spread mechanism for urban buildings was via non-fire rated roofs or openings in walls. Vegetation (between buildings and suburbs) also facilitates fire-spread where it may not have otherwise occurred.

Research information can also help firefighters prepare for attendance at domestic fire incidents. For example, research completed as part of the contestable research fund found that fatal incidents occurred predominantly at night and in the weekend, and that winter and spring saw more incidents occurring. Further, fatal fires most commonly started in a bedroom, sleeping area, kitchen or lounge.

Fire prevention research has identified that the most common type of stove-top fire is associated with the ignition of food, grease or cooking oils, and the most costly was unattended cooking fires. It argued that there are many ways of approaching the reduction of cooking fire problems – community education, improved detection, thermostatic safety controls on cooking equipment, and suppression systems.

Fire suppression research has focused on the installation of fire alarms, and there has been some work completed on low-cost sprinkler systems and other fire suppression systems. This research has focused specifically on low-cost stove-top fire suppression and the retrofitting of these local fire protection systems. If these systems can be proven to be cost-effective and have a good coverage area, they could reduce the incidence and consequences of kitchen fires. The system effectiveness is based on the operational reliability of the components and system, and the fire protection effectiveness. However, the situation of the fire being prevented in the first place is the most desired outcome.

It can be argued that any research that helps to decrease fire deaths and injuries, and the associated reduction in the amount of fire-damaged property, will have a positive influence on public health and emotional, social and economic benefits.

2.5.2 Human interaction with fire

Research provides the supporting evidence for advertising campaigns and education programmes that may be targeted at the general public, vulnerable groups in the community, or groups identified through the research as exhibiting risky behaviour. For example, national television commercials focus on identified audiences such as children, male children, or males of a certain age. These ads include the '15 seconds call to action'; 'Speed of fire'; 'Kohanga Reo'; 'Firewise crew'; and 'Consider yourself dead'.

Research has illustrated that people involved in fatal fires are agents in some capacity of fire ignition, and their deaths are often the consequence of habitual behaviours, short-term or chronic incapacity, or irrational behaviour that directly contributed to the fatal outcome. Fire safety, fire prevention and fire extinction campaigns have therefore focused on raising awareness regarding the dangers of smoking, drinking and cooking; fighting fires rather than escaping; taking notice of fire cues and getting out; and safe practises in terms of using candles as lighting and heaters.

For example, research completed in 2001 by the University of Otago highlighted the correlation between abandoned or unattended cooking, alcohol and fatal house fires. This research provided the NZFS with data and information that was subsequently used in advertising and education programmes to target certain groups, and improve the fire safety knowledge and behaviour of the public. It also helped the NZFS to meet their national goals of achieving and maintaining the estimated total number of fires, the number of fires in structures, the avoidable residential structure fire fatality rate and the number of life threatening and moderate injuries per 100,000 population.

The benefits of this research project, and its evaluation and monitoring, are that the results can then be used in advertising campaigns. It also provides the NZFS with ideas for future campaigns and ways of targeting key audiences and vulnerable groups within the general public. In terms of short-term changes, behaviour changes can be measured through the annual national fire knowledge survey. Here, the impact of fire safety messages on target audiences can be checked to ensure the comprehension and recall of target messages is high. Changes to advertising campaigns can then be made quickly or incorporated through seasonal campaigns.

3 Definitions

A review of the contestable research fund was completed by the Centre for Research, Evaluation and Social Assessment (CRESA) in 2003. This review focused on social research and social research methodologies, and argued that there needs to be a clear link between the research completed and the operational responsibilities of the NZFS. It categorised the research into investigations, monitoring and evaluation. This review looked at previous investigations or completed research, new investigations or areas of research, and new monitoring and evaluation methods, as well as the rationale for new research.

3.1 Social research

Social research is defined by CRESA as helping to gain knowledge about the social world. It incorporates a variety of perspectives, methods of gathering information, and ways of analysing data (The Centre for Research, Evaluation and Social Assessment, 2003). The most useful social research for the NZFS is applied in nature, and provides the evidence base for management and operational activities (The Centre for Research, Evaluation and Social Assessment, 2003).

When the social research strategy was completed in 2003, the research projects that were evaluated needed to be oriented to practical problem-solving and increase the understanding of the human aspects of the NZFS's work (The Centre for Research, Evaluation and Social Assessment, 2003).

Social research includes investigations, monitoring and evaluation. CRESA defined these areas as:

- Investigations are conducted to improve knowledge through describing a problem or phenomenon and its causes and effects. Investigations assist in developing or refining a policy, programme or management process.
- Monitoring is used to establish baseline data and track changes over time.
- Evaluation is undertaken to determine the merit or value of a policy, programme (intervention) or management process. Its operational relevance is to feed into decisions concerning the effectiveness of a policy, programme or management process, and whether the policy, programme or management process should be continued.

This research excluded research on the physical or environmental impacts of fire and related human activity. It only looked at research carried out in the social field that links to the operational responsibilities of the NZFS.

3.2 Benefit-cost analysis

Over 100 research reports have been published as part of the NZFS Commission's contestable research fund since its inception. The social research strategy was devised in 2003, and consequently a further review of the research completed as part of the contestable research fund was required. This review uses economic methodology, in particular benefit-cost analysis, to provide the NZFS Commission with another measure to prioritise new areas of research.

3.2.1 Methodology used to apply benefit-cost analysis

An individual (or a firm or society) should take an action if the extra benefits from taking the action are at least as great as the extra costs.

On a daily basis people make economic decisions. As part of this decision-making they attain something of value to them while going without something else that they may also value. These decisions inevitably involve trade-offs and compromises. Similarly, the NZFS Commission as part of determining their annual research priorities for the contestable research fund use economic decision-making, such as trade-offs and compromises based on the weighing of benefits and costs, to decide what research will gain funding.

The biggest difficulty in applying the benefit-cost principle is to determine reasonable measures of the relevant benefits and costs. Particularly, as the exact dollar measure for costs is rarely available. However, it can be argued that a benefit-cost framework can lend structure to reasoning even when no relevant market data is available (Frank, Jennings, & Bernanke, 2007).

Examining the framework for social research completed by CRESA in 2003, the rationale for research and in turn new investigations, monitoring and evaluation may be based on marginal benefit-cost decision-making. This is where the issue is not whether the new investigations, monitoring and evaluation should be pursued, but the extent to which they should be pursued i.e. the benefit and cost of an "additional unit of activity".

Once it has been determined if the research meets and advances the strategic objectives and national goals of the NZFS, the next decision then centres on the key recommendations of this research. If there is to be an uptake of the recommendations the rationale needs to consider the benefit-cost principle. Unfortunately, not all of the benefits are quantitative, which means qualitative measures need to be considered such as the improved level of capability and capacity of the NZFS to reduce the incidence and consequences of fire.

4 Metadata analysis

For the purposes of this research we have defined metadata analysis as data about data, or more accurately, as data used to describe other data.

4.1 Methodology

Our project brief was to examine 30 research reports. However, upon closer examination of the project reports it became apparent that one project may produce several reports. As such, we have defined a research project as one coherent piece of study. And when this has occurred, multiple reports have been grouped together into one project. This means we have examined 34 research reports. These research projects were chosen on the basis of:

- representation of a subject area/strategic objective
- budget
- period the research was completed in.

