bushfire CRC

ANNUAL REPORT 2007-08

Established and supported under the Australian Government's Cooperative Research Centres Program

CORE PARTNERS

CFA

CSIRO

THE UNIVERSITY OF MELBOURNE

QUEENSLAND FIRE AND RESCUE SERVICE

TASMANIA FIRE SERVICE

N.S.W. RURAL FIRE SERVICE

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

FORESTS NSW

Territory and Municipal Services ACT GOVERNMENT

EMA Emergency Management Australia

AUSTRALIAN CAPITAL TERRITORY EMERGENCY SERVICES AUTHORITY

NEW SOUTH WALES FIRE BRIGADES

FESA Fire & Emergency Services Authority of Western Australia

TASMANIA PARKS & WILDLIFE SERVICE

THE UNIVERSITY OF NEW SOUTH WALES

Victoria Department of Sustainability and Environment

UTAS

Forestry Tasmania GROWING OUR FUTURE

MFB

NATIONAL RURAL FIRE AUTHORITY
Te mana ahi mamaha o te motu

THE UNIVERSITY OF WESTERN AUSTRALIA

Australian Government Bureau of Meteorology

Department of Environment & Climate Change NSW

Department of Environment and Conservation
Our environment, our future

ASSOCIATE PARTNERS

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University of Wollongong

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METROPOLITAN FIRE BRIGADE SA

CHEMISTRY CENTRE

SCION

bushfire CRC

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Our Mission

The Bushfire CRC's mission is to enhance the management of the bushfire risk to the community in an economically and ecologically sustainable manner.

It includes the following objectives:

- To develop an internationally renowned centre of excellence to lead bushfire research in Australia
- To provide a research framework that will improve the effectiveness of bushfire management agencies
- To increase the self-sufficiency of communities in managing the risks from bushfires.

CRC AUSTRALIA

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INDEX

The Bushfire CRC 3
A collaborative approach to bushfire research 3
Partners in bushfire research 3
Who belongs to the CRC? 3
Our core partners 4
Our associate partners 4
Formal collaborations 4

Executive Summary 5
Achievements and activities 5

From the Chair 6
Research adoption 6
Third year review 7
Our people 7

Governance and Management 7
Management Staff 8
Program Leaders 8
New Participants 8
Bushfire CRC Organisation Structure 10

Research Programs 11
Research activities and achievements 11
Nature of major consultancies and their contribution to the CRC 12
Any changes proposed to future research directions 12
Program A: Safe Prevention, Preparation and Suppression 14
Program B: Fire in the Landscape 19
Program C: Community Self-Sufficiency for Fire Safety 22
Program D: Protection of People and Property 25

Research Collaborations 30
Continuing research collaborations 31

Communications 32
Online communications 32
Bushfire CRC online 32
Fire Knowledge Web 32
Publications 32

Events 35
Conferences and workshops 35
Annual fire industry conference 35
Community forums 35
New facility 35
Book launch 35

End User Involvement 37

Education and Training 37
Education 38
Future planning 39
Seminars/workshops/courses run for industry 39
Bushfire CRC Postgraduates 2007/2008 39

Looking Forward 2020 40
2020 and beyond 40
A CRC for Fire – Environment and Society 41

Appendix 42
Appendix A: Bushfire CRC Postgraduates 42
Appendix B: Education – Formal Courses 45
Appendix C: Financial Report 46

Glossary of Terms 52

The Bushfire CRC

A collaborative approach to bushfire research

The formation of the Bushfire Cooperative Research Centre in 2003 was a major step by the fire and land management agencies and research partners in Australia and New Zealand.

It was a move towards a better understanding of the complex social, economic and environmental aspects of bushfires. The combination of partner resources and the Australian Government's grant through the CRC program is a substantial investment in this research.

The Bushfire CRC is a collaboration of industry and research partners in Australia and New Zealand – researching into the social, economic and environmental impacts of bushfires.

The Bushfire CRC is funded for a seven-year term, 2003-2010. A new CRC bid is being developed for submission in March 2009.

Partners in bushfire research

The challenge is large – how do we best manage the bushfire risk; how do we use fire as a land management tool; what are the key issues that require further understanding; how do we balance the complex trade-off between divergent sets of social, cultural, environmental and economic values?

Today, fire and land management agencies are working closely with researchers on a nationally coordinated research program to help answer this challenge.

The program covers a broad range of topics including fire behaviour and suppression, fire as part of the natural landscape, fire weather, community self-sufficiency, firefighter safety and building protection.

Today, some challenges are being met. This publication details what is being achieved and what is being done to meet the challenges into the next decade.

Who belongs to the CRC?

End user groups – state urban and rural fire authorities, land management agencies, the Bureau of Meteorology, and Emergency Management Australia.

Research groups – universities, CSIRO, Bureau of Meteorology.

