New Zealand Fire Service

Describing the value of the contribution from the volunteer fire brigade

December 2009

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Abstract

This paper examines the economic and social value of volunteer fire brigades in small remote communities in New Zealand. Based on desk research, a survey and interviews, it describes and measures the non-monetary benefits that a volunteer fire brigade contributes to these communities and estimates the economic value added to them.

The paper demonstrates three key reasons that volunteer fire brigades (VFBs) contribute to the ongoing sustainability of small remote towns.

Firstly, a VFB provides security and protection for the property and person of residents in these areas by substantially reducing response times to fire, medical and accident emergencies. The economic valuation of this benefit is conservatively estimated at $79 million annually.

Secondly, the research describes how these brigades contribute to social cohesion and act as the social glue for retaining the community identity and spirit.

Thirdly, participating in a brigade assists in sustaining the quality of life for volunteers and their families by providing social opportunities and personal intrinsic value.

If the benefits associated with the second and third points were monetised it is likely that the economic value associated with VFBs would increase significantly.

1 Introduction

Why the research was undertaken

PricewaterhouseCoopers (PwC) was engaged to examine the national economic value of a volunteer fire brigade (VFB). The research was funded by the New Zealand Fire Service Contestable Research Fund which is administered by the New Zealand Fire Service (NZFS) and aims to build the body of knowledge on fire related issues in New Zealand. Given the substantial capital resource tied up in the vehicles and buildings required to maintain VFBs there has been a particular interest in identifying the size and nature of the benefits that accrue to them.

It was decided to set the scope of the research on clarifying and describing the benefits attributed to VFBs in small remote communities and, where possible, estimating the economic value that they contribute to communities. It does not identify costs or provide an estimate of return on investment. This is a deliberate decision taken to ensure that the focus of the research and resulting discussion is on identifying the contribution of volunteers and not on the economy or efficiency of the brigades themselves.

Please see the glossary in Appendix A for a definition of the terms used in the research.

Scope

To determine the national economic value of a VFB, the research was based on a number of core assumptions and definitions. It was decided limit the scope to:

1. study small remote communities (SRCs);
2. investigate, describe and estimate only the benefits and not the costs;
3. confine the investigation to economic analysis, excluding estimations of social benefits; and
4. apply a conservative approach to the economic analysis.

The criteria for establishing these assumptions are discussed in more detail under ‘Approach and Methodology’.

Approach and methodology

The research was conducted in an inductive manner where a number of hypotheses, identified in a search of the literature focusing on key topics related to the contribution of VFBs, were tested in the field. These hypotheses and the survey questions were adjusted accordingly for the remaining field work and the findings presented in this research. This section details the findings of the literature search and key points relating to the methodology and assumptions.

Criteria for assumptions

A number of assumptions were made to focus the research more keenly around the research topic. Below is further discussion of these assumptions to provide visibility of the reasoning behind them

Small remote communities (SRCs)

The use of the term urban, as referred to in the New Zealand Fire Service Act 1975, relates to any populated area and does not distinguish between the size and / or nature of the populated area. This research focuses on small urban areas in remote (colloquially

'rural') locations. References to populated areas distinguish between cities, for example Masterton; rural towns, for example Rangiora; and small remote communities, for example Eketahuna.

To avoid confusion with the layman's understanding of rural and the fire service's use of the word rural, the urban areas classified as rural communities were defined as remote communities for this piece of research.

The purpose of the research is to describe the VFB contribution by establishing the range of benefits that are provided to SRC. The VFBs of small remote communities that form the basis of this economic assessment were selected based on the four criteria listed below.

a) Proximity (remote or isolated) – Fire stations that fall within the borders of a city or are within ten minutes a city, for example Eastbourne, have been excluded. Towns that fall within the commuter belt of a major city are also excluded.
b) Population size – Fire stations that are based in a town with a census 2001 population of more than 2000, for example Taihape, have been excluded.[1]
c) Independence – All stations that are dependant on another station (auxiliaries) are excluded.
d) Response rate – Fire stations with a five year average of more than 50 call outs per year are excluded. The purpose of this criterion is to exclude those towns that respond primarily to traffic accidents on large state highways.

When the criteria listed above were applied, 169 VFBs were selected to be part of the research. Refer to Appendix F for a list of the 169 remote stations, defined as SRC. Table 1 below is a summary of the key statistics for the selected VFBs.

Table 1: Statistics for volunteer fire brigades in small remote communities.

	Total	Average per station
Population covered	218,221	1,291
Volunteers	2,904	17
Call outs	5,076	30
Number of vehicles	292	1.73

Source: New Zealand Fire Service Station Management System, 2007 calendar year.

Of the 169 remote communities, included in the scope of this study, two were selected as case studies for face-to-face interviews, namely Eketahuna (Tararua District Council) and Oxford (Canterbury District Council). Volunteer fire fighters (VFFs) and employers (managers) in a third remote community, Edendale (Southland District Council) were also interviewed due to the proximity of the fire station to a large Fonterra plant. Even though it did not fall within the statistical sample, it provided us with useful supporting information relating to issues of employment and industry.

Measurement of benefits not costs

The first priority of the research was to describe the non-monetary benefits that accrue to a community in which a VFB is actively maintained. In doing so, it serves to examine the nature of the contribution of time made by volunteers. It provides visibility, support and recognition to brigades and their volunteers.

[1] Census 2006 data relating to the population of small population areas was not available at the time of this research. Other population figures reported by the NZFS relate to the Census 2006.

The scope of this research is to identify and measure economic benefits. This is to balance the budget process that by its nature ignores the social and economic benefit (particularly that associated with social cohesion). A discussion of costs would naturally move the conversation away from the extremely valuable role played by volunteers and towards the economics of operating small brigades.

Further, it is noted that the comparison of precise accounting-based costs with estimates of benefits based on assumptions is not appropriate because of the differences in the precision of the data involved and the disparate nature of the sources.

Should the government, or another public interest group, find it in its interest to consider the costs, then it is a straightforward exercise to compare the cost elements with the benefits identified in this research.

Literature review

A literature review was conducted in order to identify:

- the social and economic impacts of fire brigades, and
- the economic value of volunteer fire brigades.

The literature was reviewed for valuation methods examining the economic value relating to volunteers and fire brigades based in rural communities. A subsequent analysis of the literature was also conducted later to provide a range of monetised values for the impact of fire and volunteer labour inputs.

This section details the findings of these searches.

The contribution of fire brigades

The New Zealand Fire Commission is a crown entity that is charged with protecting lives and property from fire. The New Zealand Fire Service (NZFS) protects the urban fire districts and urban centres while the National Rural Fire Authority (NRFA) is responsible for fire protection outside these urban fire districts [DIA, 2008a].

Firefighters in New Zealand are predominantly volunteers. Both the NZFS and NRFA are made up of professional firefighters and volunteer firefighters and there are approximately 10,000 firefighters across New Zealand that are involved in volunteer, paid, rural, industrial and/or defence fire brigades. Of these firefighters, over 1,700 are career firefighters but in comparison there are more than 7,500 urban unpaid volunteer firefighters[2].

Nationally

The NZFS's principle role is to reduce the incidence and consequences of fire. This includes reducing the negative impacts of fire for people, property, the community as a whole, and the environment [BERL, 2008]. The NZFS also responds to non-fire related incidents which include medical emergencies, motor vehicle incidents and hazardous emergencies. The latter includes earthquake and flood related incidents as well hazardous material spills.

[2] New Zealand Fire Service website www.fire.org.nz

In the local community

The role of the NZFS in communities is also to reduce the incidence and consequence of fire; this includes both emergency and non-emergency community services. A distinctive feature of small remote communities is their interconnectedness and the strength of the relationships within a geographical area. Firefighters are an integral part of the community and not only do they fulfil the roles expected of the NZFS, they are also involved in community activities which include fire safety promotion.

Social capital is the economic term given to the value of relationships and connection within a community and includes elements such as participation in networks, reciprocity, trust, acceptance, shared ownership and a proactive response to community problems [Bullen and Onyx 1998]. Fire brigades, in their role in the community contribute to social capital.

The Allen Consulting Group [2005], in its analysis of surf life-saving in Australia, identified the trust component of social capital as a benefit of having volunteer life-savers. Fire brigades also contribute to the trust component of social capital in that the public trust that they will be protected from fire by having access to a local brigade in the community.

Firefighters have topped the list of most trusted profession in New Zealand in the annual Reader Digest's Trust Survey for three years in a row from 2007 -2009. This is one measure of the value that local fire brigades add to social capital.

Larger levels of social capital contribute to the retention of population and the quality of life in remote towns and make it possible to manage community wide problems in the absence of the wider range of government services that are provided in urban areas. Volunteers, through their interaction with the community, have insights into their community and understand what is important and valued [Scottish Executive, 2002].

Volunteering

The definition used in this research of a *volunteer* is someone who provides a service or benefit that is not motivated by a financial or material reward. This definition is often confined to volunteering activities within charitable organisations but Bittman and Fisher [2006] believe that emergency service providers should also be included in this definition.

Volunteering in emergency services does have some key differences to volunteering in other sectors namely:

- the high expectations of volunteers and the demanding nature of the role – in the case of the NZFS there is no distinction between volunteer and paid firefighters at callouts; and
- the high time commitment – this includes volunteer firefighters having to be on standby [NZIER, 2008a].

Volunteers and the New Zealand Fire Service

New Zealand relies heavily on volunteers to manage fire, with volunteer urban and rural firefighters providing services to 80% of New Zealand's geographical area; this includes fire prevention and emergency response services. More than 9, 000 volunteers currently deal with about 32% of all incidents. Volunteer firefighters attend 55% of all motor vehicle accidents and provide civil defence emergency help, assistance to police, hazardous substance containment and clean-up, and fire safety awareness education [Volunteering New Zealand and Office for Community and Voluntary Sector, 2009].

Without volunteer firefighters the NZFS could not fulfil its role as it would be hard to maintain a credible nationwide fire protection system because volunteers make up more than 80% of the firefighting labour force [Martin, Jenkins and Associates, 2006].

Volunteer fire brigades are often the only emergency response service for small remote and semi-remote communities. The alternative for a small remote communities is a long-response time while they wait for the nearest paid fire brigade to be dispatched.

The important role of volunteer fire brigades is not disputed but, as a study in Australia found, volunteer numbers are falling [Cowlishaw and McClennan, 2006]. New Zealand is facing the same pressures with changing demographic trends and greater personal liability risks, amongst others, cited as reasons for the lower volunteer numbers [Martin, Jenkins and Associates, 2006]. NZIER [2008a] in its analysis of trends in volunteering, cite the movement of people to cities as one of the reason that rural communities struggle for volunteers.

UMR [2001] conducted research for the NZFS to understand some of the challenges facing volunteer fiefighters to assist with maintaining and growing NZFS' volunteer levels to ensure the VFBs were sustainable. Some of the challenges included busy lifestyle, time pressures, family strain and dealing with challenges.

Corydon Consultants Ltd [2008] surveyed rural firefighters to find out why they volunteered and found that the most important motivation for volunteering was the desire to give to the community. This was strongly related to their rural or semi-rural location which meant that they were often the first response at an emergency. Urban volunteer firefighters of small semi-rural and rural communities are in similar situation and feel the same sense of community ownership and see their role in the community as very positive [Hawkins, 2005].

A study of volunteer firefighters in West Germany [Zech, 1982] found that not only was the volunteer fire brigade providing a service to the community, it was also serving as a social club. The volunteer firefighters participated in community activities and enjoyed being with others who had similar interests.

In addition to being motivated by a sense of belonging and giving something back to the community; personal and skill development were also motivators for volunteering. This includes those who are motivated to develop skills that could bring some material and financial rewards in the future with evidence to suggest that those who volunteer could earn more than those who are not involved in volunteer activities [Ganewatta and Handmer 2007].

To ensure that the NZFS can respond to all fire and non-fire incidents, all firefighters, both paid and volunteer, need to be trained and need to maintain their training on order to respond efficiently to any emergency situation.

It is not, however, feasible to have a paid fire brigade in each town. Brunet, DeBoer and McNamara [2001] argue that it is actually more cost-effective for communities that need low levels of fire protection to have a volunteer fire brigade. This is due to the high cost of maintaining a paid fire brigade when there is only a limited need for fire protection or emergency services. BERL [2008] describe these costs in terms of the average cost of each unit of service delivery and its marginal costs.

Volunteer fire brigades, just like their paid counterparts, also incur costs for the upkeep of their fire station and the maintenance of the fire truck(s) and equipment. The biggest difference between paid and volunteer fire brigades is the cost of labour, with volunteer firefighters not being paid a salary.

Volunteer labour

Volunteer labour is a big component of valuing the economic benefit of a volunteer fire brigade. In addition, the employers of volunteers receive no compensation for their contribution (loss in productivity etc) [NZFS, 2008].

Some research classifies the labour (time) of volunteers as a cost and adds it to the cost for fighting and/or preventing fire. BERL [2005] estimated the contribution of urban volunteers at $62.8 million per annum[3] for New Zealand. For this research, however, the net economic benefit of a volunteer fire brigade for communities treats volunteer time as an in-kind donation (benefit) to the community.

Assigning an economic value to the volunteer firefighters' time highlights the value of the volunteer firefighter in society and how expensive it would be to replace [Ganewatta and Handmer, 2007]. In estimating an economic value for volunteer time in emergency services, Ganewatta and Hadmar [2007] believe that training, administration and stand-by time should also be included. Stand-by time is when volunteers have to be ready for immediate response (this could mean that the volunteers have to be within a certain travelling distance and have to limit their alcohol consumption).

Social benefits

After reviewing the results of a literature search and finding no literature that had valuation methodology for the social benefits of volunteer fire brigades and / or similar organisations it was decided that non-monetary benefits, such as social cohesion, would not be valued in the economic modelling. The modelling has restricted itself to valuing those benefits that relate to economically recognised outcomes.

Economic Valuation Methodology

The methods use to value economic and social impacts are different and reflect the disparity of data and tools available for each. The results of the literature search yielded little in the way of tools that would assist in valuing the social impacts of remote brigades so by necessity the analysis of social impacts focused on a qualitative study of individual communities, rather than the aggregation of quantitative data as was the case with economic impacts.

Case studies

The New Zealand towns of Oxford and Eketahuna function as brief case studies into the role of the New Zealand Fire Service in small remote communities. The case studies have been used to describe some of the social impacts observed there. These two case studies cannot, however, be aggregated in a way that produces a picture of the social impacts on remote New Zealand generally.

These communities were, however, selected to be as representative as possible of the 169 small remote communities and include north and south island towns and one which is very small (less than 500 population) with few services, and a larger town (1500 – 2000 population) with more services. Because remote communities predominantly support local farming or large production facilities a third community centred around the Fonterra factory in Edendale was also considered.

[3] This was estimated for 2004 based on a shadow price using the average labour cost per fire incident in the paid fire brigades.

To offset the difficulty of aggregating the representative case studies to provide a national picture of the social impacts on remote New Zealand, several representatives of national organisations associated with emergency response were consulted and interviewed about their perspective on the value of VFBs in SRCs. These interviews were conducted with individuals and represent the individual opinion of those interviewed not the position of the organisation. There may be some points on which others within those organisations disagree, however, these opinions help to form a picture of the as yet unquantified economic and social value of these brigades in aggregate. In the absence of better tools to quantify the social impacts, a case study approach augmented by interviews from a national perspective provided the research with a robust perspective on national impact.

In contrast, an examination of the data sources indicated that data existed on a brigade by brigade basis to support the economic impact analysis. In theory the data could then be aggregated to form a national picture if the specific brigades in the small remote communities could be identified. In reality an approximate set of callout data was all that was available at the time, however, in future updates to this research callout data for the 169 stations listed in Appendix F could be generated for 2007 and the comparative future period.

Economic modelling

A picture of national value has been derived in two ways. The first is to take some 'typical' stations as a sample and scale those to represent all 169 stations. The second method, where data is available, is to identify the contributions of every specific station.

There is a variation between the method of valuation for voluntary labour and costs avoided. Firstly, in determining the replacement cost of voluntary labour, the total number of volunteers is estimated based on the size of an average station. Secondly, an approximate number of callouts for all 169 stations is used to calculate the costs avoided due to decreased response times, because more precise data provided by New Zealand Fire Service could be used to inform an estimate of total callouts.