Our benefit-cost analysis focused on research that has been *completed* as part of the NZFS Commission contestable research fund. Therefore, it is a *retrospective* analysis.

4.1.1 Benefit-cost analysis

The research assessment framework we used to complete our metadata analysis incorporated benefit-cost analysis methodology with the strategic research framework established by CRESA in 2003. As well as cataloguing and analysing the data, our metadata analysis considered the change (benefit) that occurred as a result of the research. Previous work completed by CRESA on the social research strategy argued that there needs to be a clear link between the research completed and the operational responsibilities of the NZFS, hence the need for monitoring and evaluation. We considered this as part of developing our framework.

The biggest difficulty in applying the benefit-cost principle is to determine reasonable measures of relevant benefits and costs. We have defined a reasonable measure of the benefit as the change that has occurred as a result of the research project, and a reasonable measure of the cost as the cost of completing the project.

Not all benefit measures are quantitative, which means we have also considered qualitative benefit measures. Further, while we know the cost spent on each project funded by the NZFS Commission contestable research fund, we do not know the cost of the research that has been foregone due to other research being prioritised or funded. The exact dollar measure of this cost is not available.

BENEFITS – change that has occurred as a result of the research

COST – cost of completing the research, and research that has been foregone due to this research area being prioritised

4.2 Cataloguing of the reports

For the purposes of this research we used the key research areas that the NZFS groups their published reports into to initially examine the research from the perspective of ‘themes’.

Table 4.1 NZFS research by research area and strategic objectives, total population

	Improve community fire outcome*	Increase integration of urban and rural service delivery*	Contribute to enhanced community security *	Improve service performance accountability and resource management*	Develop and protect people and promote internal stakeholder partnership*
Built environment	74	2	72	68	22
Earthquake	3	0	3	3	1
Environment	10	0	9	5	7
Rural	20	1	20	21	4
Volunteer/people	1	1	1	6	4
Epidemiological	8	0	8	5	0
Fatal	14	0	14	4	3
Social	31	0	31	18	5
Maori	3	0	4	2	0

*Frequency indicates multiple responses

BERL calculations

As shown in Table 4.1 above, a research project can encompass many ‘themes’ and meet several of the NZFS strategic objectives. Analysing the research projects from this perspective provided us with a good overview of the type of information and data that was being produced, the companies involved in the research, the costs associated with the research, and the various recommendations that were being made. It also allowed us to explore how the research met the five strategic objectives of the NZFS.

The five strategic objectives that guide the service delivery of the NZFS are:

1. Improve community fire outcomes
2. Increase integration of urban and rural service delivery
3. Contribute to enhanced community security
4. Improve service performance accountability and resource management
5. Develop and protect people and promote internal stakeholder partnerships.

4.3 Review of the reports

Once we initially examined the research from the perspective of key research areas, we then further catalogued and analysed the reports. We considered the following aspects:

- research round that the research was completed in
- date the report was published and whether the research was completed within 12 months
- company that completed the research
- research methodology employed
- whether the research was fundamental or applied in its nature
- cost of the research and whether the research authors had received additional funding
- key research area, based on the NZFS website classification

As shown in Table 4.2 below, the largest amount of research was funded in the early years of the contestable research fund. The largest number of projects funded was in the 2000-2001 research round, where 14 projects were funded. The smallest number of projects funded was in the 2003-2004 research round, where only six projects were funded.

Table 4.2 NZFS funded research, 1998-2009, total population

Round year	Frequency
1998 - 1999	12
1999 - 2000	13
2000 - 2001	14
2001 - 2002	8
2002 - 2003	9
2003 - 2004	6
2004 - 2005	10
2005 -2006	10
2006 - 2007	8
2007 -2008	9
2008 - 2009	7
Total	106

BERL calculations

Using this distribution as a guide, we attempted to have an even distribution across the years that the contestable research fund has been operating in our sample. However, as shown in Table 4.3 below, we were top heavy in choosing research from the early years of the fund, as we considered that many of these projects were fundamental and set the scene for subsequent research, including evaluation and monitoring.

Table 4.3 NZFS funded research, 1998-2009, sample population

Round year	Frequency
1998 - 1999	3
1999 - 2000	6
2000 - 2001	6
2001 - 2002	3
2002 - 2003	4
2003 - 2004	1
2004 - 2005	1
2005 -2006	4
2006 - 2007	2
2007 -2008	2
2008 - 2009	2
Total	34

BERL calculations

We also considered the research from the perspective of the type of company that completed the research. The classifications that we grouped the companies into were academic institution such as a university, Crown Research Institute such as NIWA, the New Zealand Fire Service itself, and research consulting group such as BERL. As shown in Table 4.4 below, the majority of the research is completed by research consulting groups, followed by academic institutions.

Table 4.4 Research organisations completing NZFS funded research, total population

Organisation classification	Frequency
Academic institution	24
Crown Research Institute	21
NZFS	2
Research consulting group	57
Total	104

BERL calculations

A small number of research projects have been abandoned or have not resulted in a published report. These projects have been abandoned due to a lack of data and/or information, or the results once completed were no longer relevant. This is why the number for the total population in this table differs from the total presented in previous tables.

The distribution of the type of company that completed the research for our sample population is shown below.

Table 4.5 Research organisations completing NZFS funded research, sample population

Organisation classification	Frequency
Academic institution	10
Crown Research Institute	6
NZFS	1
Research consulting group	17
Total	34

BERL calculations

As part of reviewing the reports we also considered the cost of the research. The cost of the research was supplied by the NZFS, and data on cost was missing from 13 of the 106 research reports.

The smallest amount funded for a project was \$3,200 for a research project completed by Chilton St James School in the 1999-2000 contestable research round. This project was a pilot study that identified strategies to access vegetation fire hazards. The next smallest amount funded for a project was \$4,100 for a project completed by Bailey Partnership Limited in the 2000-2001 research round. This project analysed vehicle fires using a fatal accident database.

The largest amount funded for a project was \$140,000 for a research project completed by NZCER. This project aimed to improve the fire safety knowledge and practices of vulnerable groups. It was completed in the first round of the contestable research fund, 1998-1999.

The second largest amount funded for a research project was \$117,500 for a project completed by BERL on the cost of managing the risk of fire in New Zealand. This project was completed in the 2003-2004 research round. The third largest amount funded for a research project was \$111,000 for a project by CRESA that looked at developing indicators of household risk and targeting interventions to decrease this risk. This project was also completed in the 2003-2004 research round.

The average cost of research completed between the 1998-1999 research round and the 2008-2009 research round was \$55,993. Completed research that had a cost similar to the average cost includes an economic assessment of industrial fires in New Zealand completed as part of the 2000-2001 research round; a strategy for developing greater responsibility for fire safety and prevention completed in the 1998-1999 research round; and improving the fire performance of polystyrene insulated plane completed in the 2002-2003 research round.

For our sample population, data on cost was missing from three of the 34 research reports. The smallest amount funded for a project was \$10,000. This project was completed by

Wellington Lifelines Group in the 1999-2000 research round. It examined the key issues regarding fire following an earthquake.