Our core partners

ACT Emergency Services Agency

ACT Parks, Conservation and Lands

Bureau of Meteorology

Country Fire Authority, Victoria

CSIRO Divisions of Materials Science and Engineering and Sustainable Ecosystems

Department of Environment and Climate Change, New South Wales

Department of Environment and Conservation, Western Australia

Department of Sustainability and Environment, Victoria

Emergency Management Australia

Fire and Emergency Services Authority of Western Australia

Forestry Tasmania

Metropolitan Fire and Emergency Services Board

New South Wales Fire Brigades

New South Wales Forests

New South Wales Rural Fire Service

New Zealand National Rural Fire Authority

Queensland Fire and Rescue Service

Tasmania Fire Service

Tasmania Parks and Wildlife Service

University of Canterbury

University of Melbourne

University of New South Wales

University of Tasmania

University of Western Australia

Our associate partners

Australian National University

Charles Darwin University

Chemistry Centre, Western Australia

Country Fire Service South Australia

Department for Environment and Heritage, South Australia

Department of Justice and Community Safety, ACT

James Cook University

La Trobe University

Metropolitan Fire Service South Australia

RMIT University

SCION

University of Wollongong

Formal Collaborations

Memorandums of Understanding:

Association for the Development of the Industrial Aerodynamics

CRC for Spatial Information

CRC for Tropical Savannas Management

National ICT Australia Limited

University of California, Berkeley – College of Natural Resources – Center for Fire Research and Outreach

University of Chile

US Department of Agriculture, Forests Service

Executive Summary

Achievements and activities of the Bushfire CRC for the reporting period.

This Annual Report highlights the main achievements and activities of the Bushfire CRC in detail in the period 2007-8.

Those achievements include:

- A national seasonal bushfire outlook.
  Vehicle burnover research.
  Community safety book.
  Experimental fires in South Australia – the largest and hottest experimental burns in Australia.
- Annual conference attracting 900 industry and research representatives.
  Pre-conference workshops attracting 120 key decision makers and agency personnel.
  Conference Trade Expo attracting 100 SMEs.
- Two Stakeholder Meetings, each with 60 senior representatives drawn from each Australian jurisdiction and New Zealand, and including research partners.
- Four completed postgraduate students – all placed in industry employment.
  43 postgraduate students providing the next generation of researchers.
- Community outreach through increased website visitation, public forums, publications, displays.
  Media coverage spread across Australia and internationally.
  New media tools including *YouTube*.
- Handover of Fire Knowledge Network to AFAC, the industry peak body (launched as Knowledge Web in September 2008).

From the Chair

The Bushfire CRC operates primarily within the fire and land management industry and secondly within the broader emergency services industry.

Climate change projections show that most of Australia, but in particular the southern parts of the continent, is moving towards a hotter and drier climate. We can expect more extreme fire days across a more fire prone landscape.

The industry is now in agreement that the current practices of fire management and protection are not sustainable under these emerging conditions. The industry is now looking to the Bushfire CRC to provide direction and support in tackling these challenges.

This is having a significant impact on the objectives of the Bushfire CRC. Our research program was established in 2001/2, when climate change was not the main driver of change in this industry, or indeed any other industries.

Bushfire CRC research is now delivering outcomes on many key research questions for the industry but there is no capacity for the Bushfire CRC, now in its sixth year, to take on significant new projects.

These new research challenges are providing the basis for our proposal for a new CRC. This new CRC is being developed to meet the evolving research needs of our industry. It will build upon the outcomes of the Bushfire CRC and is being driven by our industry in collaboration with research providers to address the problem: *Existing fire management practices at all levels are not sustainable in today's changing world.*

Another significant change in the industry context in recent times has been the unprecedented rise in the level of scrutiny of the management of bushfires in Australia. The most prominent were the 2004 *COAG Inquiry on Bushfire Mitigation and Management*, the 2003 *Nairn Inquiry into Australian Bushfires*, and the 2008 Victorian Parliamentary *Inquiry into the Impact of Public Land Management Practices on Bushfires*. In addition, there has been a range of subsequent governmental and coronial inquiries into fires in South Australia (Eyre Peninsula 2005), the ACT (Canberra 2003), Victoria (alpine fires 2003 and 2006/7) and others.

Research adoption

With the Bushfire CRC entering its sixth year, most of the key research outputs and activities have been achieved or are close to being finalised. Similarly, all the postgraduate students are in their final phases of research.

This presents the Bushfire CRC with the opportunity to ensure that these outputs are properly transferred into useful outcomes for industry. Conversely, this also presents a risk in that if this process of research transfer is not successful the overall benefit of the Bushfire CRC will be undermined.

With this in mind, the Bushfire CRC has established a Research Adoption Strategy to ensure all research outputs are properly managed through to adoption. This strategy is built upon the foundations of industry partnership that have been an integral part of all research projects from their inception. All projects have both a nominated industry representative and a research leader to ensure that the development of each project from conception right through to adoption has been a collaborative effort of all parties.

Third year review

The recommendations of the Third Year Review continued to be implemented throughout this reporting period and in the lead-up to a subsequent Fifth Year Review.

In particular, significant gains were made in the two key areas highlighted by this Review:

- Forging links within the large and geographically spread industry. This was acted on through improved communication through Stakeholder Meetings, publications, online activities and events such as conferences and workshops. This involved collaboration with multiple stakeholders in every state and territory of Australia and in New Zealand.
- Maintaining researchers across a wide range of disciplines relevant to bushfire. More than 130 researchers are working on projects across Australia and New Zealand. This includes 43 postgraduate researchers – the foundations of the next generation of bushfire researchers.