All economic benefits have been considered from the perspective of the actual activities in the local community and have not included the economic costs incurred to service the brigades. Many, but not all, of the costs of running a VFB are incurred by the New Zealand Fire Service on behalf of the community. This means that generally the economic costs can only be analysed from a macro-perspective as it is difficult to isolate the costs incurred by each small remote community. Costs are not considered further in this research.

As the project evolved, general categories of economic benefits attributed to a VFB emerged. These three categories are:

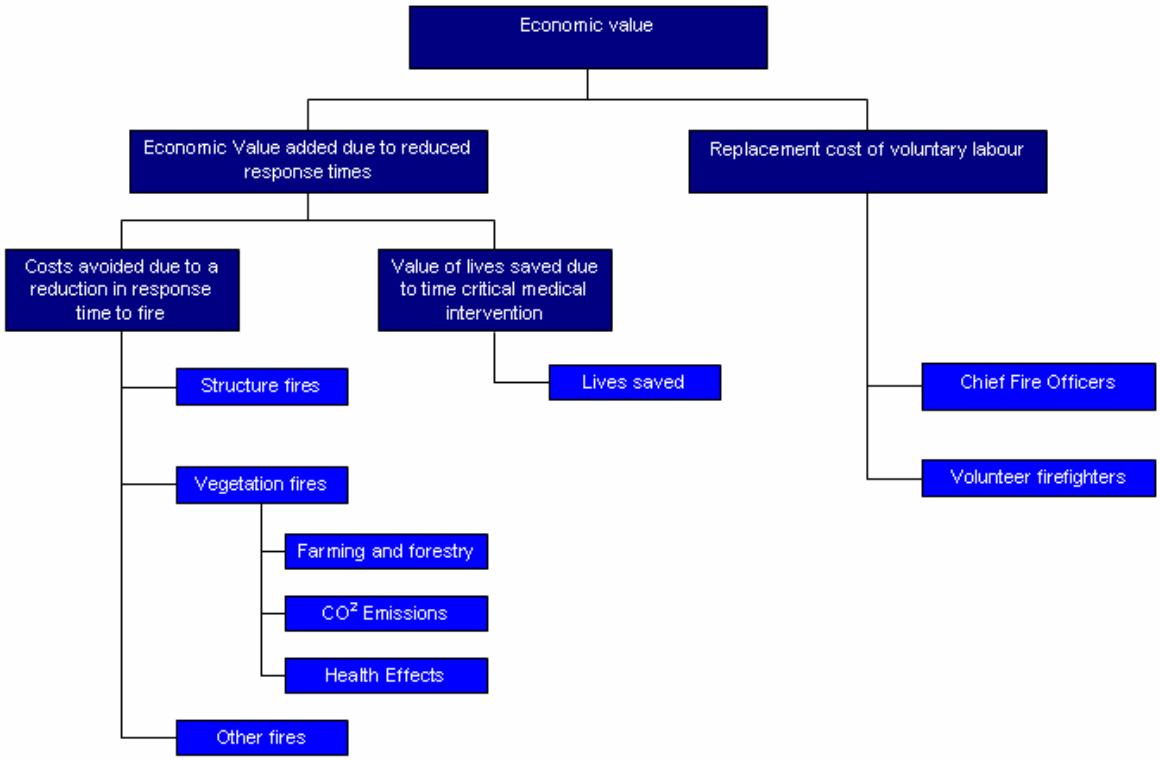
a) costs that are avoided by the community because of the physical locality of the VFB compared with a theoretical alternative solution;
b) the replacement cost of the time volunteers invest in their role as VFFs;
c) the value that social outcomes add to the social capital and quality of life for small communities.

This research measured, quantified and monetised categories a) and b) above but not c). In addition to the points noted in the scope and approach and methodology sections above, it is worth noting that although several methodologies for measuring non-monetary items are available, a method for placing a precise economic value on them is not. Specifically, the level of social capital can be measured, but would need to be measured in a sample of similar communities, some with VFBs and some without. This makes it a challenge to estimate comparable economic values.

The economic model for the analysis in this research has been constructed based on our inductive approach, to estimate categories a) and b) above. In general, the valuations are based upon methodologies identified in the literature. These methods have been taken from their original settings and applied to the New Zealand context with appropriate local assumptions where possible.

This valuation is assumption-based and conservative. As such, it is expected that the estimates are lower bounds and best described in round numbers. As the estimates are lower bounds and there is little basis for estimating an upper bound, there are no confidence intervals. The estimates do not have the level of precision consistent with accounting costs and have been quoted to the nearest million dollars.

Figure 1: Economic framework for valuing the contribution of the VFB



Source: PwC voluntary fire service economic model.

Data

Data has been collected from a range of disparate sources. Volumes have been taken as reported but where a range of values was available a common base of 2007 was used (based upon the key inputs provided by the New Zealand Fire Service). Monetary values have been converted to a common base 2009 value where possible. In some cases, an average value over a range of years has been used to level out seasonal effects.

Conservative approach

Most critically, the approach to economic modelling has been a conservative one. Where two alternative estimates were possible, the more conservative estimate was chosen. In this respect, the value identified should be viewed as a conservative estimate of value.

Consultation

Two sets of interview questions were drawn up, with one set of questions addressed at the volunteers of the fire brigades, and the other set of questions addressed at the communities with VFBs. The interview questions[4] were designed to discover the participants' understanding of the value provided by VFFs.

Interviews and workshops were used to test a potential survey tool and assess the accuracy of potential outcomes for individuals in SRCs. More importantly, these workshops highlighted additional outcomes that had not been considered or identified in the initial research.

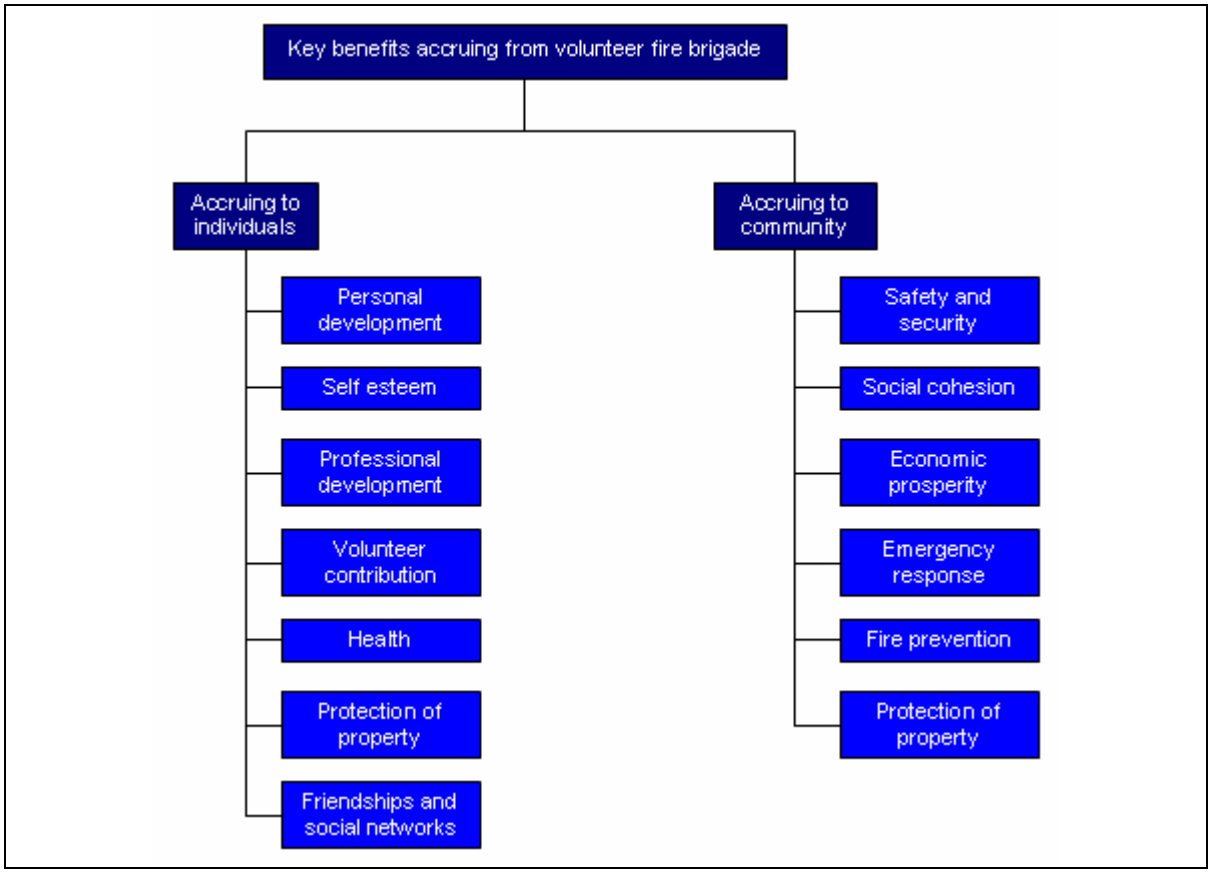
As part of the research, an online survey was deployed to provide a larger sample of opinions than that of three communities where the interviews and/or workshops took place. This also ensured greater robustness to the analysis. When the online survey responses were collated and aggregated they provided a picture of the national opinion that was set along side the qualitative opinions that were received in three communities. This comparison was used to reinforce or filter the opinions expressed in the qualitative interviews.

Value hypothesis

As described above, the focus of this research has been identifying the benefits that accrue to a community in which a VFB is actively maintained. These benefits are also referred to as outcomes, defined as 'a state or condition of society, the economy or the environment'. PwC used an inductive approach assisted by input from the New Zealand Fire Service and subsequent findings from the literature search to form a set of hypotheses that would be tested on those interviewed. These hypotheses are described in the figure below.

[4] See appendix B.

Figure 2: Value hypothesis used in the PwC research approach



Source: PwC inductive hypotheses for economic model of the Voluntary Fire Brigade 2009.

2 Core Business – Protecting People and Property

The core business of any rural volunteer fire brigade is protecting the property and people of an isolated community from fire.

Of equal importance, the modern volunteer fire brigade is often the first response to medical emergencies. Firefighters are 'advanced first aiders' and carry specialist equipment on their appliances. Both factors contribute to an estimated 33 fatalities avoided annually in SRCs. The conservative estimate made in this paper of economic value attributable to volunteer fire brigades in small remote communities (based on the 169 stations) is $79 million. Two thirds of this value is the result of responses to medical emergencies and one third from fire responses.

This chapter describes the role of the VFB with respect to formal call outs to fire and medical emergencies and the economic value associated with these activities.

The New Zealand Fire Service

The New Zealand Fire Commission is a Crown Entity that is charged with protecting lives and property from fire. The New Zealand Fire Service protects the urban fire districts and urban centres while the National Rural Fire Authority (NRFA) is responsible for fire protection outside these urban fire districts [DIA, 2008a].

The use of the term "urban", in reference to the Fire Act, has a specific reference to any populated area with little regard to its size or nature. As mentioned previously, a lay persons understanding of urban and rural will be used. Small urban areas based rurally are classified as remote communities.

The New Zealand Fire Service's principal role is to reduce fire incidents and reduce the consequences of fire. This includes reducing the negative impacts of fire for people, property, the community as a whole, and the environment [BERL, 2008]. The New Zealand Fire Service also responds to non-fire related incidents which include medical emergencies, motor vehicle incidents and hazardous emergencies. The latter includes earthquake and flood related incidents as well hazardous material spills.

In 2007:

- 73,333 incidents were attended by the New Zealand Fire Service, including events such as fires, motor accidents and chemical emergencies;
- 24,279 fires were attended by the New Zealand Fire Service, including 4,083 house fires;
- there were 5,476 vegetation fires;
- there were 33 fire deaths.

Firefighters in New Zealand are predominantly volunteers. Both the New Zealand Fire Service and NRFA are made up of professional firefighters and volunteer firefighters and there are approximately 10,000 firefighters across New Zealand that are involved in volunteer, paid, rural, industrial and/or defence fire brigades. Of these firefighters, over 1,700 are paid career firefighters and over 7,200 are volunteers in the New Zealand Fire Service.[5]

[5] These estimates were provided by the New Zealand Fire Service sourced from the NZFS Station Management System data as at August 2009.

The New Zealand Fire Service in Small remote Communities

Volunteer firefighters are a critical element in providing coverage to a disperse New Zealand population. Without volunteer firefighters (VFF) it would be difficult to maintain a credible nationwide fire protection system since volunteers make up more than 80 percent of all firefighters [Martin, Jenkins and Associates, 2006]. Volunteer fire brigades provide coverage for most of New Zealand's populated areas and there are more than 480 stations. They are particularly important in the more remote locations and can be found in communities such as Duntroon and Waitotara with populations as small as 100.

The physical proximity of VFBs reduce the response time for emergencies in remote locations because of their. These brigades are always staffed by local volunteer residents who can respond to a call far quicker than the next nearest brigade based in a larger community[6]. Although the typical volunteer must drop what they are doing, get to the station and then take the truck to the incident, it is still considerably quicker than having to wait for another brigade to travel a considerable distance from a larger town.

Reducing the response time to an incident can significantly reduce the impact of a fire or medical emergency. Some types of fires and certain medical emergencies are extremely time critical and failure to arrive within a short period may result in irreversible damage, losing control of a fire, or even loss of life. In small communities the New Zealand Fire Service is typically the only local emergency response for a fire incident, and may also be the first responder to a medical emergency or a car crash. Depending on the size of the town, there may not be a police constable or a St John's representative located locally.

Response profile

Fire brigades in general attend a wide range of types of incidents but in urban areas the paid fire fighters generally focus on a narrow range of core responses. This is because a large urban centre will often have more specialised services.

"The profile of responses for a brigade in a small remote community is typically more diverse …"

The profile of responses for a brigade in a SRC is typically more diverse because there are fewer specialist services and the VFB often acts as several services all rolled into one.

Volunteer fire brigades in SRCs do have the same core purpose as their urban and paid counterparts. This is 'to protect what the community values', that is, people and property. Protecting people and property, is reflected in the New Zealand Fire Service's official call out statistics.

Table 2 shows the range and frequency of activities attended by VFBs in the169 SRCs, with call outs to rescue and medical emergencies having the highest response (27% of call outs).

[6] This research has attempted to look only at stations that are physically remote and are more than 30 kilometres from a paid brigade.

Table 2: Number and percent of call outs by type for small remote fire brigades.

Type	No. of Calls	Percent	Calls / station
Rescue, medical call	1,412	28%	8.36
False alarms	936	18%	5.54
Vegetation fire	777	15%	4.60
Structure fire	364	7%	2.15
Hazardous incidents	388	8%	2.30
Special service calls	391	8%	2.31
Nuisance fire	321	6%	1.90
Mobile property fire	312	6%	1.85
Natural disasters	173	3%	1.02
Not recorded	2	0%	0.01
Total incidents	5,076	100%	30.04

Source: New Zealand Fire Service Station Management System, 2007 calendar year.

For the purposes of this research, fires have been categorised based on the expected impact of the type of incident. For each type of incident listed in the table above, the impact of a delayed response time will vary, from no impact for a false alarm and special service calls, to significant damage of a building or even serious injury or loss of life. The impact of a delay is significant to the economic analysis seen later in this chapter. This research considers the impact of the current response time compared to a counterfactual response time based on an alternative response scenario.

The table below, which shows the frequency of different types of call outs, is an aggregated form of the table above. It provides aggregated categories consistent with the economic analysis.

Table 3: Aggregated number and percent of call outs for small remote fire brigades.

Type	No. of Calls	Percent[7]
Structure fire	364	7%
Vegetation fire	777	15%
Other fire	633	12%
Rescue / medical	1,412	28%
Other dangerous	561	11%
Other	1,329	26%
Total Incidents	5,076	100%

Source: New Zealand Fire Service Station Management System, 2007 calendar year.

[7] Total does not equal 100 percent due to rounding.