The largest amount funded for a research project within our sample population was \$105,500. This was completed by Landcare Research in the 2003-2004 research round. This project looked at the impact of fire service activity on the environment.

The average cost of research completed between the 1998-1999 research round and the 2008-2009 research round for our sample population was \$60,527. This average cost was larger than our total population due to the number of large projects in our sample. This includes research completed by the University of Otago in the 2000-2001 research round that cost \$83,480; evaluation of the NZFSC programmes, promotions and research for Māori completed by the University of Auckland in the 2006-2007 research round that cost \$89,747; and research completed by BRANZ in the 2006-2007 research round that cost \$90,000 and reviewed the cost effectiveness and sustainability of home sprinkler systems.

4.3.1 Research methodology

As part of reviewing the reports we considered the research methodology that was used. Many projects use standard methodology for the type of research being completed such as focus groups and interviews, or CATI interviewing. Other projects that were heavily data focused used databases from within the NZFS or health and coroners databases. Our review considered whether the research used standard methodology or whether it identified a problem and sought to use a new method to gather data or complete analysis.

4.3.2 Fundamental and applied research

Our review also considered how the benefits of the research could be split into fundamental or applied research.

We defined fundamental research as research that is driven by curiosity or an interest in a question. The main motivation for this type of research is to expand knowledge, not to create or invent something. There is no obvious commercial value from the results. Fundamental research generally lays the foundations for applied research.

We defined applied research as research that uses accumulated theories, knowledge, methods and techniques to solve practical problems. It therefore has a more practical aim or objective than fundamental research. In general, if practical use of the research is likely to occur in the short-term then the research project can be termed applied research, but if a practical use is unlikely to occur in the foreseeable future then the research project can be

described as fundamental research. In the case of this project, applied research also includes completing research that evaluates and monitors current work practices.

4.3.3 Use of research

The question of whether the research informs and how it can be used was also addressed. We considered how the research feeds into other work such as subsequent research work, advertising campaigns or education programmes, and who uses the research.

5 Analysis of the reports

We assessed the reports according to two overarching criteria, as follows:

- whether the research was associated with a strategic priority area or areas.
- whether the research outputs were applicable to the purpose of the NZFS, or there was a link between the outputs and the operational responsibilities of the NZFS, in terms of fire safety, fire prevention, and fire extinction.

In making these assessments we also noted associated elements relevant to the functions of the NZFS.

Our metadata analysis indicates that research completed as part of the contestable research fund has assisted the NZFS to anticipate and plan for fire events or high risk fire seasons, and with resource allocation and management. Fire suppression research has focused on the installation of fire protection systems and tested the effectiveness of these systems. While research that has looked at the interaction between humans and fire has provided the supporting evidence for advertising campaigns and education programmes that have been targeted at the general public, vulnerable groups in the community or groups identified through the research as exhibiting risky behaviour.

While it is difficult to determine causality between the behaviour changes of individuals and the research completed as part of the NZFS Commission contestable research fund, our sample indicates this research has helped to decrease fire deaths and injuries, and the associated reduction in the amount of fire-damaged property. Further, some behaviour change can be attributed to fire safety and fire prevention advertising and education programmes. One of the aims of the NZFS is to raise the awareness of all New Zealanders about the importance of fire safety and fire prevention. It is up to the individual to take up that opportunity and change their behaviour.

We believe there is a clear link between the research completed and the operational responsibilities of the NZFS, namely reducing the incidence and consequence of fire. Our sample indicates this research has had a positive influence on public health in New Zealand, and provided communities with emotional, social and economic benefits.

In the following section we describe our findings for each research round, and provide a summary thereafter.

5.1 1998-1999 research round

In our metadata analysis we examined three research projects from the 1998-1999 research round. These research projects can be grouped according to the following themes of 'social', 'Māori', 'epidemiological', 'rural', and 'environment'. The research projects were completed for less than \$45,000 each, and were completed by a research consulting group, NZFS and an academic institution.

There was a strong link between the outputs of these research projects and the operational responsibilities and strategic objectives of the NZFS. For example, one project set out to understand why death by fire was more common among Māori than any other ethnic groups in the Bay-Waikato fire region. Once this was understood, the research project then examined the steps the NZFS could take to work with members of this community to reduce the incidence and consequences of fire. This research also provided the NZFS with feedback on their current fire safety strategies in this fire region and whether these strategies were effective.

The second project examined deprivation at Statistics New Zealand meshblock level. The outputs of this research provided the NZFS with some indication of where they needed to devote greater resources due to pockets of deprivation within fire regions. It also indicated that there may be a causal link between social and economic deprivation and fatal fires.

The third project argued that the NZFS needed to provide a fast, aggressive initial response to decrease the chances of a large costly forest fire in a rural area. While it is important for fire management practices to keep up-to-date, this research also argued that initial fire suppression capability is important and should not be under-rated.

The return on investment in these research projects was met from the point of view that all of the projects met the strategic objectives to improve community fire outcomes, contribute to enhanced community security, and improve service performance accountability and resource management. This sample therefore illustrates how the benefit from completing research in the 1998-1999 research round outweighed the cost as knowledge in fire prevention and fire management was advanced.

5.2 1999-2000 research round

In the 1999-2000 research round, we analysed six research projects. Three of these projects discussed themes such as 'epidemiological', 'social', 'fatal', and 'Māori,' while three projects were focused on themes of 'rural' and the 'built environment'. All of these projects met the strategic objectives of improving community fire outcomes and contributing to enhanced community security. The projects that focused on 'rural' themes also met the

strategic objective of improving resource management and service performance accountability.

Of the six research projects, one was completed by an academic institution, two were completed by Crown Research Institutes, and three were completed by research consulting groups. Unfortunately costs for all of the research projects were not available. However, two of the sample projects examined from this research round cost \$57,000 while the other two projects were smaller costs of \$34,500 and \$10,000.

The research outputs of the two large research projects examined from this research round, large in terms of cost, strongly link to the operational responsibilities and strategic objectives of the NZFS. However, while these research projects provided data and information that meet the strategic objectives of the NZFS we would argue it was difficult to access this information from the reports. This was due to the complexity of the information the reports were trying to communicate and the size of the research projects.

One of the projects aimed to help the NZFS gain a better understanding of the breadth of issues associated with Māori house fire fatalities. This information would then be used to develop a range of policies and strategic interventions to reduce the number of Māori affected by domestic fires. Subsequently, the outputs of this research have been used in community education fire risk management tools, in particular tools that have been developed by the NZFS that they have termed 'Working with Māori'.

However, the report produced as part of this research project is difficult to read. There is not a strong connection in the body of the text between the recommendations and the Māori Risk Template. This template appears in the appendix. Having it appear as a key part of the text would have strengthened the case for the recommendations to have been adopted. Further, the research recommendations were based on a small number of interviews; these could have been increased in number to increase the strength of the recommendations.

We agree that working on an interagency taskforce that delivers fire awareness programmes and environmental interventions to Māori should be pursued. But, we would argue that it is unconvincing from this research that the NZFS should lead this work. They should be a key player, but others could take the lead role.