Our people

Kevin O'Loughlin, the founding Chief Executive Officer of the Bushfire CRC, resigned in September 2007. He was replaced by Gary Morgan AFSM, previously Manager of Strategy and Implementation at the Australasia Fire Authorities Council and a former Chief Fire Officer for the Department of Sustainability and Environment, Victoria. Mr Morgan was also a former Board member of the Bushfire CRC and End User Leader for Program B.

The Bushfire CRC is providing innovative research and is highly regarded both in Australasia and internationally. It is particularly pleasing that our social science research, previously under-utilised by fire and land agencies, has gained notable international attention.

The outputs from all our research programs are being picked up by our industry. This knowledge base, when combined with the succession of young researchers at the Bushfire CRC, lays the foundation for all fire and land agencies to provide an ongoing high level of community resilience to fire.

Len Foster
Chair, Bushfire CRC

Governance and Management

The Bushfire CRC operates through an incorporated not-for-profit company, Bushfire CRC Ltd.

The company, Bushfire CRC Ltd, was registered in March 2003 and began formal CRC operations in July 2003. Participating parties are members of the company, which is limited by guarantee.

The Bushfire CRC's Stakeholders Council consists of representatives of each of the participating agencies.

The Stakeholders Council meets twice a year to review and receive updates on the progress of research, education, communication and other activities, and to provide strategic advice to the Governing Board. The Governing Board has 10 members, including two independent members, and meets regularly throughout the year. The company's constitution allows for participants who contribute cash of $100,000 or more per year to vote and nominate members to the Governing Board. Both the Stakeholder Council and the Governing Board have the same independent Chairman.

The Governing Board has four committees:

- An **Audit and Compliance Committee** that oversees corporate governance, audit responsibilities, finance and compliance.
- A **Users Research Committee** that ensures the research conducted meets the strategic aims of the Bushfire CRC and the needs of the users.
- A **Human Resources Committee** to advise on and oversee the Bushfire CRC's personnel matters, including selection, remuneration and performance management.
- An **Education and Research Adoption Committee** that is responsible for providing strategic advice on the overall development of the Bushfire CRC's postgraduate program, new educational initiatives, and on the strategy for research adoption.

Management Staff

Name	Title
Gary Morgan	Chief Executive Officer
Dr Richard Thornton	Deputy Chief Executive Officer, Research Director
Ian Wilson	Business Manager
Jen Lumsden	Education Manager
David Bruce	Communications Manager
Lyndsey Wright	Acting Research Manager
Noreen Krusel	Research Adoption Manager
Valerie Buckle	Executive Assistant
Vaia Delizissis	Event Coordinator
Mike Leonard	Advisor – Strategic Issues