Response times

Response times for the New Zealand Fire Service are critical in determining the impact of an incident. They are dependant on the time taken to mobilise the fire appliance, and the time taken to travel to the event. Paid firefighters in urban areas will mobilise considerably quicker than a VFF because of their physical proximity to the appliance. Volunteers typically have to drop what they are doing to get to the station as quickly as possible resulting in larger delays in mobilising the appliance. For the purpose of this research, however, it was assumed that the actual speed travelled to an incident in a remote rural area would be similar to travelling to an incident in an urban area, meaning physical proximity to the incident is the key factor in reducing total response time. Interviewees indicated that volunteers that live within the community will have local knowledge of roads and conditions that a GPS navigation unit cannot account for.

When estimating the economic impact of reduced response times later in this chapter it must necessarily be considered what a reasonable alternative response would be. The research was not commissioned with any agenda or alternative proposition in mind, however, a task of the research has been to consider alternative scenarios with which to compare response times.

Those interviewed as part of this research estimated that the average response time for an urban brigade to respond to a remote rural incident would be approximately 35 minutes. If, however, brigades were only present in the larger rural areas (greater than 2,500 population) and were not present in the SRCs then the response time to incidents in the SRC would be approximately 25 minutes. These estimates are used as average responses for the purpose of the economic modelling later in this chapter.

Based on the estimates above, VFBs can respond considerably more quickly to remote rural incidents than their nearest larger urban counterparts would be able to, when required. To measure the response time, the New Zealand Fire Service uses percentile responses as a measure of performance instead of averages which can be significantly distorted by a handful of outliers.

The response times in the table below represent the percentile responses for outside of Urban Fire Districts (UFD) which is a superset of SRCs.

Table 4: Percentile response times for non-urban fire districts.

Type	Response time (minutes, seconds)
50th percentile	12m 29s
90th percentile	27m 55s

Source: New Zealand Fire Service Station Management System, 2008 calendar year.

For the purposes of this paper, the following estimates of average response time to a callout in a remote rural community have been assumed.

Table 5: Average response time based on location of responder.

Location of responder	Response time (minutes, seconds)
Small remote community	12m 30s
Large rural community	25m 00s
Urban area	35m 00s

Source: Assumptions based on interviews with local communities, May – June 2009.

The response times listed above were derived from estimates made in the communities that were interviewed. In each of the three communities that were interviewed it was found that there was a larger rural / urban town nearby that might act as a central response point for a number of small communities.

A VFB in Rangiora (population approximately 5,000) would be able to respond to incidents in Oxford or Cust (who also have a VFB) in 30 minutes or more. A VFB in Pahiatua (population 2,577) could respond to call outs in Eketahuna or Woodville in a similar timeframe. If these brigades were paid, the time response would reduce further because of the physical proximity of paid firefighters to the station.

If the response needed to come from a major urban area, Christchurch and Masterton respectively, those interviewed suggested that the response times may be increased by 10 to 20 minutes.

These response time estimates apply for all fire related incidents. If the communities are larger like Oxford (population 1,752), they may have an ambulance service or police representative, Eketahuna (population of 441) however has neither and the VFB is the sole emergency response.

Economic benefit

The economic benefit that can be attributed directly to VFBs in SRCs includes the damage avoided as a result of reduced response times to fire, and the value of future economic contributions of lives saved through medical responses. Approximately $18 million of costs are avoided annually because of the reduction and prevention of damage to rural structures and $23 million reducing the effects of fire overall. The greatest benefit, however, is the future economic value that will be preserved because more than 28 lives are saved by VFBs in response to medical emergencies every year. Conservatively, the value of these lives saved is more than $56 million.

Table 6: Economic value of fire, medical and accident responses.

Type of call	Economic value
Fire	$23m
Medical and accidents	$56m
Total	$79m

Source: PwC voluntary fire service economic model.

The economic value reported above does not include any benefits attributable to fire prevention. The installation of smoke detectors, fire safety education and the physical presence of fire station provides constant reminders of the risk of fire. This presence and activity prevents fires before they begin but the additional associated value has not been captured.

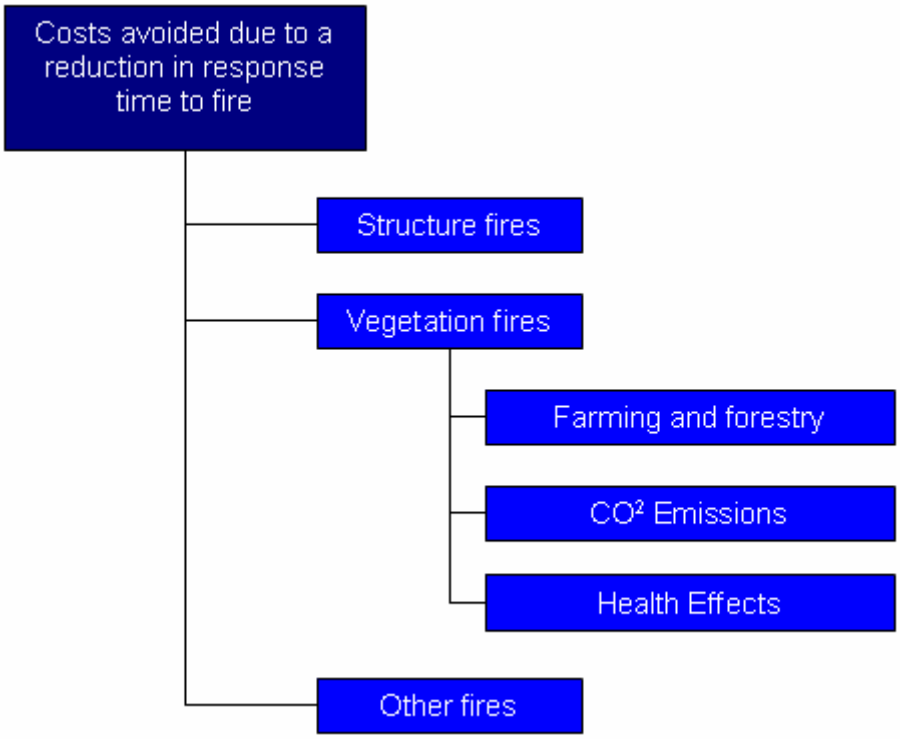
Response to fire

When a VFB responds to a real fire, it falls into one of three types defined for the purpose of this research.

1. Structure fire which poses a risk to buildings such as homes, factories, council buildings or farm buildings.
2. Vegetation fire which poses a risk to farms, forestry and recreation areas such as parks and reserves.
3. Other fire such as those that threaten mobile properties (e.g. cars).

In order to estimate the economic costs associated with each of these types of fire, a model was built. The key components of value identified can be seen in the diagram below.

Figure 3: The economic value associated with fire response



Source: PwC economic model framework of the Voluntary Fire Brigade 2009.

The total benefit, measured as economic costs avoided due to the decreased response times to fire incidents because of the physical proximity and local knowledge of VFBs in small remote communities, is estimated to be approximately $23 million.

Table 7: Annual cost avoided due to decreased response times

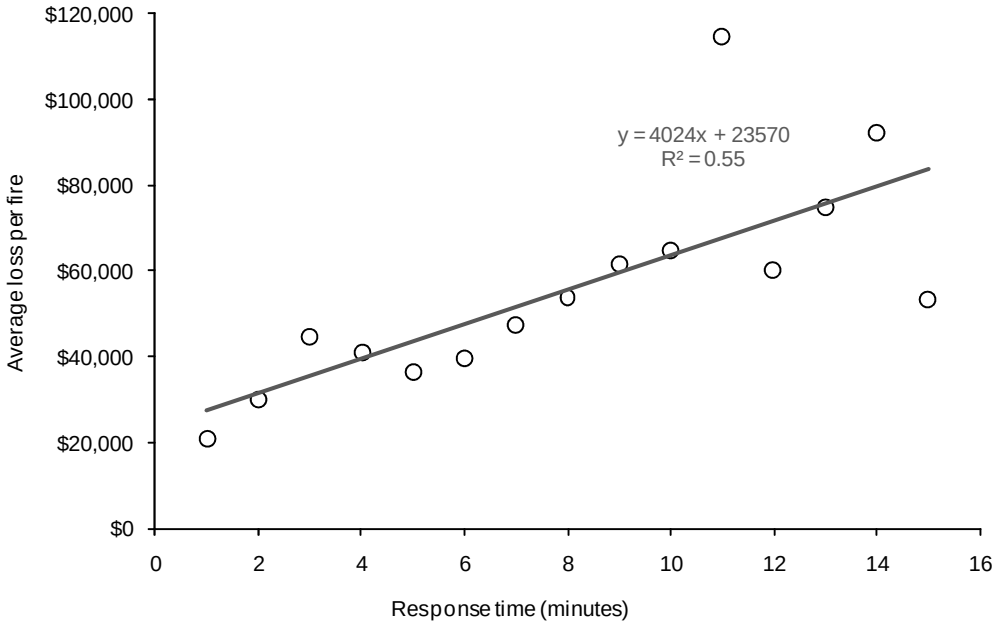
Type of Fire	Incidents	Economic benefit
Structure fires	364	$18.2m
Vegetation fires	777	$1.5m
Other fires	633	$3.2m
Total	1,774	$22.9m

Source: New Zealand Fire Service Station Management System (2007 calendar year) and PwC voluntary fire service economic model.

Structure Fires

The economic impact of structure fires is significantly greater than that of any other type of fire. In a recent paper, Challands [2009] analysed recent New Zealand Fire Service fire data specifically looking at the economic impact of damaged buildings. The analysis showed that the damage caused by a property fire increased, on average, by a rate of $4,000 per minute.

Figure 4: The nominal average value ($NZ) of damage to the structure per fire for each minute of fire service response.



Source: Challands N (2009), The relationship between fire service response time and fire outcomes, Fire Technology DOI:10.1007/310694-009-0111-y.

The economic impact of fires described above can be broken into two parts; a fixed cost which is estimated at $23,500 and a variable part due to the response time of $4,000 per minute. As discussed, a key outcome for VFBs is the reduction of response time. The impact of those decreased response times is shown in Table 8. It suggests that VFBs in small remote communities reduce real costs of fire in structural damage of between $18 million and $33 million annually.

In locations where the VFB supports major industry this cost avoidance may be much larger. In the case of Edendale and the Fonterra plant, the VFB plays a critical operational role. The VFB is within a kilometre of the plant, and can respond to an incident within five minutes. Many of the volunteers are themselves employees of Fonterra and are familiar with the risks at the plant and its surroundings. In this instance the damage of a delayed response time is significantly greater than $4,000 a minute, and the avoided cost would be higher. In reality, the plant cannot operate without some sort of fire protection and plants without local support have their own emergency rescue teams to help mitigate damage before New Zealand Fire Service support can arrive.

If this analysis is considered along side the decreased response time due to local fire brigades, then the damage avoided across 169 SRCs is estimated to amount to $18.2 million annually based on 2008 calendar year data.

Table 8: Economic impact of response times by location of responder

Location of responder	Incidents	Response time	Economic Impact per minute	Economic Impact due to response time
Small remote community	364	12m 30s	$4,000	$18.2million
Large rural community	364	25m 00s	$4,000	$36.4million
Urban area	364	35m 00s	$4,000	$51.0million

Source: New Zealand Fire Service Station Management System (2007 calendar year), PwC voluntary fire service economic model and Challands (2009).

Challands' paper [2009] discussed above also indicated that there was no correlation between response time and the loss of life in fire. "This would confirm the belief general within fire services that occupants need to self-evacuate long before the fire service arrives."[8] On the basis of Challands' research, no estimate value has been attributed to the role the New Zealand Fire Service plays in preventing fatalities or serious injury.

In the same paper, Challands [2009] also points out that there is, perhaps surprisingly, no relationship between response time and fatality. This confirms the general belief within the fire service that fire related fatalities occur relatively quickly and generally in the period before an appliance is able to arrive. If a person has not evacuated by the time an appliance responds, then the characteristics of the fire are such that the odds of surviving the fire will not change materially with a delay in response time.

[8] Challands (2009), p.9.

Vegetation Fires

The economic impact of the damage caused by vegetation fires in New Zealand is small relative to the damage caused by structure fires and is estimated at $1.5 million per year. This is due, in part, to the excellent coverage provided by the NZRFA in conjunction with local VFBs. Because of this high level of coverage, and the relatively wet climatic conditions, fires on the scale of the Australian 2009 Victorian bush fires are unlikely to occur in New Zealand. When vegetation fires reach a critical mass, they become far more difficult to contain and the scale of their damage increases several orders in magnitude. Because New Zealand's local vegetation fires are usually responded to and controlled quickly, the impact is small. This phenomenon can be seen in the NZRFA Statistics for the last three financial years shown in the table below.

Table 9: New Zealand Rural Fire Authority Statistics 2006/07 – 2008/09

Year	Number of Fires	Grass affected (hectares)	Scrub affected (hectares)	Forest affected (hectares)
06 / 07	3,983	2,342	1,410	535
07 / 08	5,170	5,310	2,598	1,174
08 / 09	4,133	612	1,221	447
3 year average	4,429	2,754	1,743	718

Source: Neil Challands (New Zealand Fire Service).

Small remote brigades were called to 777 vegetation fires last year. To value the economic impact of these fires the framework of Mendonca et al. [2004] was used. Their research into the cost of vegetation fires in South America identified losses in two components:

1. Losses to the land owner in terms of agriculture and cattle raising, and the loss of forests. For agriculture and farming this is the lease price of replacement land for the period it takes to restore the affected land. For forestry this is the value of the timber. These losses can be expressed as costs per hectare of land affected.
2. Losses to society associated with externalities including:
    a. CO^2 emissions from the depleted vegetation measured in tons of carbon emitted; and
    b. Human health damage and morbidity specifically for respiratory illness.

In applying Mendonca et al.'s framework to the estimates of economic value a number of key assumptions were made:

a) The impact of fires attended by Rural Volunteer Brigades is similar to those reported by the NZRFA in their annual statistics
b) The CO^2 emissions from forest fires incur real costs at a rate reported in the European carbon markets, irrespective of the current political position on carbon emissions.
c) That carbon costs associated with fire are not already priced into the value of the forest.
d) The same percentage of costs savings due to the decreased response time of the rural volunteer brigade, as were evidenced for structure fires, would apply to vegetation fires (68 percent).

More details of Medonca et al.'s framework and the derivation of these economic estimates can be found in Appendix D.

Table 10: Annual economic impact of vegetation fires in small remote communities

Economic Impact	Annual Economic Impact ($)
Farming and forestry	1,477,738
CO^2 emissions	1,296,987
Health effects	94,860
Total impact	2,869,585
Costs avoided	71 percent
Total damage avoided	2,037,405

Source: PwC voluntary fire service economic model.

The total impact of a vegetation fire is over $2 million. If the volunteer fire service (VFS) did not respond with reduced response times the impact of vegetation fire would be considerably higher. Based upon the analysis of structure fires it is estimated that these further costs would amount to $1.4 million (a further 68 percent)[9].

The analysis showed that the economic impact on farming in these communities is minimal provided that replacement land for grazing can be found. It also showed that the health impacts, primarily those associated with respiratory illness, were economically insignificant and could well be discounted to zero given the low level of vegetation fire.

What the economic analysis does not capture is the value attributed to the rural volunteer brigades in terms of preventing large scale fires like those seen in Victoria. Fires need to be contained, and failure to contain fires before they get out of control can lead to exponentially larger consequences. The example of the 2009 Victorian bush fires is an easy example to cite. According to the ABC [2009] the fire took the lives of more than 200 Australians and the Insurance Council of Australia [2009] has received approximately 9,105 claims for a total of $1.12 billion as of May 2009. This is merely the insured value of claims and says nothing about the raft of other social and environmental costs associated with the displacement of people and the destruction of such a wide range of natural and physical resources.

Other Fires

Other types of fire described in the beginning of this section include mobile property and nuisance fires. This research has conservatively estimated the decreased response time for these fires to save $5,000 per fire (10 percent[10] of that attributable to structure fires). VFBs in SRCs attended 633 of these fires during 2007 with costs avoided of more than $3m.