The second large project we examined from this research round looked at 'rural' themes. The premise for this research was that severe fire seasons in New Zealand have been attributed to various climatic features such as the presence of El Nino and La Nina events. To help anticipate high fire risk seasons and improve fire risk forecasting for the National Rural Fire Authority (NRFA), this project used weather data to detect and understand high/severe seasonal and monthly fire risk.

This research provided the NRFA with improved fire risk forecasting as it built on earlier work that investigated the linkages between climate predictors and severe fire seasons. It built on this work by increasing the number of climate stations examined from 10 to 21 and the number of regional climate indices from 12 to 24, and updated the year of analysis from 1995 to 2000.

The outputs of this research could be used to allocate resources, and therefore improve service performance and resource management. It could also allow the NRFA to work closely with external stakeholders who are involved in wildfires/rural firefighting. We would therefore argue that the return on investment in this research project was met from the point of view of achieving the strategic objective to improve service performance accountability and resource management.

This sample again illustrates how the benefit from completing research as part of the contestable research fund outweighed the cost, as knowledge in fire prevention and fire management was advanced.

5.3 2000-2001 research round

In the 2000-2001 research round, we examined six research reports from three research projects. These research projects were focused on the consequences of fire but it can be argued that the results from this research can be used in preventing the incidence of fire.

In this research round, the University of Otago completed a research project that examined fire-related mortality data for New Zealand between 1991 and 1997. This research project cost the NZFS Commission \$83,480 and resulted in four research reports. It contributed to the strategic objectives of enhanced community security and improved community fire outcomes. The research themes that this project sits within are 'epidemiological', 'fatal', and 'social'.

The key argument in this research project was that fatal fires are a public health concern as they result in preventable premature deaths. This research confirmed that fatal fire incidents disproportionately occurred in areas with high levels of social and economic deprivation. Further, this research also argued that intervention strategies can improve household and community safety particularly among deprived households. This finding was particularly important as background research had indicated residential fire incidents were the principal cause of death for New Zealand children, and that fatal fires impacted on the physical and mental health of surviving household members.

The outputs from this research can assist the NZFS to be prepared to fight fires, to have resources in place to prevent fire outbreaks, and decrease the consequence of fire by

allowing the NZFS to devote more resources in areas that have a higher probability of experiencing fatal fires. It can also provide the NZFS with some indication of the barriers to household fire safety among vulnerable groups.

The results of this research project are frequently referred to in subsequent research completed as part of the contestable research fund. And advertising campaigns and education programmes frequently refer to this project as supporting research.

The other two research projects we examined from this research round also met the strategic objectives of enhanced community security and improved community fire outcomes. The research themes these projects sit within were 'built environment', 'environmental' and 'earthquake'. These research projects were completed by research consulting groups, and involved modelling exercises and economic methodology to explore themes after a fire had occurred.

One of these research projects assessed the economic impact of industrial fires in New Zealand. This assessment used an applied economic research technique known as an Economic Impact Assessment (EIA) to measure the direct and indirect economic costs associated with industrial fires. The EIA allowed the indirect (supply-chain) impact of changes in business activity due to industrial fire incidents to be measured in terms of changes in economic output and employment. The results showed that the economic impact of industrial fires in New Zealand is large. However, effective fire prevention education and strategies, and the effective use of the services provided by the NZFS at a fire incident could decrease the economic impact of industrial fires, including the cost of emergency services attendance at industrial fires.

The research outputs from this project are valuable to the NZFS and external stakeholders such as insurance companies, engineers, building owners, local government and others with a concern in the prevention and extinction of industrial fires. Research outputs such as this are an example of where the NZFS works with external stakeholders to manage the risk of fire. A further example is the third project looked at in this research round that examined the risks from fire following an earthquake.

This project developed practical modelling tools to visualise the potential spread of fire after an earthquake. The aim of this research was to assist the NZFS anticipate and plan for a fire event following a natural disaster. The tools developed as part of this research could be used to improve understanding about the hazards affecting major urban areas after an earthquake and to identify appropriate strategies for reducing consequent losses. Directly and indirectly, this research project meets all of the NZFS strategic goals. It cost \$62,400 to complete this research, but the potential decrease in fires, fatal fires, and life threatening

injuries after an earthquake, due to fire may be substantially decrease due to this investment.

5.4 2001-2002 research round

Three research projects were examined from the 2001-2002 research round. Each of these projects were completed by research consulting groups and the themes of these research projects were predominantly 'built environment', 'environmental', 'fatal' and 'social'. The projects varied in cost from \$33,000 to \$78,000 and used tools and methods such as a literature review, simulation, benefit-cost analysis, event tree analysis, and geographic information system (GIS). Two of the three projects looked at the impact of changes in legislation or regulations.

The first project we examined looked at the likely costs and benefits associated with introducing new regulations to improve the fire safety of upholstered furniture in New Zealand. This project was proactive in the sense of examining the benefits and costs of introducing new regulations rather than looking at the impact of the current regulations.

The second project was more reactive in focus as it examined the impact of a revision to the New Zealand Building Code after it occurred. This revision introduced a new type of fire safety precaution (FSP) called a Type 5 alarm. It was argued that the benefits of this alarm are a reduction in unnecessary NZFS call-outs and the unnecessary evacuation of a building, but the costs are an increase in fire risk to the occupants. This research concluded that given the ability to measure the risk, decisions regarding the New Zealand Building Code - such as the introduction of the Type 5 alarm that lowers safety - should be supported by a formal and quantitative risk analysis.

The third project was a modelling exercise that looked at fire spread among urban centres after an earthquake. This research built on work completed by the same company in the previous research round. It used the two previously developed GIS models to populate data on buildings in the Wellington central business district (CBD).

Simulations were run to determine the consequences of post-earthquake fire. The total property loss due to fire-spread between buildings with non-combustible claddings was assessed, and a survey of buildings in the Wellington CBD determined that the dominant fire-spread was due to non-fire rated roofs or openings in walls. Vegetation between buildings and suburbs could also facilitate fire-spread after an earthquake, where it may not have otherwise occurred.

All of these projects meet the strategic objectives of improving community fire outcomes and contributing to enhanced community security. However, from our analysis of these projects

we would argue proactive research that meets the strategic objectives of the NZFS, such as the first and third projects discussed above, is of greatest benefit as it aims to prevent fire rather than deal with fire incidents.

5.5 2002-2003 research round

Three research projects were examined from the 2002-2003 research round. Two of these projects were completed by research consulting groups while one was completed by a Crown Research Institute. The themes of these research projects were predominantly 'built environment', 'environmental', and 'rural'. The projects varied in cost from \$55,000 to \$89,600 and used tools and methodology such as a literature review, modelling simulation, benefit-cost analysis, and workshops. Two of the three projects resulted in more than one report being produced, hence the large size (cost) of the projects.

Two of these projects met the strategic objectives of improving community fire outcomes and contributing to enhanced community security. However, one of the projects looked at improving service performance within the NZFS. Similar to the projects examined in the 2001-2002 research round, we can split the research into proactive and reactive. Two of the projects were proactive while the third – looking at the levy - was reactive.