Chief Executive Officer, Gary Morgan

Program Leaders

Program A
Jim Gould
CSIRO Forest Biosciences

Program D
Bob Leicester
CSIRO Manufacturing and Infrastructure Technologies

Program B
Mark Adams
University of New South Wales/ University of Sydney

Program E
Christine Owen
University of Tasmania

Program C
John Handmer
RMIT University

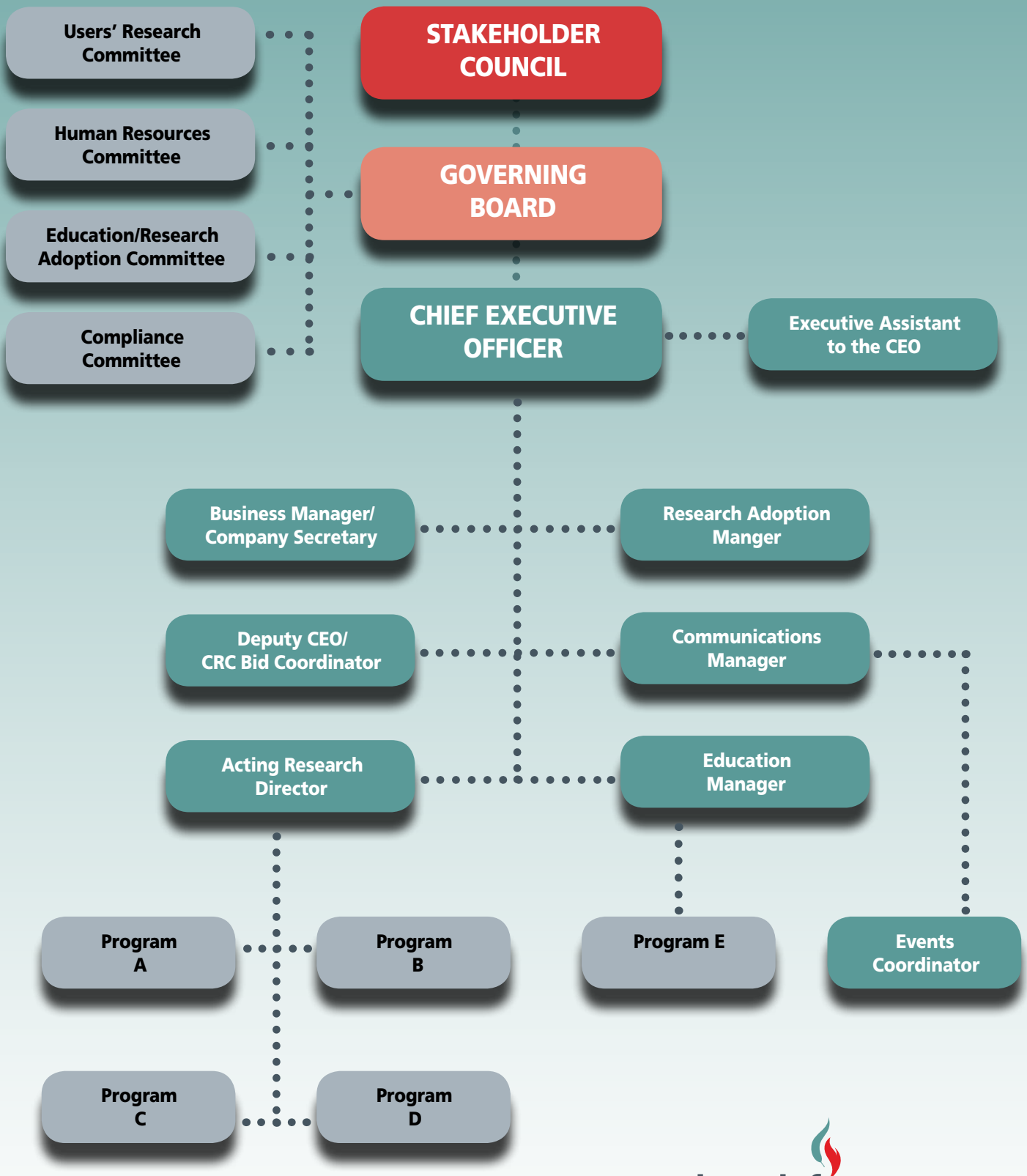
New Participants

- University of New South Wales
- New Zealand National Rural Fire Authority and The University of Canterbury – joint partner

CEO, Governing Board Members and Committee Members

Name	Organisation	CRC Position / Role
Kevin O'Loughlin		CEO (to 11 September)
Gary Morgan		CEO (from 11 September)
Len Foster		Independent Chairman Director Audit Compliance Committee HR Committee
John Baird	Rector, Australian Defence Force Academy	Director Education/Research Adoption (Chair)
Neil Bibby	Chief Executive Officer, Country Fire Authority	Director Audit Compliance Committee
Joanne Bloch	Independent	Director Audit Compliance Committee (Chair)
Naomi Brown	Chief Executive Officer, Australasian Fire and Emergency Services Authorities Council	Director HR Committee (Chair)
Ray Canterford	Assistant Director, Bureau of Meteorology	Director (from 29 May) Users Research Committee
Murray Dudfield	National Rural Fire Officer, New Zealand Fire Authority	Director Users Research Committee Education/Research Adoption
John Gledhill	CEO/Chief Officer, Tasmania Fire Service	Director HR Committee Education/Research Adoption
Brian Richardson	General Manager, Ensis Forest Biosecurity and Protection	Director (to 19 April) Education/Research Adoption
Alistar Robertson	Dean, Faculty of Natural and Agricultural Resources	Director Users Research Committee
Ewan Waller	Chief Fire Officer, Department of Sustainability and Environment	Director Users Research Committee (Chair)

Bushfire CRC
Organisation Structure



bushfire CRC

Research Programs

Research activities and achievements

Key Research Achievements 2007-8	
Seasonal Bushfire Outlook 2007-2008	A national initiative through which fire service agencies have been provided with significant information on weather and fire danger outlooks for the period as compiled by Bushfire CRC researchers. Now in its second year, this information continues to have a major influence informing pre-season preparations in all states and territories. Researchers and fire service agencies delivered an Outlook for both northern and southern Australia.
Cars burnt in bushfire	Bushfire CRC research initiated by the NSW Rural Fire Service with CSIRO scientists tested seven cars under simulated bushfire conditions and found, among other results, that the greatest risk to the occupants was the release of toxic gases, rather than heat radiation. The research gained much media attention and was used by AFAC to refine the national public guidelines relating to the safety of car occupants.
Climate change report	A report for the Climate Institute on the impact of climate change and fire weather for south-east Australia has been widely used by governments, research organisations and the media. The report concluded that a hotter world meant longer fire seasons and more intense bushfires.
Developing an ongoing capability in bushfire research	One of the key reasons for establishing the Bushfire CRC was the national shortage of bushfire researchers. The Bushfire CRC now has more than 130 researchers, including postdoctoral fellows and PhD students, working in the area, many with international recognition. This will provide a lasting research capability for the industry.
Community Safety Book	This book is a compilation of all the community safety research projects underway at the Bushfire CRC. As such, it is the first publication of its type in the world that summarises the research into the community safety aspects of bushfire. Published by CSIRO Publishing, this book is an invaluable reference for fire and community safety managers in fire and other emergency related industries.
Experimental fires at Ngarkat	More than 100 bushfire researchers and fire agency personnel from around Australia converged on the Ngarkat Conservation Park in South Australia in March for a series of controlled burns under several separate Bushfire CRC research projects designed to improve fire management in Australia. A total of 18 experimental fires were completed. The final output of this study will be a prescribed burning guide for areas of similar vegetation type around Australia.
Fire in the high country	HighFire, the high country project that was funded as a special allocation from the Australian Government, has completed its three-year program. It has shown the critical link between fire and a range of impacts on the carbon balance, water yields and other ecosystem processes in alpine Australia. The project has also led to new insights on high country communities and bushfire risk management.