Medical assist and motor vehicle responses

In 2007, there were 1,412 medical / rescue calls in small remote communities. Conservatively, it has been estimated that 1 in every 50 of these responses will result in the attending firefighters applying life saving medical treatment that would otherwise have been too late in coming. This means that the future economic value of 28 lives in small remote communities can be attributed directly to volunteer firefighters each year. The value of this contribution is estimated to be $56 million annually.

[9] This estimate is explained further in Appendix D.

[10] Research assumption.

Traffic accidents (rescues) and medical responses may vary significantly in terms of severity. Not every event is a life threatening emergency, but the frequency of serious crashes and medical events such as cardiac arrest is high. Medical and accident responses can be very different but the injuries that are presented to the attending firefighters have commonalities. For the purpose of this analysis medical and rescue calls have been treated as one group in regard to requiring medical attention.

VFFs are all 'advanced first aiders' with access to equipment on the appliance, which means they are able to:

a) resuscitate and perform CPR;
b) give shocks using the defibrillator;
c) stabilise a patient to prevent further damage particularly in the case of back and head injuries;
d) stop severe haemorrhaging; and
e) administer oxygen that is carried on board.

This level of first aid is sufficient to prevent both fatalities and serious injury in many cases. VFFs will be the first response to an incident in most cases. Even within major urban areas ambulance staff find that the volunteer brigades will respond quicker to an outlying area such as Eastbourne. In remote communities, however, VFBs will be the first response more often than not. The frequency of the VFB being the first response, and the length of time they will wait for a St John's emergency response unit depends entirely on the town.

In Oxford, where there is a local emergency response unit, it is common to find the VFB there ahead of the St John's unit during working hours when it is less likely that a St John's volunteer is available. At night the St John's unit may receive the call first but typically the fire service will be called irrespective. If CPR is administered, the fire service is almost certain to be involved as sustained CPR requires a team of people.

In Eketahuna, which does not have a local ambulance response the VFB will always be the first response and a patient can expect a significant delay for additional support.

As suggested earlier, it is not an infrequent occurrence for the Fire service to provide life saving interventions. To assign the value of a saved life to the response of the VFB the analysis would need to be certain that the reduced response time alone prevented a fatality. In making this assessment on a case by case basis an expert would need to consider what treatment the public might have provided, how long the alternative response would take, and the effects of this delay on the particular type of injury to name just a few considerations. It is an extremely complex assessment for anyone to make on an individual case by case basis let alone at an aggregated level.

For the purposes of estimating the value of the VFB interventions this research has presented three scenarios of callout frequencies that result in lifesaving interventions. The scenarios include every 100th callout, every 50th callout and every 20thcallout that results in a lifesaving intervention.

The economic value of each of these lives has been assessed using the Value of a Statistical Life (VoSL) as described by BERL in their 2007 report for the Fire Service. In describing what the value encompasses they say: "This value is thought to express all the tangible and intangible values of a life lost or a life saved. It includes the usual monetary concepts of the present value of future income and also the intangible enjoyment of life, or conversely pain and suffering of a life lost." [BERL 2007, p1]. The value calculated by BERL was just over $2 million per life in 2006 and $2 million in 2009 dollars represents a suitably conservative estimate for the purposes of this paper.

Table 11: The value of lives saved in small remote communities 2004 – 2008.

	Frequency of life saving callouts		
	1 in 100	**1 in 50**	**1 in 20**
Lives saved (#)	14	28	71
Value per life ($)	$2,000,000	$2,000,000	$2,000,000
Total value ($)	$28,000,000	$56,000,000	$142,000,000

Source: PwC voluntary fire service economic model, New Zealand Fire Service / BERL Report.

Of the three scenarios, the middle estimate has met with the most agreement. The statements below put this estimate in context.

- In 2007/08 firefighters in brigades with fewer than 50 call outs per year, 1 in 10 medical or emergency calls required firefighters to extract a person. 'Extraction' is the most severe type of response and requires a person to be carried from a house or removed from an accident, using the jaws of life for instance.
- Given there are 169 fire stations in SRCs, the middle scenario represents only one life saved in every five stations annually.

This is a conservative estimate and only represents the number of lives saved that are directly attributable to the VFB's more timely intervention compared with other alternatives. It is certain to be the case that VFBs make a contribution towards saving many more lives in conjunction with ambulance services. Without a line by line analysis of individual cases, however, it seems prudent to be conservative in any estimation.

Using the VoSL, derived in relation to fire, for lives saved in medical and road emergencies it is assumed that the public's willingness to pay is the same for both. BERL's [2007] paper identifies that the value of the New Zealand willingness to pay road VoSL is much larger and had a value of $3.05 million in 2006. In 2008 the Ministry of Transport further updated previous work and used a VSOL of $3.35m in The Social Cost of Road Crashes and Injuries. To reflect the conservative nature of the estimates this research has adopted a rounded estimated value of $2 million per fatality avoided.

This analysis only accounts for the protection of life and does not account for the prevention of further serious injury for example brain damage or paralysis. The Ministry of Transport [2008] estimates the value of preventing serious injury at around 17.5 percent of the VoSL. It can be reasonably expected that the VFB prevents as many serious injuries by their quick arrival as they save lives. Since the calculation of this value is a derivative of any assumptions made in calculating the impact of lives saved, no further value is attributed to the prevention of major or minor injuries.

The estimate of the economic cost of preventing fatalities needs to be considered in context of the assumptions made. It should be clear, however, that the benefits for medical and rescue responses, particularly in small remote communities are at least as large as the value of fire responses. In fact, based on this estimate the true value is likely to be twice as large, than for fire response. Please note that the estimate excludes the value of preventing any serious injuries.

Most people in rural communities recognise the wide range of activities that the VFB performs but would be surprised to learn that the value of the medical outcomes is as great, or exceeds the value of fire outcomes. The smaller the community, the more important and valuable is the medical response to the community because of the dependency on a single service for all emergency response.

This is particularly true for senior citizens who rely on this type of response. Access to health services becomes increasingly important as the population ages. There is evidence that older people move from rural centres because of the lack of health care. This has been evidenced in demographic research which shows that emigration from rural areas is highly targeted to young adults (18 -24) and the retired [Chalmers 1994].

Other types of calls

The New Zealand Fire Service also provides a wide range of public protection services in small remote communities which may have an economic benefit:

- by assisting Police, it helps to protect property and prevent injury;
- first response to chemical spills, electrical hazards, ruptures and explosions and accident containment ensure no further harm occurs;
- all volunteer firefighters are briefed for civil defence emergencies and in a natural disaster, the fire station is often a civil defence station and firefighters often participate in restoring and securing property during floods, storms and other weather related incidents.

Although there is a benefit associated with these activities, as has been described in more detail in following chapters, none of these benefits have been valued in the economic model. This is because of the high level of uncertainty surrounding a) quantifying the benefit in absence of research and b) what the alternative solution would be if the VFS did not exist.[11]

Summary

The minimum estimate of direct costs avoided due to VFB callouts in small remote communities is $79 million annually based on data from 2007. This equates to approximately $467,000 per station per annum. This is derived primarily from the value of fatalities avoided and the prevention of further damage by fire to structures. The economic value of the medical and rescue responses are at least 2 – 3 times larger than that of the fire response based on the findings of this research.

[11] In the absence of a trained volunteer others would likely step into the gap but would not necessarily be equipped to be as effective (e.g. having access to road cones to divert and direct traffic during an accident).

3 Over and Above - the Value of Volunteer Labour

The cost to replace the time spent by firefighters in their firefighting role as calculated in this research is significant and is estimated to be in the order of $12 million annually. The average value per volunteer, for their firefighting activities is $5,864 which is more than six times the contribution of the average New Zealander recorded by Statistics New Zealand in 2004.

This chapter describes the nature of the volunteer role within the NZFS, discussing different methods for valuing volunteering and places an economic value on this volunteering in small rural communities.

Background

To ensure that the New Zealand Fire Service can respond to all fire and non-fire incidents, all firefighters, both paid and volunteer, need to undertake extensive training. Further, they need to maintain their fitness and constantly fresh their training in order to respond efficiently to emergencies.

Volunteer fire brigades, similar to their paid counterparts, also incur costs for the upkeep of their fire station and the maintenance of the fire truck(s) and equipment. Some of the key differences between paid and volunteer fire brigades are:

- the cost of labour, with the exception of the token fee paid to Chief Fire Officers, volunteers are unpaid;
- the number of active call outs is significantly greater for paid brigades; and
- the average time taken to mobilise an appliance is shorter for paid brigades because of their physical proximity [New Zealand Fire Service, 2008].

The employers of volunteer fire fighters receive no compensation for the time that their workers are absent due to VFB activities [New Zealand Fire Service, 2008]. Some interviewed said a minority of employers would deduct wages for the time taken off by volunteers; however, this was not the experience of most firefighters.

The value of the estimated benefit when the time of VFFs' is monetised highlights the value of the volunteer firefighter in society and how expensive it would be to replace [Ganewatta and Handmer, 2007]. In estimating an economic value for volunteer time in emergency services, Ganewatta and Hadmar [2007] believe that as well as actual time spent in action, time spent in training, administration and stand-by time should also be included. Stand-by time is when volunteers have to be ready for immediate response (this could mean, for example, that the volunteers have to be within a certain travelling distance and have to limit their alcohol consumption).

Size of the contribution

Volunteerism is central to New Zealand's fire protection strategy. As at July 2009, the New Zealand Fire Service worked with over 7,500 volunteers across the country and is actively recruiting to raise that number to over 8,300. These volunteers encompass both firefighters and non-firefighters (e.g. administration support). Of the 169 small remote communities included in this research, no VFB had fewer than seven VFFs in 2007 with an average of 17 members for these stations.

Volunteering as a firefighter involves more than the average commitment to a group and is certainly on par with high level sport in terms of time commitment. VFFs will typically find themselves involved for more than five hours every week in official duties. In addition, as individuals, firefighters will often find themselves involved in other community activities that they have been drawn into as a function of their role as a volunteer firefighter

The official duties mentioned previously are wide ranging but generally encompass the activities briefly described below.

- Call outs – this forms the core component of a VFF's official duties and the response rate for each station can vary quite significantly. Call outs are extremely diverse in nature. For example, they can range from an hour for a simple call out, to days or weeks for vegetation fires. Given the amount of time required to mobilise and return to normal routines, the duration of a call out is rarely less than an hour, even if it is a false alarm.
- Training - this is a strict requirement to being a VFF and involves a regular commitment of time, usually once a week.
- Meetings and briefings – these usually occur weekly and combine together administration, training and social aspects. Meeting are essential to ensure that the latest skills, training and protocols are employed consistently.
- Social events – this includes promotional activities and fundraising and are more irregular but are not infrequent. Activities such as fundraising are common to all stations, and a firefighter could expect to be involved at least twice a year.

Other activities such as maintaining fitness are integral to their role as firefighters. These are outside what are identified as the official duties but are a requirement of continued participation. The VFFs also have access to a voluntary health monitoring programme referred to as the Hauora Model (holistic healthy lifestyle model).

Each VFB has a Chief Fire Officer (CFO) who commits substantially more time to volunteer activities. Although the CFO receives a small prescribed payment for this role, an annual honorarium, it is not a payment for service but rather intended as recognition of the additional duties and responsibilities that comes with the position. The CFO may spend anywhere between 10 and 30 hours a week on training and duties. For the purpose of the PwC economic valuations, it is conservatively assumed that the CFOs spend, on average over the year, 15 hours in total per week.

How to treat volunteer labour

The literature includes a number of different approaches to identifying and valuing volunteer labour. Some studies classify the labour (time) of volunteers as a cost, adding it to the cost for fighting and/or preventing fire, while others value it as an input to the community or an in-kind contribution. The literature reflects the range of different perspectives about the role and related value added. The lesson from the literature is that analysis of the contribution of volunteers needs to be seen in the context of the specific roles of volunteers, the volunteers capability and experience, and the amount of physical, managerial and intellectual effort contributed by the volunteer.

Valuing volunteer labour

The two most common ways of valuing volunteer labour are referred to in the literature as replacement cost[12] (market- price proxy) and opportunity cost. Replacement cost assumes that an activity in unpaid work is worth the same amount as it is in market employment [Statistics New Zealand 2007]. Opportunity cost assumes that the value of the volunteering is equal to what individuals would have otherwise done with their time. Traditionally this is valued as what they would earn for the equivalent time in their normal profession.

[12] Replacement cost in this context refers to what it would cost to employ a person with an equivalent skill set were such a person available. In accounting terms replacement cost may be referred to as something different.

For practical purposes, the United Nations Statistical Division and New Zealand's official statistics use the replacement cost method described above. In the Non-profit Institutions Satellite Account: 2004, Statistics New Zealand uses a standard wage based on a range of professions. The estimated average wage was $12.15 per hour in 2004.

Another approach was developed in a study done by PwC for the NZ Federation of Voluntary Welfare Organisations [2004], the Counting for Something: Value-Added of Voluntary Agencies (VAVA) Study. In this study, workshops were held with ten large voluntary agencies who came up with a range of market values to cover the value of different roles of volunteers and what it would cost if they were to paid positions instead. This approach was different in that it allowed for a graduated scale of seniority and experience instead of merely applying a blanket wage for each industry activity.

BERL [2005] estimated the contribution of urban fire service volunteers at $62.8 million per annum[13] for New Zealand using the replacement cost method. A reasonable approach is to assume that professional and volunteer fire fighters perform similar roles. Based on this, the replacement cost method can be applied based on specific wage information.

Replacement cost is the approach adopted for the PwC economic model with the addition of a graduated scale of wages which reflects the differences between in experience required for Chief Fire Offices versus other volunteer firefighters.

In a recent media statement, New Zealand Fire Service Chief Executive Mike Hall [New Zealand Fire Service, 2009] indicated that the basic wages for a fire fighter in New Zealand ranged from $40,000 – $70,000 and that wages were set based on combination of experience and skill. For paid firefighters, overtime could further increase the take home package.

Paid firefighters work shifts of four days on, four days off. This equates to 48 hours every eight days, which is more than a typical 40 hour week. Paid firefighters have between 5 and 6 weeks leave per year which is more than many other professions that are paid for a 40 hour week. On this basis hourly rates used in this research have been calculated using a 40 hour week.

The method adopted in this research was to use a replacement cost method that differentiates between two key skill sets in a fire brigade - the firefighter skill set and the CFO skill set.

VFFs do not typically attend as many events (call outs) as their paid counterparts and, generally, do not require the same level of training and practice. On the other hand, they are typically long serving with considerable experience which helps close any technical proficiency gap. On this basis, it seems reasonable to assume that the replacement cost of a VFF, for their level of work, would be consistent with a paid fire fighter that is trained, yet new to the service.

CFOs of VFBs dedicate significantly more time and are generally better trained than the other VFFs. The replacement cost of their service is, therefore, estimated at the top end of the base salary scale for paid firefighters.

The table below shows the hourly rate for valuing volunteer labour in the fire service using the replacement cost methodology and based on the assumptions discussed above.

[13] This was estimated for 2004 based on a shadow price using the average labour cost per fire incident in the paid fire brigades.

Table 12: Assumptions about the replacement cost of volunteer fire fighters

	Annual salary	Hourly rate
Volunteer firefighter	$40,000	$19.23
Chief fire officer	$70,000	$33.65

Source: New Zealand Fire Service, research assumptions.

This research has considered the economic impact of 169 stations for which each must have a minimum of 4 volunteers to comply with the New Zealand Fire Service requirement that a brigade must have a full complement of firefighters in a truck to respond to a call out. In reality, the average number of volunteers per station is closer to 12 including the CFO. The replacement cost valuation was, therefore, based on 1 CFO and 11 VFFs per VFB.

Each VFF, as discussed previously, conservatively contributes 5 hours per week and each CFO contributes an average of15 hours per week. This equates to an annual contribution of 225 hours for a VFF and 675 hours for a CFO, based on the further assumption that volunteers are available for at least 45 weeks in a year, taking into account 7 weeks when they are unavailable because of holiday leave And other unavailability.

Based on the assumptions of time contributed, replacement wage rates discussed above and applying the PwC economic model, the annual replacement cost of volunteer firefighters is estimated to be just under $8 million for the VFFs. The addition of CFOs is estimated at an additional $3.8 million. When rounded, this equates to an estimate of $12million in economic value per annum.