The first project we examined was the first in a series of reports in a three year programme of research that looked at integrated climate and fire season severity forecasting. No recommendations were made at the end of this research project as it was part of a three year programme of research. Rather, the results were used to help anticipate severe fire seasons and ensure the NRFA were prepared to meet this increase in risk. This research could also help the NRFA with resource allocation and management, and planning with external stakeholders such as farm and forest owners and local government authorities. It could also help the NRFA with training and ensure that people were available and trained when these weather conditions predominate.

Internally, the outputs from this research could be used by volunteer firefighters in areas with potentially high fire risk. The outputs of this research could be used in fire prevention preparation such as training, fire risk management, incident control, decreasing the impact of fire on the environment, or decreasing the spread of the fire.

This research cost \$55,000 and resulted in two research reports. The outputs from this research relate to the national goals of: achieve and maintain the number of vegetation fires to less than 120 per 100,000 population; ensure annual area burnt by wildfires is less than the previous 10 year average 75th percentile; and contain 95% of all wildfires within two hours of being reported. These goals link to the purpose of the NZFS which is fire safety, fire prevention and fire extinction, and the strategic objectives of the NRFA.

This research also feeds into the 'C'mon keep it green' national television commercials. These commercials use a character called Bernie to promote the importance of keeping a watchful eye on the fire weather danger rating in an area. It also feeds into the 'Rural' education programmes. The purpose of these programmes is to provide fire safety information specifically to people who live in a rural or rural/urban fringe community. This research is therefore very relevant to the NZFS and the reduction of the incidence and consequence of fire, particularly in rural areas.

The second project we examined from this research round used benefit-cost methodology to examine fire safety regulations in non-residential buildings. This is an immediate concern since having effective and efficient regulatory structures affects fire safety in commercial, industrial and community buildings.

This research found that New Zealand's approach to fire safety regulations was 'light handed' relative to other countries due to poor alignment between the incentives to individual stakeholders, and the net benefits to the community. In particular, the association between the NZFS levy and the value of the building insured meant highest costs often fell on stakeholders with the lowest fire risk. Further, the regulations primarily impacted on new buildings whereas fire risk is inherent in the whole building stock.

This research therefore recommended that the NZFS establish a small taskforce to review the regulatory structure and its performance, focusing initially on the structural weaknesses or potential weaknesses highlighted in this report. The primary focus would be on implications for the NZFS but the review should also encompass the wider social and economic implications such as whether the current levy structure is an effective and fair reflection of risk. This research argued that a revised structure may establish clearer incentives for stakeholders who are contributing disproportionately to the levy.

The third project reviewed the firefighter selection process currently used by the NZFS. This project cost \$89,600 and involved a literature review, and a series of workshops and surveys. The output of this review was to determine the potential improvements that could be made to the competencies and selection tests used to assess firefighter applicants.

The outputs from this research project were focused on the fifth strategic objective of the NZFS – developing and protecting people, and promoting internal stakeholder partnerships. However, the outputs of this research also allow the NZFS to provide a professional response to other emergencies as well as build their own capability and capacity in regards to reducing the incidence and consequence of fire. Further, it could be argued that the outputs from this research allowed the NZFS to undergo an evaluation exercise to determine

the value or merit in their existing policies, programmes or management processes in regards to recruitment.

The results of the review determined that the NZFS currently assesses firefighter applicants on many skills and abilities critical to successful firefighter performance, and that the current selection tests elicit valuable information from firefighter applicants. However, the review highlighted opportunities for the NZFS to improve the way in which they currently assess firefighter applicants. Specific recommendations included providing NZFS assessors with in-depth training and clear and comprehensive instructions on how to assess, rate, and short-list applicants on the selection tests, to ensure assessment accuracy and consistency.

5.6 2003-2004 research round

In the 2003-2004 research round, two research projects were examined. These projects were completed by a research consulting group and a Crown Research Institute. The themes of these research projects were predominantly 'built environment', 'environmental', 'fatal' and 'social'. The projects were both substantial in terms of cost, with one project costing \$72,000 and the other \$105,500.

The first project was based on 131 cases of unintentional domestic fire fatalities. Based on these fatalities, the project argued for the need for differential intervention strategies for 'at risk' groups. Further, for NZFS fire safety and prevention strategies to be effective they must address the behavioural characteristics of victim groups, especially socio-psychological processes, and attitudes and cognitive processes that contribute to elevated fire risks.

The outputs from this project are now part of the supporting research for national television commercials such as the '15 seconds call-to action', 'speed of fire', 'keep looking while you're cooking', 'don't drink and fry', 'unattended cooking kills', and 'consider yourself dead' campaigns. Educational programmes were also developed from the outputs of this research. These programmes were developed in such a way as to be relevant to the age group and the nature of what is being taught. The four programmes include: pre-school programme; get firewise year 1 & 2; firewise year 7 & 8; senior secondary. These programmes are delivered by teachers with support from firefighters. Each of these advertising campaigns and education programmes have a fire safety message that builds on the outputs of this research such as how unintentional fires start, how injuries and deaths occur, and the reactions/behaviour people have in regards to interacting with fires.

These outputs can therefore be clearly linked to the national goals of the NZFS and the strategic objectives of improving fire outcomes and contributing to enhanced community security.

The second project examined in this research round met the strategic objectives to improve service performance accountability and resource management; develop and protect people and promote internal stakeholder partnerships; and increase the integration of urban and rural service delivery. The research was completed by a Crown Research Institute and examined the potential impact of firefighting operations on the environment.

This research determined the types of pollutants generated by firefighting activities, and how these might affect particular species and ecosystems. It also identified a range of alternative fire control and effluent management tactics that could be implemented to prevent or minimise contact between pollutants and organisms or ecosystems. It also suggests other areas where further research would be beneficial.

While this research project does not meet the national goals of the NZFS of decreasing the total number of fires, or the avoidable fire fatality or injury rate it does examine techniques and technology that the NZFS could adopt and adapt to reduce the impact of fire. The focus of this research is very much on fire management, and it can be argued that the outputs of this research meet the stated purpose of the contestable research fund of advancing knowledge in fire management. The cost of this project was substantial, but the benefit to the environment and in turn fire management it can be argued outweighs this cost, making this project a worthwhile investment from the perspective of the NZFS.

5.7 2004-2005 research round

Only one project was examined from the 2004-2005 contestable research round. This project was completed by a research consulting group and cost \$48,000. However, the company who completed this research also made a contribution to the total cost of the research project. The themes of this research project were predominantly 'built environment', and 'environmental'. This research project met the strategic objectives to improve community fire outcomes, contribute to enhanced community security, and improve service performance accountability and resource management.

This project was proactive in its focus. It investigated the cost-effectiveness of different fire protection strategies in industrial buildings such as sprinklers, manual suppression, and compartmentation. It developed a risk-cost-benefit model using @RISK to estimate the cost of fire in industrial buildings.