Nature of major consultancies and their contribution to the CRC

The Bushfire CRC has continued to undertake consultancies for the Climate Institute, ACTEW and the Australian Fire and Emergency Service Authorities Council (AFAC) and individual fire service agencies during this financial year. These have all enabled the Bushfire CRC to undertake a broader scope of work than would have been otherwise possible.

The work with the Climate Institute resulted in increased understanding of the impact of climate change on fire danger across Australia and has resulted in a substantial report that has generated significant media and community interest.

Work with individual fire service agencies (in particular Department of Sustainability and Environment, Victoria, and NSW Rural Fire Service) has enabled an extension of existing Bushfire CRC projects into guidelines and other products that are more accessible to the industry.

Any changes proposed to future research directions

The Third Year Review of the previous year indicated that the general direction of the Bushfire CRC was still relevant and the research outcomes would provide benefit to the industry and the community.

A detailed review of the projects in January 2008 indicated that the current direction is supported by the industry. A critical analysis of the research outcomes confirmed four targeted outcome areas for research adoption. The four areas are:

- Fire fighter safety
- Community safety and engagement
- Aerial suppression
- Prescribed burning

A number of significant external pressures, in particular climate and demographic change, have become important as planning for a new CRC progresses.

HOMES AND THE BUSH

DEFENSIBLE SPACE

Completed

- Vehicle burnovers – this study has been adopted by AFAC to refine national guidelines on what to do if caught in a bushfire while driving. This report highlighted the dangers of being caught in a vehicle in a bushfire and outlined the protective actions to take based upon the findings of the tests conducted under simulated bushfire conditions.
- Performance under bushfire conditions – burning tests have been conducted on common types of fencing, water tanks, power poles, windows and decking. This research has helped define what residents need to know when constructing houses in bushfire zones.
- Based on the research on household building materials, advice was provided to Standards Australia and AFAC on Building Standard AS3959.
- Bushfire CRC scientists evaluated the house losses after the Eyre Peninsula fires of 2005 and the Canberra fires of 2003. They looked at why some houses burned and others survived. This led to better advice on how people can prepare and protect their homes.

Ongoing

Why are we still building without defensible space, in unsafe areas?

- Research is continuing into other aspects of residential housing including the surrounding vegetation, external water sprays, roofing, external cladding and gas supply. This will add to the sum of knowledge on community household preparation.
- Researchers are also developing a risk analysis model that will assist fire managers and local authorities to develop policies for building at the interface.

Program A:
Safe Prevention, Preparation and Suppression

End User Leader: **Steve Rothwell, Queensland Fire and Rescue Service**
Alternate: **Bob Conroy, NSW Parks and Wildlife Services**
Program Leader: **Jim Gould, Ensis – Bushfire Research Group (CSIRO)**

Fire managers need reliable tools that make the best use of emerging technologies to support their decisions in how best to manage the landscape, before, during and after a bushfire. This program is providing a better understanding of key issues such as fire behaviour, fire weather, bushfire danger rating, and strategies for aerial and ground suppression.

Overview

This program provides better understanding of fire behaviour, fire weather, the danger of bushfires and strategies for suppression. The program is end user focused and as such aims for delivery of decision support tools that will be enhanced through interaction between the researchers and the end users. The program is improving the management of fires by delivering a better, more tightly integrated understanding of strategies for prevention, preparation and suppression of bushfires.

The first five years of the Bushfire CRC have seen major advancements of research activities within this Program and the focus is now moving to research adoption. There is now a greater depth in a full range of science disciplines required to reduce the risk and impacts of bushfires, including meteorology, fire behaviour, computer science, remote sensing fuel and risk management.

The recruitment of PhD students and postdoctorial researchers has enabled us to advance knowledge in key areas that will bring continued benefit to Australia and New Zealand. Program researchers are being recognised as world leaders in their field and are invited to participate in national and international conferences, advisory committees, and collaborative research activities. For example, Program Leader Jim Gould and Project 4.1 Leader Kelvin Tolhurst were invited as keynote speakers for the Field Workshop on Forest Disturbances – modelling spread in forests, at the University of Western Ontario, Canada, in November.

Highlights

Industry workshop

One of the highlights over the year has been the Bushfire CRC Fire Behaviour Workshop – *State of Knowledge – Australasian Update*, at the Bushfire CRC/AFAC Annual Conference in Hobart in September. The Bushfire CRC co-hosted this workshop with CSIRO Bushfire Dynamics and Applications Group and all the program's projects key finding and research applications were presented. Around 120 participants attended the workshop with representation from majority of the Bushfire CRC end user stakeholders.