Table 13: The value of volunteer labour for firefighters in small remote communities 2007

	VFF	CFO
Number of volunteers	1848	169
Annual volunteer hours per volunteer	225	675
Replacement cost per hour	$19.23	$33.65
Annual replacement cost	$7,995,834	$3,815,910
Total replacement cost for VFF in SRC		**$11,811,744**

Source: PwC voluntary fire service economic model.

The average volunteer in New Zealand added $3,274 in 2004, according to Statistics New Zealand [2007]. If the numbers above are used to derive an equivalent value for VFFs in SRC, then the value is $5,864 per firefighter in 2009 dollars. When the time value of money is considered, this is the equivalent of $5,054 per person in 2004. This suggests that the contribution of VFF in SRC is 55 percent greater than the average volunteer and more than 6 times greater than the average New Zealander ($815) as reported by Statistics New Zealand.[14.]

[14] Based on the NZ mean population 2004.

4 Strong Foundations – Making the Community Work

Volunteer firefighters are “pillars of the community” and generally “good blokes”, according to those interviewed for this research. When something needs doing, when someone has a major problem, the VFB is a community resource that can solve problems, big and small, in the community.

This chapter describes in greater detail the nature of the contribution the volunteer fire brigade makes to the community, including the way in which it interacts with other emergency services.

VFBs in small remote communities

Volunteer fire brigades are often the only emergency response service for small remote and semi-rural communities. The alternative for SRC’s is a long-response time while they wait for the nearest paid fire brigade to be dispatched. The important role of volunteer fire brigades is particularly important in context of a study in Australia which found, that we now live in an environment where volunteer numbers are falling [Cowlishaw and McClennan, 2006].

New Zealand is facing similar pressures with changing demographic trends and greater personal liability risks, amongst others, cited as reasons for the lower volunteer numbers [Martin, Jenkins and Associates, 2006]. NZIER [2008a], in its analysis of trends in volunteering, cites the movement of people to cities as one of the reasons that rural communities struggle for volunteers.

It is not, however, feasible to have a paid fire brigade in each town. Brunet, DeBoer and McNamara [2001] argue that it is actually more cost-effective for communities that need low levels of fire protection to have a volunteer fire brigade. This is due to the high cost of maintaining a paid fire brigade when there is only a limited need for fire protection or emergency services. BERL [2008] describe these costs in terms of the average cost of each unit of service delivery and its marginal costs.

The role of VFBs in the community

The previous chapter talked about the activities of the firefighters in relation to their core business of fighting fires. That discussion was extended to include other activities such as medical and emergency response to accidents and crashes. It noted that these activites form an equally large part of their work load.

Excluded from the previous discussion on firefighter activities is the irregular tasks that are performed. These tasks are unlikely to fall within the official mandate of VFFs. They are the tasks that every rural volunteer fire brigade finds itself doing whether an alarm goes off or not. These tasks are diverse and range from ‘one-offs’, for instance running the truck to the circus to hose down an overheated elephant, to more frequent activities, for instance moving the piano from the hall to the stage and back again in the local town hall.

Other examples include:

- rescuing a cat from a tree
- clearing storm damage and trees
- clearing cattle and stock from the roads
- bomb callout

- rescuing a child stuck in a toilet
- repairing fences and roofs
- Civil Defence responders.

There are also many social roles that the VFFs fill in the community, for example:

- running the bar at social functions;
- repairing pensioner flats;
- building and renovating the town hall; and
- community security.

Social capital

The economic value of a volunteer fire brigade for a community is predominantly the indirect or secondary benefits that arise from volunteering. These benefits are commonly referred to as social capital and incorporate the interaction between people and the contribution towards social and economic development. VFBs and social capital are discussed in more detail in this section.

Relationship with other emergency services

The VFB is almost always the first response to an emergency and in many communities is the only local emergency response. The VFB, with its local knowledge, are invaluable for working along side other emergency response service providers.

Police

VFFs are the first source of Police backup in rural communities and implicitly provide some of the functions that Police do if there is no local representative.

When playing a backup role to the Police, it is common to find VFFs providing a physical presence to reinforce the local officer in dangerous physical situations. The presence of VFF can be of great comfort and relief for an at risk officer.

VFF know the protocols for road safety and have the equipment and skill to redirect traffic in the case of a traffic accident, a chemical spill or a fallen power line. This type of preventative action could be taken by a constable but when they are operating solo there may not be the time or opportunity to act.

VFF have also been known to assist Police in investigations. In a unique story that is typical of the resilience of rural towns, VFF were part of a stakeout operation to catch local vandals who had been tagging the town. The vandals were caught with the help of communications equipment and the early morning perseverance of the volunteers. A similar community operation (in the nineties) was discussed with the Oxford VFB where the Brigade was involved with apprehending arsonists.

It is also worth noting that firefighters also bear a cost on behalf of the community when it comes to fatal accidents. Although a value has been ascribed to the lives saved by medical and accident responses, the scene that meets a first responder can be traumatic for many people.

Civil Defence

Civil Defence has emergency response plans and protocols to cover rural as well as urban areas. The VFS is a critical part of this plan as the Civil Defence relies on these volunteers to organise people and mobilise resources in their communities.

VFFs are trained to respond to civil defence emergencies and has the appropriate equipment to tackle the various types of incidents associated with civil defence emergencies. In addition, the VFS has the necessary communication infrastructures to

coordinate the local response and keep people informed, with the fire station also being the Civil Defence collection point for many towns.

In the words of one Civil Defence staff member responding to a question about what it would mean for the Civil Defence response plan if there were no volunteer firefighters in the small remote communities:

"We simply couldn't do it without them, it's just not possible".

VFFs are recognised community leaders. This, combined with the authority associated with their uniform, is essential to organising a quick and efficient response that saves lives and minimises damage to property.

The VFS will coordinate responses to less severe emergencies that may not involve Civil Defence but have the knowledge to assess when Civil Defence needs to be called in. High winds and floods are common in geographically remote towns, and the VFS is always on hand to clean up the mess. Often their role will go beyond just the immediate incident. Those interviewed as part of this research reported VFFs returning to scenes of damage days or even weeks later to check things were still secure, and sometimes even to inspect the repairs. This is well beyond the mandate of the fire service.

Ambulance

Unlike other emergency response services, ambulance services are not run by a single body. Although St John is the representative in most cities, it is not true for all centres. In Wellington, for example, medical emergency response is provided by Wellington Free Ambulance.

The medical call centres are also housed separately to fire and police which makes cooperation slightly more difficult. The call routing process, however, still ensures that the closest and most available emergency service will respond to medical emergencies, and in SRC (particularly in work hours) this will be the New Zealand Fire Service.

At a national level VFBs are an integral part of the medical coverage. As discussed in the chapter 'Core Business – Protecting People and Property' in the section on medical responses, VFFs are not a substitute for a qualified paramedic. In many cases, however, the combination of response time, on board equipment and advanced first aid is sufficient to prevent fatalities, and prevent further damage before St John or another ambulance service can arrive. In this respect, the two services work in partnership in a spirit of cooperation that sees the best possible outcome for the patient. This may include sharing the strenuous work involved with CPR, or extricating patients. Although it is true in urban areas as well, it is particularly true in SRCs that the Fire Service complements the ambulance services by providing appropriately trained resources to back up the ambulance officers. Those interviewed expressed genuine attitudes of appreciation and co-operation. There was no trace of competition or competitiveness expressed by the interviewees for this research.

National Rural Fire Authority

There are 90 rural fire authorities in New Zealand. The rural fire authorities comprise Local Territorial Authorities, Department of Conservation, Defence Force and Rural Fire District Committees. They are responsible for fire suppression and prevention, and for protecting the forest and rural lands as set out under the Forest and Rural Fires Act 1977.

There are over 3,000 volunteers and part-time rural firefighters that belong to the rural fire authorities and they are responsible for rural fire fighting under the Act. The New Zealand Fire Service plays an integral role in supporting the NRFA, often travelling outside their defined 'urban fire district' [DIA 2003] as the first responders to an incident. The New Zealand Fire Service is the first responder to as many as 80 percent of rural fires.

If the New Zealand Fire Service, as the first responder, makes the decision to call the NRFA to the incident, then the rural fire authority responsible for the area will then take command when it arrives at the fire scene. The NRFA is ultimately responsible for managing rural fire incidents so both organisations have operating protocols in place, in addition to a charging mechanism, to manage the associated costs. Without the cooperation of the New Zealand Fire Service, the NRFA would require considerably more resources and a significantly greater number of volunteers.

Describing social capital

A distinctive feature of small remote communities is their interconnectedness and the strength of the relationships within a geographical area. This closeness represents a high level of what researchers often refer to as social capital. Social capital includes elements such as participation in networks, reciprocity, trust, acceptance, shared ownership and a proactive response to community problems [Bullen and Onyx 1998].

The Allen Consulting Group [2005], in its analysis of surf life-saving in Australia, identified the trust component of social capital as a benefit of having volunteer life-savers. This could be true of volunteer firefighters in that the public trust that they will be saved from fire by having a volunteer fire brigade. The fire service's main role is to prevent fires, save lives and protect property and assets from fire. In general, the public does not regard the fire service as having a mandate to a secondary role where they will also assess the nature and level of care required, as is the case with the police of ambulance response.

"Social capital includes elements such as participation in networks, reciprocity, trust, acceptance, shared ownership and a proactive response to community problems."

Both factors contribute to the public perception of trust as illustrated in the results from the annual Reader Digest's Trust survey. Firefighters have topped the list of most trusted profession in New Zealand for three years in a row from 2007 -2009.

Social capital contributes to the retention of population and the quality of life in remote towns and makes it possible to manage community wide problems in the absence of a wider range of government services that are provided in urban areas. Volunteers, through their interaction with the community, have insights into their community and understand what is important and valued [Scottish Executive, 2002].

VFFs are critical to maintaining the high level of social capital needed to sustain a small remote community. This research indicates that they are the social glue for these towns and act as a community resource that helps communities solve problems. As one gentleman suggested, *"When someone has a problem, they call the Fire Brigade"* because they are the people that help. An excellent example is the case of the shifting piano. In the local community hall there was a piano that was sometimes needed on the stage and sometimes on the ground. The firefighters were called on regularly to shift it up and shift it down. A piano is extremely heavy and requires between four to six strong people to move. Without the service of VFF the piano may simply not be moved and although the impact would not be life threatening it would reduce the capability of the community.

Capability is an important concept in rural New Zealand. Significant population decline in rural areas over the last 30 years has resulted in a significant reduction of services. Without the population base to support them, commercial services such as banks and medical clinics have been unsustainable, as have traditional government services. This is part of the reason why rural communities try to be as self sufficient as possible. They cannot rely on the services provided from major urban centres and they see their local VFB as one of the last remaining services that provide them with a sense of autonomy and protection.

Symbiosis

In small communities where there are decreasing government and economic services, the community and the VFB have a unique relationship. Often the VFS will be the only emergency service in town and its presence is a stark counter to the closed down banks and service stations. In these towns the community and VFS support each other - exchanging social capital as a means of mutual enrichment. This phenomenon represents a symbiotic relationship because of the mutual need of both the fire service and the community where continuing existence of the one is interlinked with the existence of the other. In reality a community may not fail without a fire brigade but VFBs make a tangible difference to their sustainability and ability to recover from disaster.

Social symbiosis

The community needs the VFB for protection against fire, but fire related call outs are only a small part of what the fire service does for the community. The service, as described previously, also has an official role in responding to both emergency and non-emergency incidents that are not necessarily fire related. The local VFB's engagement with the non call-out activities arguably makes an equal contribution to the life of the community. When the organisers of the town fair, for example, need someone to put up the stage, they call upon the services of the VFB.

In return for this service, given privately or publicly, the local brigade receives the support of the community. This support is reflected in positive outcomes for the fire service which include three factors briefly described below.

- Effective fundraising: The local community is the subject of most fundraising efforts, either for specialist equipment or for general funds.
- Respect: VFFs are highly regarded which in turn leads to the public showing appreciation and goodwill for the work of the service. This in turn helps to retain volunteers and provides an increased intrinsic reward for their work.
- Cooperation is provided during callouts: The effectiveness of the service is enhanced by the support and cooperation that a positive public provides them. It allows them to do their core job quicker and more effectively. One interviewee attributed this support to the lack of suspicion surrounding the service. The New Zealand Fire Service has been identified as the most trusted government service in part because the service has no obligation or agenda except to help. This was contrasted with the Police who have obligations to investigate and report legal breaches.

The VFB and the local community both rely on this social symbiosis to function effectively. VFBs act as the social glue that holds together many of the communities' cooperative activities and are often a catalyst for maintaining the current standard for quality of life.

Economic symbiosis

Small remote communities have been suffering a decline in prosperity and population for a number of decades. Results from the Statistics New Zealand 2006 Census show that even over a relatively short period (1996 -2006), the population in highly rural and remote areas[15] continues to drop.

[15] Includes the categories of 'highly rural/remote area' and 'area outside urban/rural profile'.

Table 14: Highly rural and remote areas NZ population 1996 - 2006

	1996	2001	2006
Population	71,565	66,333	65,097
Percent of population	0.0198	0.0177	0.0162

Source: Statistics New Zealand 1996, 2001 and 2006 Census results.

A study commissioned by the US Economic Development Administration [Feser and Sweeney, 1999], found that out-migration (emigration) and population loss exert an adverse impact on communities. These adverse impacts include:

a) a depletion of critical human capital
b) restriction to and/or increased costs to access markets and technology
c) increased demand on local governments to provide the same level of service with fewer people to spread the burden over.

In relation to a) and b) above, when people leave rural communities the community finds it no longer has the technical skills, experience or access to technology that it once had. These things can still be accessed but with both a significant time lag and increased cost. For example, a technician to repair a key piece of equipment or repair an infected computer may be accessible but not on the same day or within the same week. This may have an immediate economic impact depending on the critical nature of the equipment. In addition, a rural community may find that there are travel and accommodation costs associated with the service and those vendors may be unwilling to travel which will restrict the access and choice associated with the service.

It was also noted by several of those interviewed that as rural population declines, so do the resources available to local government. As a result, rates were forced to increase and the relative quality of local government services often dropped. The infrastructure required to service a large rural area does not change greatly whether the population is 4,000 or 400; however, the people bearing the cost for such a service reduces considerably. Inevitably, there is both a degradation of the relative quality of the service and an increase in the rates burden to support the service. Quality declines while cost increases to offset the large population losses.

Many of the survey respondents attributed the decline in population to one of the points a) to c) above and linked this to the subsequent decline in local services. The New Zealand Fire Service is often the only nationally linked service the community has access to aside from the local four-square or mini mart, which is usually locally owned.

In this capacity, the New Zealand Fire Service has an economic impact on the long term sustainability of the town. The respondents indicated that they anticipated that the absence of the fire service would accelerate the population decline and potentially affect the long term viability of any businesses in the area. The protection and security that a VFB provides to residents through improved response times is critical to the economic continuation of small remote towns. Without it, the continuation of these economic units is in doubt. This effect, however, is unlikely to apply in larger towns where more services are available.

This research has not attempted to quantify the value of the economic impact associated with slowing down or preventing urban migration due to the difficulty of isolating how a fire brigade contributes to stave off further decline. This impact also varies considerably between communities depending on size and geographic characteristics. However, the point must be made that amenities contribute to the quality of life and economic growth of rural communities. A study by Steven Deller [2001] of 2,243 rural communities in the US showed the positive impact of amenities on economic growth indicators. Similar research in Canada supports this position [Ferguson 2007].

Both studies recognised recent lifestyle trends in North American where people were increasingly moving to new rural communities equivalent to 'lifestyle blocks' in New Zealand. Although net migration in New Zealand is away from rural communities, lifestyle blocks may well be a driver for economic growth in rural areas. The level of overall amenities, such as the fire service, is one factor that an individual might consider when evaluating a move to a rural lifestyle.

Other elements of cohesion

The symbiosis that was observed in these communities speaks strongly to a number of elements that contribute to social capital. The reciprocal and collaborative nature of the cooperation around community problems, such as the vandalism referred to earlier, illustrates the part VFFs play in building social capital.