However, the risk-cost-benefit model was problematic. It used data from previous research completed on the cost of industrial fires (one of the projects mentioned in a previous research round) and supplemented this with data from a literature review. This research highlighted that better data would reduce uncertainty in the results. For example, better data on the area of fire loss experienced in industrial buildings, and fire loss areas observed in

buildings with different types of fire protection. Better quality data on the performance and operational reliability of the fire protection systems would also be helpful to a project such as this but the reliability of the fire protection systems did not feature strongly in the sensitivity analysis. Due to problems with the model, we would argue that the link between the outputs of this research and the strategic objectives and national goals of the NZFS is not as clear as with other projects completed as part of the contestable research fund.

5.8 2005-2006 research round

In the 2005-2006 research round, three research projects were examined. These projects were completed by a research consulting group, academic institution, and a Crown Research Institute. The themes of these research projects were predominantly 'built environment', 'environmental', 'volunteer/people' and 'social'. The projects ranged in cost from \$42,000 to \$69,000. One project resulted in two research reports.

Two of the research projects meet the strategic objective to improve community fire outcomes, contribute to enhanced community security and improve service performance accountability and resource management. One of the projects just met the objective of contributing to enhanced community security. This last project illustrates how there is a link between research outputs and the operational responsibilities of the NZFS in terms of fire safety and fire prevention, particularly among vulnerable groups such as the elderly.

This research project was based on the premise that older people are over-represented in fire statistics. The NZFS wanted to know why this was the case, and the steps that could be taken to change this. The outputs of this research found that older people do not perceive fire as a high risk in their homes and do not place an emphasis on preventative measures. Other factors that contribute to this issue include: medication and reduced mobility and sensory factors put older people at risk in the incidence of fire; older people tend to live alone, and they engage in risky behaviour associated with cooking, heating and using electric blankets and fail to appreciate these risks; in addition, burns and scalds are accident risks that older people do not recover well from.

The findings of this research allowed the NZFS Commission to take actions to education this group and decrease their risky behaviour.

The next research project we examined from this research round focused on improving understanding about fire danger due to the effects of climate variability, and the likely impacts on fire danger of El Niño-Southern Oscillation (ENSO) and Interdecadal Pacific Oscillation (IPO). Differences in fire danger under the individual and combined phases of ENSO and the IPO were compared using long-term fire weather records. These records were completed as part of a previous study that built a fire danger climatology database.

Results from the study indicate that the ENSO and IPO climate variability cycles can increase or decrease fire dangers in different parts of the country, which is driven by patterns in rainfall and temperature changes.

The outputs of this research allow the National Rural Fire Authority to prepare for the fire risks associated with seasonal and annual climate cycles and make earlier assessments regarding fire weather severity. These assessments are possible due to research methods developed by NIWA. This allows the NZFS to forecast fire risk from two to four weeks in advance by looking at the likely range of temperatures (daily maximum and minimum, soil, average wind speed, daily rainfall and solar radiation at 70 sites, and rainfall and temperature at over 100 sites). We discussed the benefits of this research and how it met the strategic objectives of the NZFS in an earlier section that discussed a related project. We would argue that with the completion of this programme of work the NZFS would have a comprehensive database in regards to climate and fire, and any further work in this area would have to be assessed from the point of view of marginal benefit.

In a previous contestable research round, we completed a metadata analysis of a project that looked at the recruitment programme of the NZFS. As a result of this research project, the NZFS adopted a competency-based recruitment programme. Similar to the project that looked at the risks, perceptions and experiences of older people and fire, this research took a monitoring and evaluation approach. It monitored baseline data i.e. the new competency recruitment programme, and evaluated the changes that have occurred as a result of this programme.

The project drew on observations and interviews as well as a literature review and meets the strategic objective of developing and protecting people, and promoting internal stakeholder partnerships. This research cost \$46,220 and was completed by people based at two academic institutions.

The outputs of this research project are focused on increasing the understanding of the human aspects of the NZFS's work. As such it meets the objective of developing and protecting people, and promoting internal stakeholder partnerships.

5.9 2006-2007 research round

In the 2006-2007 research round the focus of the research projects was on evaluation and monitoring. Up until this point, the NZFS through the contestable research fund had gathered an insight into the impact on the environment of fires, including weather patterns, and the behaviour and attitudes of vulnerable groups towards fire. The focus of this round then turned to evaluating and monitoring fire prevention and fire reduction work among vulnerable groups to determine if what the NZFS was doing was working and making a

difference. The most obvious measure of this change in behaviour was a decrease in the number of fire incidences including death and injury, and a decrease in the destruction of the built environment caused by fire.

In this research round, we examined two large (cost) research projects. Both projects cost approximately \$90,000 each, and were completed by an academic institution and a research consulting group. Both projects had a 'social' theme but one project focused more on 'Māori' while the other looked at the 'built environment'. The project that focused on 'Māori' looked at evaluating the NZFS programmes, promotions and research that involves Māori, while the second project investigated the cost effectiveness of home sprinkler systems incorporating sustainability aspects.

In the later research, a life cycle assessment approach was used to evaluate sustainability issues regarding home sprinkler systems. This project built on a project completed in the 2001-2002 research round completed by the same company. This project revisited the model established in the earlier project and accounted for input parameter uncertainty (caused by a lack of data as mentioned earlier) by including input distributions instead of single value inputs, and by conducting simulations that sampled the input distributions.

Overall, this new piece of research provided a broader insight into the overall costs and benefits of home sprinkler systems, including aspects that had no monetary equivalent, and added value to the earlier work. Further, it recommended that other residential properties that may benefit from home sprinklers be identified. For example, residences in rural areas may benefit from sprinklers due to the potential extra time delay in the NZFS (which may be solely volunteer based in some areas) arrival at the scene and potential water supply problems. In addition, a house fire in a rural or remote area would be more likely to be adjacent to ecologically sensitive areas. Therefore, less water used in a sprinkler system would mean less soil and aquatic contamination, in combination with a smaller fire. This would decrease the total damage, including environmental damage, associated with a fire.

Despite our earlier concerns about the model used in this project, the subsequent research completed to improve this modeling now means the research more clearly links with the strategic objectives and national goals of the NZFS. Therefore, it could be argued that the benefit of an additional unit of activity to complete this further area of research exceeds the cost of the second research project.

The outputs of the second research project we looked at in this research round could be useful to internal stakeholders, particularly those involved in selecting and funding future research projects and the evaluation of existing research projects and programmes. This research could also be used in the monitoring and evaluation of current and future

programmes and projects involving Māori. However, while we would argue the outputs from this research could be used by NZFS staff who work closely with Māori, the research findings need to be easily accessible and put into a more user-friendly format to encourage this due to the length and density of this report. Further, despite our earlier concerns about the 'logic model' from a research project completed in 2001, this model was adopted by the NZFS and subsequently reviewed as part of this project.

Several recommendations from this research project are relevant to the NZFS meeting their strategic objectives and we have listed them here.

- Develop and resource a unified evidence-based media strategy for communicating fire safety messages to Māori
- Carry out more focussed research into the effectiveness of mass media promotions with Māori
- Investigate ways in which interpersonal communication can be better used to get the fire safety messages into Māori communities
- NZFS should review its research needs with a view to updating and evolving the understanding of how its projects can best serve Māori
- Efforts should be made to disseminate research into accessible formats to staff so they can use data in refining their work.
- This evaluation found that the diversity of research investigations completed by the NZFS is a strength, but the age of some of the projects and the dearth of quality evaluation research looking at the effectiveness of programmes is a problem.
- Need to do evaluations of print media and radio campaigns (may have subsequently been completed). Also, there is scope for the development of more targeted fire safety messages and promotion that are tailored to each target audience to change behaviour.
- Need to converge risk and prevalence data with cultural and location so you get location specific studies that focus on the needs of particular Māori communities.