Project Vesta

In November, CSIRO and Department of Environment and Conservation Western Australia in collaboration with and support from the Bushfire CRC and AFAC nationally and internationally launched the Project Vesta findings and the new national forest fire behaviour prediction systems for dry eucalypt forest.

Fuel and fire behaviour modelling

In March, the final experimental fires to develop a national prescribed burning guide for mallee/heath fuel types were completed, with these experiments providing invaluable data at the upper end of the fire weather range. In fact, these experiments were the first time in the history of fire research in Australia that fire researchers were allowed to ignite experimental fires under very high fire danger conditions. This was due to the diligent efforts of the South Australia Department for Environment and Heritage and the South Australia Country Fire Service in providing not only well-prepared experimental plots but also fire suppression resources ranging from two-person first-strike units and a skidder to aerial water bombers. A total of 18 experimental fires were conducted at the Ngarkat Conservation Park in South Australia. These experiments involved researchers from several Bushfire CRC projects, including Program D projects (fire fighter health and safety and air toxics exposure and management) and international researchers from New Zealand, Denmark, and Spain.

Four experimental fires were completed in New Zealand on a steep slope of manuka shrubland (*Leptospermum scoparium*) fuels. Data from these experiments will be added to the data from the 2005 experimental fires and other historical shrubland fire behaviour data.

Grassland curing

Field data were collected from a number of sites across Australia and New Zealand during the course of 2007/08, with significant support from end user agencies, including volunteers. The sites were in Western Australia, Victoria, ACT and New South Wales in Australia, and the North and South Islands of New Zealand.

Good progress has been made with the development of remote sensing techniques to determine curing, and the final systems developed will be applicable across a range of grassland types of Australasia, using the latest remote sensing technology. This will represent a major step forward in the tools available for fire and land management agencies.

Fire weather and fire danger

The Bureau of Meteorology conducted workshops bringing together fire weather researchers and stakeholders for northern and southern regions to forecast seasonal bushfire weather outlooks across Australia. Reports and outlook maps were distributed to all end user agencies.

A report describing trends in frequency of strong, deep (Ash Wednesday 1983-like) fronts over south-eastern Australia under climate change scenarios has been approved for publication as a Centre for Australian Weather and Climate Research report and is now in press. A journal paper is currently being drafted based on this report.

Evaluation of aerial suppression

Aerial suppression experiments were conducted to compare the effectiveness of different suppressants (retardant, foam and gel) delivered by fixed wing aircraft on mallee-heath fires at Ngarkat Conservation Park in South

Australia. These experiments required an extended field trip and the partnership of other Bushfire CRC researchers and agencies to complete research tasks such as plot preparation, fuel characterisation, weather measurement, fire behaviour measurement and post fire assessment.

Bushfire risk management tool

A collaboration with the USDA Forest Service Missoula Fire Laboratory has seen the incorporation of a terrain modified wind-field component (Wind Ninja) into the Australia McArthur fire spread model, making fire spread in complex terrain more realistic. Collaboration with the Alberta Provincial Forest Fire Centre, Sustainable Resource Development, has led to further investigations on how to best model the spread of fire across the landscape. Both these collaborations have resulted in a healthy exchange of program development ideas, software and international visits.

The fire spread simulation model called Phoenix was used as part of a new national training initiative to develop people with a high level of fire behaviour prediction skills. It is intended that these fire behaviour analysts will become key users of Phoenix software in the future, to both deal with real-time wildfires and to plan developments such as infrastructure, settlements, and prescribed burning programs.

Project title	Project Leaders	Objective
A1.1 Fire behaviour modelling	Jim Gould, Wendy Anderson	To improve firefighter and community safety in the management of bushfires, by providing better knowledge and understanding of the interaction of fire, fuel, weather and topography across Australia.
A1.3 Fuel classification and availability	Peter Ellis	To develop a single fuel classification system in Australia to be used in smoke emission models, fire behaviour predictions and habitat modelling. To develop a model of fuel availability based on fuel, weather and fire behaviour characteristics.
A1.4 Improved methods for the assessment and prediction of grassland curing	Stuart Anderson	To develop improved methods for the assessment and prediction of grassland curing as an input into fire danger rating systems and fire behaviour models.
A2.1 Fire weather and fire danger	Graham Mills	To improve the operational utility of fire weather forecasts and outlooks by providing a better understanding of wind, temperature and humidity structures and distributions, on the very short-term (1-12 hours), short to medium term, and seasonal time scales.
A3.1 Evaluation of suppression techniques and guidelines (aerial and ground)	Jim Gould	To optimise the effectiveness and efficiency of aircraft use during firefighting operations.
A4.1 Bushfire risk management	Kevin Tolhurst	To develop a risk management decision support system for communities living in the rural/urban interface, town planners, power companies, firefighters and land managers.
A5.1 Fire spread simulation	George Milne	To develop a physically accurate modelling, simulation and animation toolset that will permit rapid execution of a model of a specific bushfire situation to permit the prediction of fire development and the effect of containment strategies.