As will be shown in the next chapter, where the reasons for volunteering are discussed in greater detail, the social element of a VFB is important for recruiting and retaining volunteers. The fire service is more than just a duty; it is also a social community. In particular, small towns with little more than a pub and a service station, may only have a couple of clubs and physical locations to centre social activity around. It is not a surprise, then, that the local fire station becomes a focal point for the social activities of the VFB members and their families. These facilities and the shared experiences gained during service develop friendships, trust and personal networks which all contribute to social cohesion.

The presence of a brigade is essential to the sense of security and independence that a rural community feels. This is particularly important for older people who are less mobile and, therefore, more dependent on others. Two examples cited during the interviews support this argument. The first example is where the fire service promotes fire-safety in the community by installing smoke alarms in the houses of pensioners. The second example is where the VFFs secured the roof of a pensioner's flat and then returned to repair the damage caused during a storm. Health is a particularly important issue to the elderly and the knowledge that the fire service are competent, trained and have some medical equipment adds to their sense of safety.

VFBs provide an independent and autonomous response to community problems. Rural communities are often reluctant to rely on their urban counterparts to provide what they need. The presence of a fire station on the main road is a constant reminder of their independence and the ability to provide and protect their community. In this respect the profile of the fire service at community events, and even the location of the station is important. The VFS is a key symbol of the communities' ability to cope with community problems.

The magnitude of any estimate of the contribution from the VFB towards social outcomes will vary significantly depending on the size of the community. In this research, small remote communities are, by definition, towns with a population of less than 2,000. These towns represent a wide rage of community structures but, in general, the smaller the community, the greater the level of influence the VFBs will have on social outcomes. In a town like Eketahuna (population 441), the relative importance of the VFB was larger than in Oxford (population 1752) where it, in the words of one participant, "has a committee for everything".

Local government perspective

Twelve local community representatives were interviewed to gain insight into how the community viewed the contribution of the VFB. The perspective of representatives of local government, which is one step further removed, was also included in this research to gain further insight into the economic value of having a VFB in the community. To get a view on this perspective, a short online survey was sent to mayors, and chief executives of Territorial Authorities that were identified as having large rural catchments. Representatives of City Councils and those focused on urban areas were excluded from those surveyed.

Each participant was asked to rate the contribution of the volunteer fire service to various social and economic outcomes on a scale of 1 to 5 (with 1 being the lowest and 5 the highest). In total there were 51 responses. The table below is a summary of the responses. If the responses for all questions were summed, then the average response was a positive one (averaging 3.98).

Table 15 : Local government survey responses July 2009.

Answer options	1	2	3	4	5	Response count
Protection of assets and property	1	3	3	15	28	50
Citizens' personal well-being	1	3	11	19	17	51
Sense of security (trust that there is somebody who has the knowledge and skills to respond to any emergency)	1	3	8	12	26	50
Community spirit	1	2	8	15	25	51
Community sense of identity	1	2	17	16	15	51
Knowledge of fire safety	3	4	9	17	18	51
Emergency response	3	2	3	13	30	51
Economic prosperity of the town	2	11	16	12	8	49
				answered question		**51**

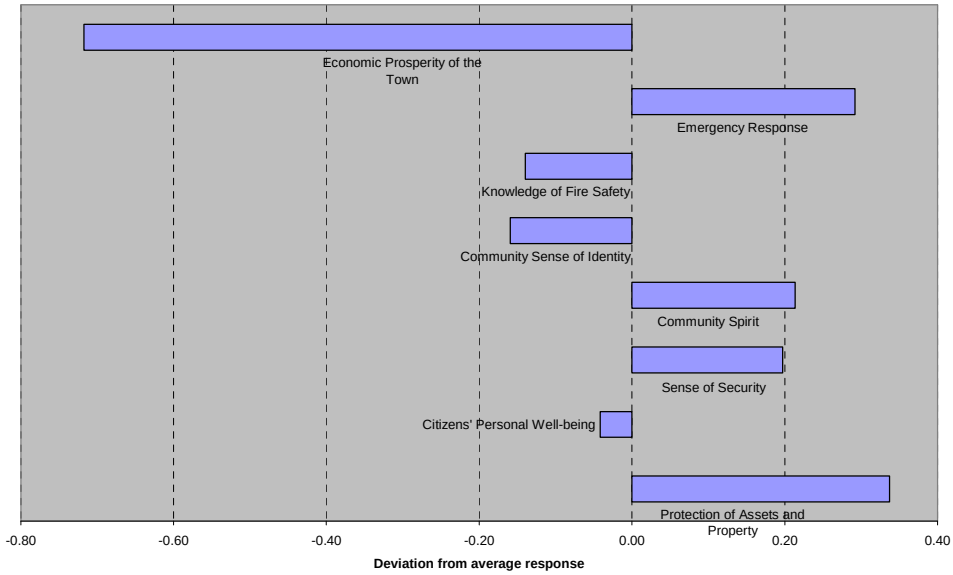
Source: PwC Survey of TLAs in rural areas, 2009.

Because the survey used an arbitrary scale, the individual response values are most valuable when considered relative to each other. Figure 4 on the next page shows the deviation from the average response (3.94) to demonstrate more clearly which areas were deemed valuable by the survey respondents.

The most important roles of the local VFB, from the perspective of local governments are the Protection of Assets and the Emergency Response capabilities. This makes sense because it addresses those tangible issues with the clearest economic linkages. Local governments, to ensure that communities had access to these capabilities, would have to find alternative solutions if the local VFB did not exist.

In the US, every town has its own independent fire brigade and makes the decision whether to employ a full or part time brigade or use a volunteer solution based on economic viability [Brunet, DeBoer and McNamara 2001]. In this respect, the existence of local brigade with its provision of equipment and volunteers is a cost avoided for local governments. The most likely alternative solution to VFBs would be an expansion of the rural fire services which are funded by local governments. These rural services, however, currently rely heavily on the coverage provided by VFBs who are generally the first response to vegetation fires that occur within the vicinity of populated areas.

Figure 5 – Deviation from average response by question July 2009.



Source: PwC Survey of TLAs in rural areas 2009.

The figure above shows that local governments also recognise the role VFBs play in providing safety and cohesiveness outcomes. The high response to the questions of community spirit and sense of security illustrate this.

"a vital part of many small communities"

One hypothesis that was investigated as part of this research related to the multiplier effects that would accrue to a community because of the investment made by the New Zealand Fire Service. The upkeep for a fire station provides work for local mechanics and builders for example, and the hypothesis tested whether this had a material impact on the town. Despite the research by Dellar (2001) and Ferguson (2007) that demonstrated linkages between amenities and economic prosperity, the overwhelming opinion expressed in the survey and interviews was that the impact was negligible.

In conclusion, the combination of qualitative survey responses and personal interviews indicates that local governments recognise and value the role the VFB plays in rural communities. This includes recognition of the considerable costs that would be incurred if the VFS was replaced. Although economic benefits are at the forefront of local governments' minds, they also recognise the social value provided by the service. In the final words of one participant: *"Our brigade is bloody amazing".*

5 The Best Social Club in the World – Why They Do It

VFFs join and continue to volunteer in voluntary fire brigades for three primary reasons according to those interviewed for this study. First, they have a strong sense of responsibility for protecting people and property. Associated with this, secondly, is their desire to give back to the community and help preserve the quality of life they enjoy. Thirdly, the brigade is a community in itself, and in addition to its other functions, it is a social club that the volunteers can be a part of and belong to.

This chapter describes the results of a survey of VFFs and the insights gained about their motivations from a survey of literature and interviews with volunteers in three communities.

Background

Croydon Consultants Ltd [2008] surveyed New Zealand rural firefighters to find out why they volunteered and found that the most important motivation for volunteering was the desire to give to the community. This was strongly related to their rural or semi-rural location which meant that they were often the first response at an emergency. Urban volunteer firefighters of small semi-rural and rural communities are in similar situation and feel the same sense of community ownership and see their role in the community as very positive [Hawkins, 2005].

A study of volunteer firefighters in West Germany [Zech, 1982] found that not only was the volunteer fire brigade providing a service to the community, it was also serving as a social club. The volunteer firefighters participated in community activities and enjoyed being with others who had similar interests.

In addition to being motivated by a sense of belonging and giving something back to the community; personal and skill development were also motivators for volunteering. This includes those who are motivated to develop skills that could bring some material and financial rewards in the future with evidence to suggest that those who volunteer could earn more than those who are not involved in volunteer activities [Ganewatta and Handmer 2007].

It has already been demonstrated that communities rely heavily on volunteers and that the presence of a VFB means small remote communities avoid significant economic and social costs. There is, however, one further area of benefit; the personal intrinsic reward and value to the individuals that volunteer for these services. Making a contribution to their communities adds to the volunteers own sense of well being and quality of life. This is particularly valuable in rural communities where suicide rates among males are considerably higher than they are in urban centres (National Rural Health Alliance 2009)[16]. The economic value of personal wellbeing has not been quantified by this study and hence is another reason why the findings of this research may be conservative.

Ultimately, however, the value associated with volunteering is best explored by discussing the motivations behind the decision of individuals to volunteer. To inform the analysis for this research, 25 firefighters from three brigades were interviewed and 67 Chief Fire Officers from SRCs responded to an online survey.

[16] The vast majority of volunteer firefighters are male.

Motivations

A number of hypotheses were considered in developing the approach to this research around why firefighters volunteer for a dangerous and sometimes disturbing job. These hypotheses were tested in workshops and augmented with information collected in the initial interviews and finalised for the online survey described above.

Each participant was asked to rate the value they receive from the volunteer fire service on a scale of 1 to 5 (with 1 being the lowest and 5 the highest). In total there were 67 responses. The average response from the VFFs was 4.02. The results of the survey are presented in the table below.

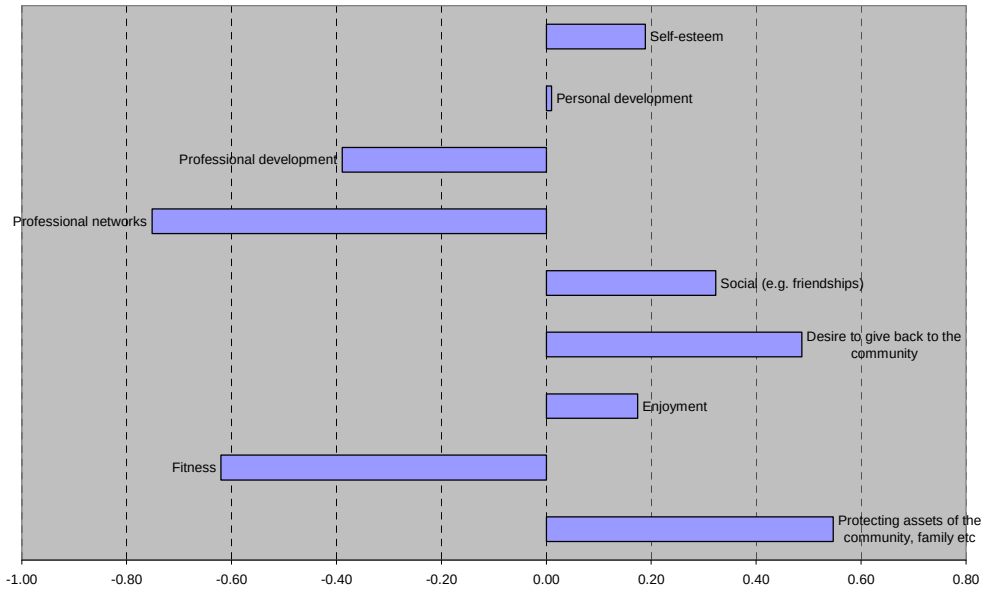
Table 16: Volunteer firefighters survey responses July 2009.

Answer options	1	2	3	4	5	Response count
Self-esteem	0	2	8	31	26	67
Personal development	1	1	13	32	20	67
Professional development	1	10	18	19	17	65
Professional networks	3	10	27	20	7	67
Social (e.g. friendships)	0	2	3	32	30	67
Desire to give back to the community	0	2	4	19	42	67
Enjoyment	0	3	7	31	26	67
Fitness	1	11	24	19	10	65
Protecting assets of the community, family etc	0	0	6	17	44	67
				answered question		**67**

Source: PwC Survey of SRC Chief Fire Officers, 2009.

Because the survey used an arbitrary scale, the individual response values are most valuable when considered relative to each other. The figure below shows the deviation from the average score to demonstrate more clearly which areas were deemed valuable by the survey respondents.

Figure 6: Deviation from average response by question July 2009.



Source: PwC Survey of SRC Chief Fire Officers 2009.

The survey results presented above give an indication as to which of the motivations are most important with protecting the assets of the community, family and desire to give back to the community being the most important.

Responsibility and participation

The need for local emergency services is well understood and recognised in the rural communities. Rural towns are typically tight knit communities and are connected to most other citizens, by acquaintance at least. The damage of a single structure fire will be felt by the community as a whole and rural communities understand they face greater exposure to risk from accidents, weather and medical emergencies. Mitigating this risk was the highest rating motivation in the survey.

One might attribute this to a strong sense of duty and obligation that VFFs typically feel. VFFs exhibit a willingness to participate and contribute to the community and many of the firefighters interviewed indicated they were involved in multiple community groups. One such firefighter was involved in eight different groups and boards in his community. Others were involved concurrently with related groups. For example, two VFFs were part of search and rescue while another two VFFS were qualified paramedics. It is not a surprise, then, that the desire to give back to the community was ranked a close second in the motivations survey.

During the interview phase of this research, there was a noticeable difference in the responses depending on the age group. It may be that the responses of Chief Fire officers may well have biased the results toward economic rather than social outcomes. Chief Fire Officers are necessarily older and more experienced than other VFFs. During interviews, it was the older officers that were more likely to emphasize the duty aspect of service, while the younger were more likely to emphasize the social aspects.

Social

The social aspect ranked third among motivations in the survey. The social connectedness of the groups and the sense of belonging was also a common feature of the interview responses. During interviews, three firefighters that had recently moved to new rural communities indicated that joining the fire service was a good way of getting settled in. Their previous professions/occupations were more suited to a larger urban community, but all three had found a place in the community and attributed involvement in the Brigade as a significant factor influencing their ability to integrate into the community.

The volunteer fire brigades that were visited for this research had aspects in common with any other sports or social club. Volunteer fire stations typically have separate spaces for meetings, training and social functions. The area for social functions will include a kitchen and a bar and is used for plenty of social activity. In a smaller centre, this is sometimes a community facility and firefighters talked of hosting barbeques for their families, regular social functions and the facilities being a place to watch the rugby and spend time with their mates. An important finding from the analysis for this research is that those facilities dedicated to the social interactions of the brigade are regarded as just as integral to the life of the Brigade.

Anecdotally, the demand for volunteers is increasing due to a plethora of new interests and social services. In this respect, supporting the social side of the brigade becomes increasingly important for recruitment and volunteer retention. One participant was quoted as saying: *"This is the best social club in the world".* The research carried out for this research indicates that the social aspect of the brigade is a key driver for continued participation and retention of volunteers.

Less significant factors

An initial hypothesis shaping the approach of this research was that personal and professional development, including fitness, was an important driver for volunteering. In fact, the interviews and surveys found that it was relatively less important reason for volunteering. Firefighting may provide some convenient and useful skills, but professional development was not a significant motivational driver for volunteering.

Employer perspective

The dynamics of volunteers and their employers were excluded from the specific questions in this research and so the sample of those that could comment on the employer's perspective was limited. Those that did comment included managerial staff from the Fonterra plant in Edendale, as well as several volunteers who were employers, and more often than not, had staff that were also part of the same brigade.

Because of the isolated nature of the Edendale plant, access to fire prevention is essential for its continued operation. There are multiple examples, from the last ten years, of manufacturing plants burning down and not being replaced. This can prove devastating for the surrounding community and shows a clear linkage between the VFB and economic

continuity.[17] In isolated locations, commercial facilities simply must have fire coverage or expose themselves to significant risk.