These recommendations clearly illustrate the link between the research outputs of the contestable research fund and the operational responsibilities of the NZFS. This project provided the NZFS with the ability to develop community education tools and programmes specifically for Māori as well as tools for home safety and other education programmes. These tools and programmes can help the NZFS meet their national goals by targeting certain groups through advertising and education programmes, but it could also be argued that these programmes will help to improve the overall fire safety knowledge and behaviour of the public.

5.10 2007-2008 research round

In the 2007-2008 research round, two research projects were examined. These projects were completed by research consulting groups. The themes of these research projects were 'built environment', 'environmental', 'fatal' and 'social'. They cost \$62,000 and \$45,400 respectively. The first project we examined was an evaluation project of an advertising campaign while the second was a project that drew on databases, interviews and survey to measure the ratio of the area damaged or destroyed by fire to the total building area.

The first research project we examined involved an evaluation to test the effectiveness of the NZFS kitchen fire campaigns. As part of their monitoring and evaluation work, the NZFS wanted to test if the message and campaigns targeting the general public were being absorbed and whether behaviour change had occurred, resulting in fewer kitchen fires.

A key outcome of this project was to make recommendations for future education and advertising campaigns based on identified gaps in current knowledge and understanding. For example, all respondents felt that a combined 'fire prevention and dealing with fires' approach is necessary. And promotions at workplaces, on meat packaging and at retail outlets were considered the most effective.

Other resources such as the education programmes are regularly up-dated and changed and the outputs of this research may be considered as part of that update. Also, advertising campaigns can change and seasonal campaigns can draw on a single message for a short period. This use of seasonal campaigns could aid the NZFS to support some of the outputs from this research. If a particular message is not being effective or is not reaching its target audience then the seasonal campaigns could be used to deliver this message.

The outputs of this research met the purposes of fire safety and fire prevention, and could result in behaviour changes that could aid fire extinction. The outputs of this research project, and its evaluation and monitoring, could also be used in other advertising campaigns and when various information channels are being considered. This research therefore provided the NZFS with ideas for future campaigns, and ways of targeting key audiences and vulnerable groups within the general public.

The second project we examined looked at the role the NZFS plays in limiting the damage to buildings from fire. To measure and assess their firefighting effectiveness the NZFS records a significant amount of information at the site of the fire. One of the main measures used is the ratio of area damaged or destroyed to the total building area. However, this may not be an adequate measure because localised damage can result in major costs or total replacement of the building.

This research project investigated the costs of recovery following a fire, using the criteria used by insurance assessors to write-off a partially damaged building, and developed a more accurate measure of response effectiveness, using data already collected by the NZFS.

The outputs from this project can be used to illustrate how the NZFS is reducing the incidence and consequences of fire and contributing to their strategic objective of enhancing community security by ensuring damage to buildings is localised. The developed measure can also be used to improve service performance accountability and resource management, by more accurately measuring the effectiveness of NZFS firefighting techniques.

5.11 2008-2009 research round

In the 2008-2009 research round, two research projects were again examined. These projects were completed by research consulting groups. The themes of these research projects were 'built environment', 'environmental', and 'volunteer/people'. The project costs were \$60,000 and \$92,000 respectively. The first project also received additional funding for the second part of the research from another source. Both projects used economic methodology, the first by looking at the cost effectiveness of localised fire suppression systems in kitchens, and the second project by placing a 'value' on the contribution volunteer firefighters make to the NZFS.

The first project we examined was based on the premise that residential kitchen fires are attributable to a large proportion of residential fires leading to deaths, injuries and damage. A reduction in kitchen-related fires would therefore make a significant impact on the community.

The objectives of this research were therefore to develop a methodology for a cost effectiveness analysis to evaluate the impact of retrofitting active residential kitchen stove-top fire protection systems. This methodology was developed and tested. The second objective of this project was to use experimental data from a completed BRANZ study to test and develop performance criteria for determining the appropriateness of retrofitting the stove-top protection systems. This performance criteria can then be used by the NZFS and others who are interested in retro-fitting houses with stove-top protection systems to determine if the system is appropriate and performing correctly. Performance means fire protection effectiveness – fire spread and flashover – so coverage area of the local fire protection system. Both of the objectives of this research were therefore met.

The outputs of this research meet the strategic objectives of improving community fire outcomes, and contributing to enhanced community security. Further, the outputs of this research could be used by the NZFS to promote the use of sprinkler systems, and in particular a local fire protection system that targets the stove-top. This promotion could

involve working with building owners such as property developers and landlords, as well as with home owners. It could also be used to promote this system to builders and building contractors, and to various building associations. The outputs of this research could also be used in the promotion of legislation changes in regards to the Building Code, if necessary. Internally, this research can be used by NZFS in their public education campaigns to promote the use of sprinkler systems in homes, and in particular the retro-fitting of local fire protection systems such as this.

The second research project we examined discussed the economic and social value of volunteer firefighters in small remote communities. This research was based on desk-based analysis, a survey and interviews. It described and measured the non-monetary benefits that a volunteer fire brigade contributes to these communities and estimates the economic value added to them. Further, the research outputs demonstrated three key reasons why volunteer fire brigades contribute to the ongoing sustainability of small remote towns.

Volunteer fire brigades:

- provide security and protection for people and property in areas where the response times to fire, medical and accident emergencies may be long.
- contribute to the social cohesion in a community and act as the social glue for retaining the community identity and spirit.
- assist in sustaining the quality of life for volunteers and their families by providing social opportunities and personal intrinsic value.

This research clearly meets the strategic objective of developing and protecting people, and promoting internal stakeholder partnerships. It also illustrates more of the human aspects of the NZFS's role in the community. Not only does the NZFS reduce the incidence and consequence of fire in small remote communities but they attend other accidents and emergencies, and provide social cohesion through providing social opportunities and a point of focus for community events. The outputs of this research highlight the ever expanding role of the NZFS, the importance of volunteer members of the NZFS, and how people play a key role in fire prevention and fire management at a community level.

5.12 Summary of findings

Examining the total population from the perspective of the strategic objectives, Table 5.1 illustrates the frequency in which a research project is associated with an objective.

Table 5.1 NZFS research by strategic objectives, total population

NZFS strategic objectives	Frequency*	Percent
Improve community fire outcome	75	71
Increase integration of urban and rural service delivery	3	3
Contribute to enhanced community security	73	69
Improve service performance accountability and resource management	71	67
Develop and protect people and promote internal stakeholder partnership	23	22
*Multiple reponses		

BERL calculations

Similarly, from the perspective of our sample population, Table 5.2 confirms that a large proportion of the research completed as part of the contestable research fund is associated with the objectives of improving community fire outcomes, and contributing to enhanced community security.