Bushfire CRC 2003 - 2008
RESEARCH HIGHLIGHT

AERIAL SUPPRESSION

AIRCRAFT – ESSENTIAL WITH A COST

Completed

- Final report on effectiveness of aerial suppression.
- Final report on cost effectiveness.

These reports help fire agencies determine the most effective combination of suppression resources and the economic efficiency of aerial suppression. They highlight the importance of rapid first attack, the essential combination of ground and aerial resources and the cost disadvantage of large fixed wing air tankers.

Ongoing

How do we respond to the public/government call for more aerial? At what expense?

- Researchers are building aircraft scenarios into a fire management business model to provide fire managers with better decision support tools to enable the selection of the right type of aircraft for the right type of fire.
- An analysis of the operational effectiveness of aerial suppression in the 2007/08 season is in progress, together with the results of aerial suppression tests at experimental burns at Ngarkat Conservation Park, South Australia, in early 2008. These tests compared a range of chemical suppressants (retardant, foam and gel).

FIRE BEHAVIOUR AND FIRE WEATHER

BUILDING THE EXPERTISE

COMPLETED

- An annual, nationally consolidated view on the seasonal fire outlook has been operational for three years. This is coordinated between all states and territories and has provided an essential basis for requests on resource funding for upcoming fire seasons. Fire managers from agencies around Australia have developed maps that indicate the likelihood of bushfires in specific geographic regions, taking into account climate changes, weather forecasts, vegetation growth, rainfall data and local fire management resources. These are now used for government discussions on resource allocation and funding.
- Tools for gridded fire weather forecasts are allowing better predictions on fire behaviour.
- Tools to better predict wind changes are helping protect firefighters and the general community.
- A report for the Climate Institute on the impact of climate change and fire weather for south-east Australia. The report concluded that a hotter world meant longer fire seasons and more intense bushfires.
- A study of "blow-up" conditions has led to new knowledge on the dry slots phenomenon. This knowledge can help fire managers on the fire ground plan for and reduce risk.
- Project Vesta – new fire behaviour and fuel assessment models are now being considered by fire agencies.
- A report on assessment methods for grassland curing has provided a tool to better predict curing, fire risk, rate of fire spread, and the fire resources required.

ONGOING

How will fire behave under a warmer climate and drier land?

- Researchers are describing fuel dynamics and fire behaviour from more than 40 experimental burns under very high fire danger weather conditions at Ngarkat Conservation Park, South Australia.
- A study is developing a universal classification of fuel types and extent of fuel consumption.
- A study is developing a semi-physical model for fires in pine plantations, based upon case studies from the recent Tumut and Mt David fires.

Program B: Fire in the Landscape

End User Leader: **Liam Fogarty, Victorian Department of Sustainability and Environment**
Alternate: **Tony Blanks, Forestry Tasmania**
Program Leader: **Mark Adams, University of New South Wales**

Overview

There has been strong progress across the many varied projects of Program B this year.

The clear and obvious increase in confidence in the effectiveness of prescribed burning, as shown by land management and other responsible agencies in several states, has been a pleasing achievement which in part can be attributed to the research activity in this field. That outcome alone is a significant achievement for the Program.

The confidence in prescribed burning is supported by the significant increase in scientific knowledge in the subject across Australia – east to west, north to south. The increase in knowledge spans ecosystem attributes as diverse as biodiversity, water, carbon, nutrients, and greenhouse gases. Much research during this year has focused on helping agencies understand and then develop the range of applied and adaptive fire regimes that deliver outcomes that are optimised (rather than perfect) for a range of values.

Another significant achievement in the course of the year has been that many of the senior scientists in Program B continue to be interviewed for press or radio or have appeared in television news and documentary programs, mostly in 'expert commentary' roles. They have been sourced for their expertise in areas as diverse as climate change, prescribed burning, megafires, forest management, water management and the impacts of drought.

Education

Program B, with 19 out of the total 43 students, continues to be a major provider of students and student outputs within the Bushfire CRC.

There has been completion of several PhD theses from students at a number of different universities. These include Ken Scott on Fire and Savannah Grass Ecology, and Adam Leavesley on the Impact of Fire Mosaics on Birds in Mulga Woodlands of Central Australia.

Publication

The rate of publication has increased this year as projects moved towards maturity. A good proportion of output publications are appearing in international journals of significance; quite a few in journals with impact factors greater than two. Recent publications from the universities of Western Australia, Melbourne, Tasmania, and New South Wales are indicative of the high quality of work completed with Bushfire CRC support. A project that has achieved a strong increase in outputs this year has been Project B3.1 *Impacts of Fire on Ecological Processes and Biodiversity*, led by Dr Alan York from the University of Melbourne. These include the Wildfire Chronosequence Project Establishment Report out of the University of Tasmania with assistance from Forestry Tasmania.

Many Program B researchers attended major conferences during the year.

Industry and research links

Many of the research teams worked closely with land management agencies so that research outputs are more readily turned into industry-focussed outcomes. Notable in this regard are:

- The strong partnerships with the Department of Environment and Climate Change in New South Wales by Professor Ross Bradstock and his team on Project B1.2 *Fire Regimes and Sustainable Landscape Risk Management*.
- The Department of Environment and Conservation in Western Australia and Lachie McCaw and his team with Project B1.1 *Managing Fires in Forested Landscapes in South Western Australia*.