In Edendale, the volunteer fire brigade is handily placed less than a kilometre from the factory as the crow flies. A number of Fonterra staff are volunteers and their knowledge of the site is invaluable for a quick response. In this scenario, Fonterra encourages participation and avoids the significant cost of having to have its own emergency response unit on site. The VFB cannot deal with certain chemical related emergencies but has the knowledge to assess if the paid fire brigade from Invercargill needs to be called in. Two of the firefighters are also trained paramedics and this provides added synergies for the employer.

Some volunteers are themselves employers and are naturally sympathetic to the staff volunteering. Instances were found of owners / managers and selected staff volunteering in all three locations visited. Either the employer encouraged the staff member to be involved or, through the brigade, was able to provide the staff member with a job. In both cases, it appears that it was the favourable attitude of the employer that encouraged volunteering. The interviews suggested an ambivalence about the costs incurred by the business (time spent by the employee as a volunteer). Those that worked for themselves were also ambivalent about the cost with the exception of case where there were prolonged callouts which could see them off work for several days. The attitude of those that were interviewed towards lost productivity was a relaxed one and is thought to be indicative of the rural approach to life (and paid work).

Two volunteers did indicate that they had, on occasion, been docked wages by their employer and this was part of the personal cost to being a volunteer. This was, however, the exception rather than the rule.

[17] Industry has always been a driver for the placement of volunteer fire stations. The town of Orawia in Southland is a good example. The town is now an obscure and remote location and is one of only two towns with volunteer fire brigades that have closed because they did not have enough volunteers for the minimum crew of four required. It was once the location of a cement plant, but since its closure the town has seen a decline in economic prosperity and as a consequence no need for a VFB.

6 Economic Impact

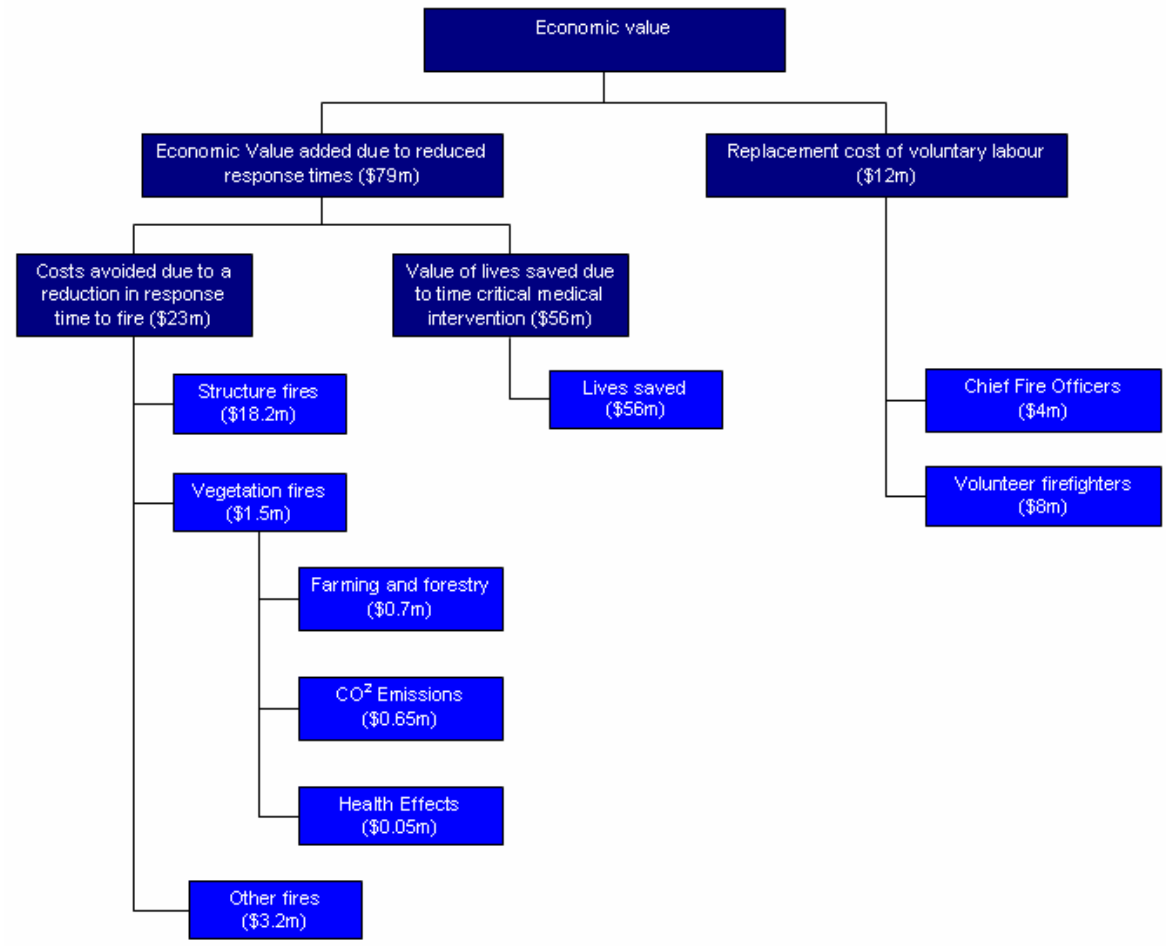
A major theme from the research carried out for this research is that the value of the volunteer fire brigade goes far beyond those variables that can be easily quantified in an economic model. This includes the value of social cohesion, the value of independence and security, and the personal benefits to the volunteers themselves. For the purpose of assessing the economic impact, however, a more limited range of variables has been considered.

This chapter provides a summary of the economic impacts identified in this research.

Economic model

The figure below is a summary of the economic impacts associated with having a VFB in a small remote community.

Figure 7: Economic value of VFB based on key impacts identified for small remote communities



Source: PwC voluntary fire service economic model.

For the purposes of this research, an economic valuation was calculated based on conservative assumptions. The value of fire prevention, for example, reflects the costs avoided due to a reduction in response times. It does not, however, describe the contribution that response time makes towards reducing the risk of a major fire like that

seen in Victoria earlier in the year. Hence, it may underestimate the full benefit of the VFS's activities. The rationale for taking a conservative approach is that the focus of this analysis is on identifying the key factors that contribute to the economic value. Further work is required to validate sources of data relevant to these factors and so in the meantime, where assumptions are required, the more conservative assumptions are selected.

The estimates presented below were made primarily using methodologies and assumptions from other research and adapted to the local context. For this reason, the findings should be considered carefully and not relied on for detailed analysis. The results do, however, provide a good estimate of the quantum of the values involved when a comprehensive approach is taken to identifying the variables that contribute to the economic value of the voluntary fire brigade.

Table 17 : Annual economic value of the voluntary fire brigade in 2007 dollars

Type	Value
Emergency response	$79 million
Replacement cost of labour	$12 million
Total	$91 million

Source: PwC voluntary fire service economic model.

The analysis shows that an estimated $79 million in economic value is added by the VFB in SRC's every year based on analysis of 2007 data. This is the equivalent to approximately $467,000 for every brigade in a SRC. This analysis also shows that the estimates of the economic contribution based on the replacement cost of the volunteer contributions of labour by paid staff in these communities amounts to a further $12 million. Conservatively, then, an estimated total of $91 million of associated value can be attributed to the SRC VFBs.

7 Conclusion

This research has identified and described the economic and social contribution of the VFB and estimated that economic value associated with VFB's operating in small remote communities.

The approach for describing and estimating this value resulted in findings relevant to three key areas of interest. These were:

- the protection of people and property;
- the pivotal social role that volunteer fire brigades play; and
- the motivations driving volunteers.

The primary role that the New Zealand Fire Service plays in protecting people and property was affirmed by the analysis and the value of the medical response was found to provide the most economic value. It is estimated that $56 million of value per annum can be attributed to the lives saved by medical and accident responses and a further $23 million in costs avoided per annum due to decreased response times can be attributed to VFBs. In contrast, the benefits from a reduction in health and carbon impacts are small.

Rescue and medical calls were the most common type of callout for SRCs and were three times more frequent than structure fires. The response times to these incidents and the risk of a much larger fire is significantly reduced because of a local brigade.

In addition to the economic value of emergency response, the VFB contributes considerable value because of the important role it plays in contributing to the social capital of a small remote community. Based on the surveys of TLAs and Fire Chiefs, the research found that the local brigades are often a community resource that helps give communities a sense of independence and autonomy. The VFB can act as the social glue for these communities. In general, the importance and reliance on the VFB is greater when the community is smaller. At a national level, the VFB is an integral part of the emergency response network that could not be replaced. It is relied upon for response to fire, medical, accident and civil defence emergencies.

Volunteers in these brigades provide considerable amounts of their time for free. If this labour were valued at replacement cost, then its value is estimated at $12 million per annum (in 2009 dollars). This is more than $5,000 per volunteer and more than 6 times the volunteer contribution of the average New Zealander (as found in the Statistics New Zealand satellite account for the non-profit sector). The largest contribution comes from chief fire officers who work more than 15 hours a week on average.

As the research identified, volunteer fire brigades are critical to the quality of life in SRCs and are treasured by the residents of these rural towns. Volunteers do what they do to protect, give back and to keep in touch with their community. The social aspects of the volunteer fire brigades cannot be understated and this is a major driver for the continued participation of volunteers.

If the economic value attributed to emergency response and the replacement of volunteer labour are combined together, the total value attributed to VFB in SRC is $91 million. This calculation does not include the contribution made to social capital, the autonomy of the community or the preventative impacts of having an emergency response presence in small rural communities. In this respect the figure calculated is a conservative minimum estimate.

Further Research

That the VFB contributes a great deal to the level of social cohesion was a hypothesis that the evidence from this research's surveys and interviews strongly supports. The framework for describing social capital [Bullen, 1998], applies a survey tool to measure the amount of social capital in a community. It could be used to measure the level in towns with volunteer fire brigades. If comparable towns without a VFB could be found and then measured, a quantitative indicator of comparison could be evaluated. This is, however, a sizeable exercise outside the scope of this study.

As part of its upcoming General Social Survey, Statistics New Zealand is planning to measure social capital and cohesion in 2010. When the results of the Statistics New Zealand survey become available, it will be interesting to contrast results between urban and rural areas. This would be a useful comparison and a source of quantitative evidence that could provide a basis for robust quantification that could be added to the economic value calculated by this study.

Further there are additional benefits that can be attributed to the preventative role that a presence in small rural communities provide. The installation of smoke detectors, fire safety education and the constant reminder of a physical fire station provide constant reminders of the risk of fire. Describing and quantifying these benefits is a natural extension of this research.

This research has provided a static analysis of the value added by VFB's at a point in time. The economic model has been developed, however, to be refreshed with new data at a later date.

The survey questions also provide a comparable survey base with which to test specific types of communities in future studies. Both elements suggest that a future evaluation may allow for a dynamic picture of value to be created.

Appendix A: Glossary of Terms

Cost avoided	Costs that would have been incurred if no equivalent fire protection service was available.
CPR	Cardiopulmonary resuscitation
Economic impact	Equivalent to economic value
Economic value	The equivalent monetary benefit of an unpriced good or service.
NRFA	National Rural Fire Authority
NZFS	New Zealand Fire Service
NZFVWO	New Zealand Federation of Voluntary Welfare Organisations
Outcome	(1) A change in the state or condition of society; (2) The result of an activity.
Replacement cost	The cost of replacing the human resource provided by volunteers with an equivalent service
SRC	Small Remote Community
SU	Stock unit
TA	Territorial Authority (Local Government Organisation)
VFB	Volunteer Fire Brigade
UFD	Urban Fire District
VFF	Volunteer Firefighter
VFS	Volunteer Fire Service

Appendix B: Consultation List

Consultation 1 – Eketahuna

Interviews:

Maureen Reynolds (Mayor of Tararua) and John Harman (Chair of Eketahuna Community Board).

Katrina Dimock (Eketahuna Community Health Board)

Workshops:

Eketahuna Volunteer Fire Brigade – 9 VFFs attended the workshop

Consultation 2 – Oxford

Workshops:

Community leaders:

- Bob Leader – Oxford Advisory Board, Lions, Area Board
- Vic Allen – Oxford Advisory Board, Medical Centre Board
- Wayne Schrink – Oxford Charitable Trust
- Ken Terry– Police Constable
- Marie – St John Ambulance Emergency Response
- Angela Lyons – Oxford Senior Citizens

Oxford Volunteer Fire Brigade – 13 VFFs attended the workshop

Consultation 3 – Edendale VFB / Fonterra

Interviews:

Charlie Nicholson – Plant Manager at Fonterra Edendale

Bob Wallis – Process Manager at Fonterra Edendale

Scott Cameron – Improvement Facilitator at Fonterra Edendale.

Others

Interviews:

Richard Emery – Wellington Free Ambulance

Heather Clark – National Advisor, Volunteer Services New Zealand Fire Service

Alan Walker – Manager Development, New Zealand Civil Defence

Susan Bain - Telecom Operations Manager 111

George Harper – Southland District Council (Oversight for Orawia)

Appendix C: Interview Templates

Interview with Local communities

Date: **Location:**

Person(s) interviewed:

Introduction

A brief background was provided on who we are and why we are conducting this interview/focus group. This will include an explanation of the types of questions we are asking.

1. Please could you introduce yourself and explain your role in the community?

2. Tell us a little about the range of roles the volunteer fire service performs?

3. Before we ask you some specific questions about the volunteer fire brigade could you please give us a brief overview of your impression/thoughts of the volunteer fire brigade?

Questions

4. Do you know any VFFs (family, friends etc)?

5. When last did you see the volunteer fire brigade?

    a. Fire emergency

    b. Non-fire emergency e.g. car accident

    c. Non-emergency e.g. fire awareness programme

    d. Training exercise

    e. Community fundraising

6. What presence/profile does the volunteer fire service have in the community?

7. What would it mean to your community if there was no volunteer fire brigade (e.g. an emergency response that has local knowledge of the community)?

8. What value does the volunteer fire brigade have for you and/or the community?

    - Potential cost saving for local government

    - Any flow on effects from the economic investment into the volunteer fire brigade

11. Have you observed any benefit to local business and employers from employing volunteer fire fighters?

[Distribute survey if possible]

Conclusion/Summary

PwC to answer any questions and get feedback that has not been addressed by the preceding questions. PwC to summarise the key responses back to the interview/focus group to ensure that their answers were correctly understood.

9. Do you have anything else you want to mention or any questions you would like to ask?

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On a scale of 1 to 5 (with 1 being the lowest and 5 the highest) how does the volunteer fire brigade contribute to the following (please circle the number):

Safety	**1**	**2**	**3**	**4**	**5**
Community spirit	**1**	**2**	**3**	**4**	**5**
Community sense of identity	**1**	**2**	**3**	**4**	**5**
Knowledge of fire safety	**1**	**2**	**3**	**4**	**5**
Emergency response	**1**	**2**	**3**	**4**	**5**
Economic continuity / prosperity	**1**	**2**	**3**	**4**	**5**
Sense of security (trust that there is somebody who has the knowledge and skills to respond to any emergency)?	**1**	**2**	**3**	**4**	**5**

Additional comments/feedback:_____

_____

_____

_____

Interview with volunteer fire brigade

Date: **Location:**

Person(s) interviewed:

Introduction

A brief background on we are and why we are conducting this interview/focus group. This will include an explanation of the types of questions we are asking.

1. Please could you introduce yourself and explain your role in the fire service and how long you have been a volunteer?

2. Tell us a little about the range of roles the volunteer fire service performs?

Optional question

3. Before we ask you some specific questions about the volunteer fire brigade could you please give us a brief overview of your impression/thoughts of the volunteer fire brigade?

Questions

4. In your capacity as volunteer firefighter how often are you involved in the following activities?

    a. Fire emergency response

    b. Non-fire emergency response e.g. car accident

    c. Non-emergency e.g. fire awareness programme

    d. Training exercise

    e. Community events/fundraising

5. How often are you involved in community events - this is in addition to being involved in your role as a volunteer firefighter?

6. What presence/profile does the volunteer fire service have in the community?

7. What would it mean to your community if there was no volunteer fire brigade (an emergency response that has local knowledge of the community)?