Table 5.2 NZFS research by strategic objectives, sample population

NZFS strategic objectives	Frequency*	Percent
Improve community fire outcome	28	82.4
Increase integration of urban and rural service delivery	1	2.9
Contribute to enhanced community security	28	82.4
Improve service performance accountability and resource management	17	50.0
Develop and protect people and promote internal stakeholder partnership	8	23.5
*Multiple reponses		

BERL calculations

The research projects that meet these strategic objectives strongly focus on reducing the incidence and consequence of fire. They also tend to fall within the research themes of 'built environment', 'social', and 'rural'.

We found no evidence of projects that were not related to at least one of the strategic objectives of the NZFS.

However, there is a clear lack of research associated with two of the five strategic objectives. To date, only a small amount of research has been completed that meets the strategic objectives to increase the integration between the urban and rural service delivery and develop and protect people, and promote internal stakeholder partnerships. It can be argued that these strategic objectives are focused internally on the human aspects of the NZFS and their internal processes, policy and programmes.

If the NZFS was to undertake more monitoring and evaluation research, the amount of research that meets the strategic objectives mentioned above could potentially grow.

Monitoring research is used to establish baseline data and track changes over time, while

evaluation is undertaken to determine the merit or value of a policy, programme or management process. Now that the NZFS has invested in areas that have established baseline data, and put in place policy, processes or programmes due to contestable research recommendations, one area that more research could be completed in is the evaluation and monitoring field.

In terms of the NZFS purpose and operational responsibilities, our assessment is summarised in Table 5.3. It is clear that the majority of research outputs are associated with, or have links to, the fire safety and prevention purpose of the NZFS. However, we found relatively less linked to the fire extinction purpose.

Table 5.3 NZFS research outputs by purpose, sample population

NZFS purpose	Frequency*	Percent
Fire safety	25	74
Fire prevention	30	88
Fire extinction	14	41
* Multiple responses		

BERL calculations

This again reflects our argument that the majority of research completed to date under the contestable research fund has met the strategic objectives to improve community fire outcomes, to contribute to enhanced community security, and to improve service performance accountability and resource management. Research that meets these strategic objectives is often focused on fire prevention and fire safety rather than fire extinction. The NZFS may wish to consider completing more research that improves their knowledge of fire extinction such as monitoring and evaluating fire extinction effectiveness, and examining new methods and skills regarding fire extinction techniques.

Further, according to our sample analysis, there was little difference in terms of relationship with NZFS purpose and strategic objectives due to the size² of projects. While larger projects did tend to relate to more than strategic objective, it was clear that project size was not a determining factor in establishing such a relationship(s). In addition, ordering our sample projects by organisation type similarly did not make a difference to our findings.

Finally, having determined that the majority of the research completed to date meets at least one strategic objective we need to return to benefit-cost analysis. We know from earlier discussions what the costs of most projects are, including the average cost of the projects in the total population and the sample population, now we need to consider the benefits that were gained from the research. As discussed in section 3, these benefits should centre on

² In terms of research funds invested.

the provision of robust analysis for decision-making, and information and data that can inform practices and procedures. To date, the research completed as part of the contestable research fund has done this. Further, when the benefits of an 'additional unit of activity' has been equal to or less than the cost to the NZFS of undertaking the next steps, research outcomes have been undertaken and recommendations pursued.

5.12.1 Human behaviour and causality

The NZFS aims to raise the awareness of all New Zealanders about the importance of fire safety and fire prevention, and as an organisation they recognise the importance of fire extinction. It is up to the individual to take up that opportunity and change their behaviour, and each individual weighs their opportunity costs and benefits of taking that step.

Some behaviour change can be attributed to fire safety and fire prevention advertising and education programmes, and the services provided by the NZFS. However, it is difficult to determine causality between the behaviour changes of individuals and the research completed as part of the NZFS Commission contestable research fund.

What we can see is that as a result of this research, advertising and educational campaigns, programmes and materials have been produced, and that these programmes and materials have reached some parts of the population. These campaigns, programmes and materials have resulted in greater recall of fire safety messages, a decline in 'risky' behaviour in regards to fire safety and fire prevention, and behaviour changes in terms of interacting with fire and installing fire prevention measures in homes such as sprinklers and smoke detectors. However, we can not conclusively argue if these changes have been the result of the research completed as part of the contestable research fund or the result of other factors. This is where the evaluation and monitoring of the NZFS and the annual fire knowledge survey may play a role.

The fire knowledge surveys are one measure of changes in peoples' behaviour, attitude towards fire safety, and perceived risk in regards to fire safety in their home and the perceived risk of a serious fire occurring in their home. They indicate behaviour changes such as the installation and maintenance of smoke alarms, and determining if these smoke alarms are working. The surveys also examine behaviour in the household that could cause fire such as unattended candles and cooking with grease, fat or oil.

The fire knowledge surveys are able to pick-up changes in individuals' behavior and/or attitude towards the NZFS. In 2006 for example, fire knowledge survey findings indicated that New Zealanders were becoming apathetic to fire safety messages. And argued that the NZFS needed to remain innovative in their communications to inform and motivate desired behavior.

Despite the difficulty of determining causality, we would argue that our metadata analysis indicates that research that aims to prevent fire rather than deal with fire incidents is of the greatest benefit to the NZFS.

6 Concluding comments

Overall, our metadata analysis indicates that the contestable research fund is meeting its stated purpose to advance knowledge in fire prevention and fire management in New Zealand to meet the Commission's statutory interest as laid out in the Fire Service Act 1975 (Part II). The research being funded is closely aligned to both the purpose and the strategic objectives of the New Zealand Fire Service.

Further, we would argue that the products and services (research outputs and recommendations) produced as a result of the contestable research fund are appropriately viewed as public goods.

Public goods are goods or services that are non-rival and non-excludable. Rivalry means the extent to which consumption of a good or service by one person diminishes its availability for others. Excludability is the extent to which non-payers can be excluded from consuming a good or service. If a good or service is non-rival and non-excludable a private company cannot effectively charge for it. Consequently, the supply of such a good or the provision of such a service is unlikely within the context of a private operator.

However, just because a good is a public good does not necessarily mean the government should provide it. Ideally, the only public goods the government should consider providing are those whose benefits exceed their costs. The cost of a public good is the sum of all the explicit and implicit costs incurred to produce or provide it. The benefit can be measured by considering how much people would be willing to pay for it. With a private good the relevant price is the highest sum *an individual* is prepared to pay. But, with a public good the relevant price is reflects what *the community* (or government on behalf of the community) is willing to pay.

In this context, the government's 'willingness to pay' can be seen to be safeguarded in the stated strategic objectives and purpose of the NZFS. Consequently, we would argue that the benefits of the contestable research fund, including a decrease in the loss of life and injury, and destruction of property, exceed the costs of commissioning this research.

However, while we know the cost and outcomes from each project and benefits, we are unable to the establish the opportunity cost (i.e. potential outcomes) from projects that have not been funded due to others being prioritised.

Nevertheless, given the close alignment of funded projects and their outputs to the purposes and strategic objectives of the NZFS, we are comfortable in concluding that the Contestable Research Fund is a valuable investment.

7 Bibliography

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