Optional

8. What value does the volunteer fire brigade have for you and/or the community

    - Any flow on effects from the economic investment into the volunteer fire brigade – additional work

9. How much time per week do you spend in activities related to the volunteer fire brigade?

(Survey handout)

10. On a scale of 1 to 5 (with 1 being the lowest and 5 the highest) what value do you get from volunteering in terms of:

    a. self-esteem;

    b. personal development;

    c. professional development;

    d. desire to give back to the community;

    e. enjoyment;

    f. fitness;

    g. protecting assets of the community, family etc;

    h. networks; and

    i. social (e.g. friendships)?

11. What is the personal cost of being a volunteer firefighter, in terms of:

    a. financial;

    b. family; and

    c. social life?

12. What additional skills and attributes do you bring to the workplace as a result of being a volunteer fire fighter?

Conclusion/Summary

PwC to answer any questions and get feedback that has not been addressed by the preceding questions. PwC to summarise the key responses back to the focus group to ensure that we have captured their answers.

Do you have anything else you want to add or any questions you would like to ask?

NZ Fire Service Commission: Determining the national economic value of a volunteer fire brigade

On a scale of 1 to 5 (with 1 being the lowest and 5 the highest) what value do you get from volunteering in terms of (please circle the number):

Self-esteem	**1**	**2**	**3**	**4**	**5**
Personal development	**1**	**2**	**3**	**4**	**5**
Professional development	**1**	**2**	**3**	**4**	**5**
Desire to give back to the community	**1**	**2**	**3**	**4**	**5**
Enjoyment	**1**	**2**	**3**	**4**	**5**
Fitness	**1**	**2**	**3**	**4**	**5**
Protecting assets of the community, family etc	**1**	**2**	**3**	**4**	**5**
Networks	**1**	**2**	**3**	**4**	**5**
Social (e.g. friendships)	**1**	**2**	**3**	**4**	**5**

Additional comments/feedback:_____

_____

_____

_____

Appendix D: Applying Mendonca's Framework

Vegetation Fires:

The most common type of fire that rural VFB are called to is vegetation fire. Mendonca et al.'s [2004] research into the cost of vegetation fires in South America identified losses in two components:

1. direct and indirect losses to the land owner in terms of agriculture and cattle raising, and the loss of forests. These losses can be expressed as costs per Hectare of land affected;and
2. losses to society associated with externalities including:
    a. CO^2 emissions from the depleted vegetation, measured in tons of carbon emitted; and
    b. human health damage and morbidity, specifically for respiratory illness.

This research describes a framework for estimating the observed consumption and production losses attributable to fire. When populated with suitable data, the framework provides a basis to estimate the quantum of cost associated with vegetation fires. This is only one step removed from an estimate of the savings that can be attributed to the volunteer fire Brigades.

The data that was used to populate Mendonca et al.'s framework is extensive and complex and replicating the study would be a research project in itself. To estimate the quantum of costs, however, is an exercise that could be performed at higher level and one this research has tackled. It must be stressed that the estimates for the impact of vegetation fires have been derived for the purposes of estimating the quantum of cost only and are based on key assumptions.

Land used for farming and forestry can be significantly damaged by vegetation fires rendering it useless for its commercial purpose. A number of parameters were estimated.

- Mendonca et al.'s research estimates that affected owners required alternative leasing for three months and estimated the impact by considering average leasing rates. In the New Zealand context, Land Information New Zealand commissioned a review of Pastoral lease rentals in the South Island [Armstrong, Englebrecht and Jeffries, 2008], suggested leasing rates were between $15 – $20 per stock unit (SU).
- Stock densities will vary considerably depending on the quality of the land and the type of animal being raised. Data obtained from Environment Waikato[18] suggests average stock density levels in Waikato of approximately 5 SU per hectare for sheep, and 17 or 18 for dairy. An estimate of 10 SUs per hectare has been assumed and translates to $150 / hectare per annum or $37.50 per hectare for the three month relocation period.
- When these numbers are considered it becomes clear that the impact of relocating stock (approximately $25,000) is small relative to the value of forestry or the protection of property.

[18] Stock density data available from: http://www.ew.govt.nz/Environmental-information/Environmental-indicators/Land-and-soil/Land/riv9-data/ [accessed July 2009].

- Forests are a different case. Stock can be saved or relocated however the burning of forests represents a total loss of value. One method of valuing forestry is to use the insured value of the timber. Although the crown may not be insured for native forest the method provides an estimate of the loss to the country. One such bulk policy [Forest Enterprises Ltd, 2008] for more than 20,000 hectares of forestry across a range of owners and plantations provides coverage of $8,600 per hectare[19].
- Statistics from the New Zealand Rural Fire authority regarding the extent of damage caused by vegetation fires can be seen in the table below.

Table 18: New Zealand Rural Fire Authority Statistics 2006/07 – 2008/09

	Number of fires	Grass affected (hectares)	Scrub affected (hectares)	Forest affected (hectares)
06 / 07	3,983	2,342	1,410	535
07 / 08	5,170	5,310	2,598	1,174
08 / 09	4,133	612	1,221	447
3 year average	4,429	2,754	1,743	718
Hectares per fire		0.622	0.394	0.162

Source: New Zealand Rural Fire Authority

- These statistics indicate the damage to three types of vegetation over a three year period for rural fire callouts. These callouts have a similar profile as vegetation fires attended by the VFBs. If this same damage ratio is applied to 777 VFB callouts it indicates that total damage based on current response rates is approximately 483h of grass and 126h of forest.
- The cost of damage to farming land estimated using the grass affected statistic above is $18,000. Total damage to forestry estimated using the forest affected statistic above is close to $1.1 million.

Table 19: Farming and forestry damage in small remote communities 2004 – 2008.

	Hectares affected	Value of affected land per hectare	Economic impact ($)
Agriculture (grass)	483	$37.50	18,112
Forestry	126	$8,600.00	1,083,600
Total			1,101,712

Source: New Zealand Fire Service, PwC Model

[19] 21,221 hectares with a total insured value of $182,517,049.

This method of valuation lacks the depth of analysis that the regression model related to structure fires has. There is little evidence to suggest what the impact of a delayed response could or would have. Fires need to be contained, and failure to contain fires before they get out of control can lead to exponentially larger consequences. The example of the 2009 Victorian bush fires is an easy example to cite. According to the ABC [2009] the fire took the lives of more than 200 Australians and the Insurance Council of Australia [2009] has received approximately 9,105 claims for a total of $1.12 billion as of May 2009. This is merely the insured value of claims and says nothing about the raft of other social and environmental costs associated with the displacement of people and the destruction of such a wide range of natural and physical resources.

New Zealand faces significantly different terrain and atmospheric conditions to Australia and is unlikely to see a fire of the magnitude of those seen in Victoria. What is important, however, is to recognise the value of the current level of protection, and the role of volunteer firefighters in substantially reducing the risk of a significant and uncontrolled rural fire. This value is not articulated in this report.

Mendonca et al. identifies economic losses due to CO^2 emissions. In the present international climate CO^2 impacts must be considered in any economic analysis. It has been reported that "Fire accounts for roughly half of greenhouse gas emissions from deforestation and about twenty percent of total emissions from human activities" [Bowman et al., 2009].

- The cost of carbon has fluctuated significantly since emissions trading began. Mendonca et al. [2004] noted that "The price of carbon is subject to variations as a result of the methodology used for it's calculation, being strongly influenced by the international political scenario and by international emissions reduction agreements." In this research the price of carbon is based upon the current European Climate Exchange prices. Because of the fluctuations described above a historical price seemed inappropriate. The estimate is likely to be conservative given that the price of carbon is low due to decreases in production brought on by the current economic climate. This price used is 27.17 [20]
- Carbon emissions from fire are difficult to identify but a study on the 2007 California wildfires suggested that they emitted as much as 25 percent of California's annual output of CO^2 which equated to 7.9 million metric tons[21]. It was reported the fires damaged more than 500,000 acres[22] or 202,343 hectares. An estimate of 39 metric tons of carbon per hectare has been used to predict emissions during vegetation fires.
- In total 915 hectares of vegetation fires emitted 35,685 metric tons of carbon to an estimated value of $969,561.

[20] The trading price on July 08 2009 was approximately 13 euro per metric ton. The exchange rate between NZD and Euro at this time was 0.4784 providing a carbon price of NZD 27.17.

[21] "Estimates of CO2 from fires in the United States: Implications for carbon management", Christine Wiedinmyer and Jason C. Neff, Carbon Balance and Management as http://www.scientificblogging.com/news_account/guessing_the_carbon_footprint _of_us_wildfires [accessed July 2009]

[22] http://en.wikipedia.org/wiki/October_2007_California_wildfires [accessed July 2009]

- There is a risk in this analysis that the cost of any carbon emissions has already been costed into the insured value of forest. It can be argued then that the benefits associated with preventing the release of carbon has been double counted. Given the variability and uncertainty over the Emissions Trading Scheme and its implementation it has been assumed that the market has not yet priced this into the
- The final part of the Mendonca et al. equation is the health outcomes of fire, particularly those related to respiratory disease.
- A study of an 116,000 hectare fire in Alberta in 2001 originally published in the Canadian Journal of Forest research provides an estimate of the economic impact. The study estimated between $9million and $12 million of effects relating to restricted activity, mortality risk, and acute respiratory symptoms [University of Alberta, 2006]. This equates to an impact of approximately $80 per hectare of damage.
- In total it is estimated that 915 hectares of damage occurred in small remote communities suggesting health affects in the range of $71,000. It could be argued that such small quantities of smoke are unlikely to have any health effects and that a critical mass of damage is required before health impacts would occur. In the absence, however, of other evidence this seems a suitable solution and the overall level indicates that is it is not a significant factor in the value model.

In total, the economic impact of vegetation fire in small remote communities is:

- Farming and forestry – $1.1m,
- CO^2 emissions – $1.0m,
- Health effects – $0.1m,
- Total $2.2m.

The analysis of structure fires showed that the value of economic costs avoided due to a decreased response time to structure fires, was estimated to be $18.2 million. This figure was derived using the incremental component of a linear regression model [Challands, 2009] but equally the same model could be used to calculate the total cost of structure fire.

The linear regression model calculates total damage as $23,570 + $4,000 per minute of response. Under this model the total damage to structures given a 12 minutes and 30 seconds response time is $26.8 million and a further $18.2 million (the amount saved) would be incurred if the response time was 25 minutes. The ratio between the cost reduction and total damage for structure fires is 68 percent.

The analysis of vegetation fires produced an estimate of $2.2 million for total damage but no estimate of savings due to decreased response times. There was not an intuitively obvious alternative (the counterfactual position) to compare actual damage against. In lieu of a counterfactual scenario similar to that of structure fires it has been assumed that the economic impacts of vegetation fires scale in a similar way to those of structure fires. The ratio derived above (68 percent) has been used to calculate the costs avoided due to decreased response times for vegetation fires. The resulting estimate is $1.5 million as described in the table below.

Table 20: Derivation of cost savings for vegetation fires.

	Structure fires	Vegetation fires
Savings due to decreased response time	$18.2 million	***$1.5million***
Total damage	$26.8 million	$2.2 million
Saving / total damage	68 percent	68 percent

Source: Output from PwC economic model.

Appendix E: PwC's Inductive Economic Model

Callouts						
	Fire					
		Structure Fires				
			Number of Fires		364	
			Cost avoid per minute	4,000		
			Reduction in response time (minutes)	12.5		
			Cost avoided per fire		50,000	
			Structure fire costs avoided			18,200,000
		Vegetation Fires				
			Farming			
			Hectares of Grass		483	
			Cost of lease per stock unit	15		
			Stock units per hectare	10		
			Annual lease per hectare	150		
			3 month estimate		37.5	
			Farming Costs incurred			18,113
			Forestry			
			Hectares of Forestry	126		
			Value of timer	8,600		
			Forestry costs incurred			1,083,600
			Carbon emissions			
			Hectares burnt	915		
			Carbon per hectare (tons)	39		
			Carbon emitted (tons)		35,685	
			Carbon price (dollars per ton)		27.17	
			Carbon Costs Incurred			969,561
			Health effects			
			Hectares burnt	915		
			Health Costs per hectare	77.5		
			Health costs incurred			70,913
			Vegetation costs incurred			2,142,186
			Costs avoided			0.68
			Vegetation costs avoided			1,456,687
		Other Fires				
			Number of fires		633	
			Other fire cost / structure fire cost	0.10		
			Reduction in response time (minutes)	12.5		
			Cost avoided per fire		5,000	
			Other fire costs avoided			3,165,000
			Total Fire Costs avoided			22,821,687
	Medical					
			Number of medical and accident callouts	1412		
			Frequency of life saving interventions	0.02		
			Number of lives saved		28	
			Value of a statistical life		2,000,000	
			Total Medical Costs avoided			56,000,000
			Total Costs avoided because of callouts			78,821,687
Volunteer Labour						
			Number of Stations	169		
			Volunteers per station	11		
			Total volunteers		1859	
			Hours per volunteer per year		225	
			Volunteer hours per year			418275
			Replacement cost per volunteer hour			19.23
			Replacement cost			8,043,428
			Chief Fire Officers		169	
			Hours per volunteer per year		675	
			Volunteer hours per year			114075
			Replacement cost per volunteer hour			33.65
			Replacement cost			3,838,624
			Replacement cost of volunteer labour			11,882,052

Blue text indicates an input
Black text indicates a derived number

Appendix F: List of Volunteer Fire Brigades in Small Remote Communities

Akaroa
Apiti
Ashley Clinton
Athenree
Balfour
Bay View
Benneydale
Blackball
Browns
Brunner
Bunnythorpe
Chatham Islands
Cheviot
Clinton
Clyde
Cobden
Colac Bay
Collingwood
Cooks Beach
Coromandel
Culverden
Cust
Darfield
Dipton
Duntroon
Eketahuna
Fairlie
Fox Glacier
Foxton Beach
Glenavy
Granity
Hahei
Halcombe
Hanmer Springs
Harihari
Hawarden
Heriot
Himatangi Beach
Huia
Hunterville
Kaeo
Kaingaroa
Kaitangata
Kaiwaka
Kaponga
Karamea
Kawakawa Bay
Kawhia
Kimbolton
Kohukohu
Kumara
Kurow
Lake Hawea
Lake Tekapo
Lawrence
Leeston
Little River
Luggate
Lumsden
Mamaku
Manaia
Manapouri
Mangakino
Mangaweka
Mangawhai
Manunui
Manutuke
Mapua
Matawai
Middlemarch
Millers Flat
Moana
Mossburn
Murchison
Murupara
Naseby
National Park
Ngahere
Ngunguru
Nightcaps
Norsewood
Nuhaka
Oakura
Oban
Ohai
Ohura
Okaiawa
Okaihau
Okato
Omakau
Omapere
Omarama
Opunake
Orepuki
Ormondville
Otane
Otautau
Otematata
Outram
Owaka
Owhango
Oxford
Paekakariki
Palmerston
Patea
Patutahi
Piopio
Pleasant Point
Pongaroa
Porangahau
Portland
Pukerau
Ranfurly
Rangiwahia
Ratana
Ravensbourne
Rawene
Reefton
Riversdale
Riverton
Rongotea
Ross
Roxburgh
Ruatoria
Runanga
Russell
Seddon
Southbridge
St Andrews
Takaka
Takapau
Taneatua
Tapanui
Tapawera
Te Araroa
Te Karaka
Te Kauwhata
Thornbury
Tikitiki
Tokanui
Tokomaru
Tokomaru Bay
Tuatapere
Turua
Twizel
Upper Moutere
Urenui
Waiatarua
Waiau
Waikaia
Waikaka
Waikari
Waikouaiti
Waimahaka
Waimangaroa
Waipara
Waipawa
Waipu
Waitahuna
Waitati
Waitotara
Wakefield
Wallacetown
Ward
Waverley
Weston
Whakapapa
Whataroa
Wyndham

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http://www.frsito.org.nz/index.html

Fire police

http://www.firepolice.co.nz/

National rural fire authority

http://www.nrfa.org.nz/FireNet/Regions/Rural

or

http://nrfa.fire.org.nz/FireNet/Regions/Rural

New Zealand Fire Services Commission

http://www3.fire.org.nz/

United Fire Brigades' Association of New Zealand Inc.

http://www.ufba.org.nz/