Much work has gone into fostering links with industry, and the improved interaction between researchers and industry over the year is a testament to the success of this effort.

Project completion

A number of projects reached completion during the year:

- The Project B2.1 *Smoke Plumes and Hazes from Rural or Urban Fires* has completed the research that is now being implemented as a routine tool for monitoring the likely spread of smoke from bushfires and prescribed fires. This model is useful for land managers for prescribed burns, for urban agencies for toxic industrial plumes, for health agencies for community advice, and for other affected industries including agriculture, tourism and aviation.
- Project B5.1-3 *HighFire*, the high country project that was funded as a special allocation from the Australian Government, completed its three-year program. That project has however, established on-going and

long-term research trials and monitoring programs in the alpine areas of New South Wales, the ACT and Victoria. These sites require further ongoing support, ultimately through a new CRC, but initially from other sources. Moves are now well underway to achieve this ongoing funding.

Research Adoption

It is also now very clear that there is still a large volume of research outputs waiting to be published and transferred into outcomes for the industry. The recent budget discussions within the Bushfire CRC have highlighted the great potential for research completed within Program B to have a major impact on the industry. Project leaders are now at the critical stage of working in close collaboration with their end user leaders to devise ways and means of spreading the messages so that the research can be fully adopted.

Project title	Project Leader	Objective
B1.1 Managing fires in forested landscapes in south-western Australia	Lachlan McCaw	To identify patterns of change in the abundance and richness of biota as a result of different fire regimes in forested landscapes in south Western Australia.
B1.2 Managing bushfire risk in a changing world	Ross Bradstock	To provide optimal solutions for sustainable bushfire risk management, in differing ecosystem, management and global/climate change contexts.
B2.1 Behaviour of smoke plumes and hazes	Graham Mills	To assist in the reduction of impact of smoke from an urban or rural fire on community health and safety by predicting the transport, dispersion and concentrations of smoke particulates.
B2.2 Smoke composition and impact on health and ecosystems	Tina Bell	To identify and quantify the chemicals in smoke produced from biomass burning.
B3.1 Effect of fire on ecosystem processes and biodiversity	Alan York	To understand the interaction between fire, vegetation, invertebrates and soil organisms in carbon and nutrient cycling, and how this contributes to biodiversity conservation and ecosystem function.
B3.2 Prescribed fire and biodiversity in northern Australia	Alan Andersen	To enhance the effectiveness of fire management for biodiversity conservation in northern Australia.
B4.1 Synthesis and integration	Mark Adams	To synthesise existing data and integrate with world literature and produce plain language text on prescribed burning.
B4.2 Multi-scale analysis of patterns in ecological processes in relation to fire regimes	Pauline Grierson	To integrate ecological information derived at smaller scales with larger scale management perspectives.
B6 HighFire: underpinning evidence-based policy for fire regimes and their management in the high country	Mark Adams, John Handmer, Rick McRae, Rod Weber.	To contribute to the current evidence-base for fuels management, understanding and improving human resilience and managing bushfire risk in high country landscapes.
B7 Eucalypt decline in the absence of fire.	Neil Davidson	To study tree decline caused by reduced frequency or absence of fire.

PRESCRIBED BURNING: FIRE REGIMES AND BIODIVERSITY

WHY WE CARE

Completed

- Changes in climate will almost certainly result in changes in fire frequency and severity, Bushfire CRC research has shown. This finding has many implications for fire and land managers in how the land is managed and how resources are allocated.
- Bushfire CRC research has shown how all fires – prescribed fires and bushfires, from the Top End to alpine country – carry implications for biodiversity. There are significant negative impacts on biodiversity for many ecosystems if fire intervals are less than two to three years. However, fire intervals of five to 10 years have few, if any, discernable negative impacts, provided there is sufficient diversity in fire frequency and intensity.
- Long-term research sites across the high country of Victoria, New South Wales and the ACT have shown the critical impacts of fire on water quality and yield in both the short and long term. Short-term increases in yield are offset by reductions in quality, for example the siltation after fire affects rivers and water storages. Long-term reductions in yield from regenerating forests will pose considerable risks to flows in major rivers and to residential water supplies.
- The same high country research has also shown the critical impacts of fire on both the short and long-term carbon balance of ecosystems. The effect of fires on soil carbon is emerging as one of the great unknowns in the global carbon cycle. This research on soil carbon will provide an essential knowledge base for community, industry and government bodies developing Emissions Trading Schemes.

Ongoing

- *Fighting Fire with Fire* – this soon to be published book discusses the role of fire in Australia's ecosystems, and how to manage fire both for safety and for biodiversity.
- Research is now identifying a number of classes of compounds that are common in smoke from eucalypt fires, which have the potential to be used in predictive smoke models.
- Many plants and animals act as 'indicator species' – they can indicate the effects of fires on a wider range of other species and processes. Researchers are looking at a range of soil and litter dwelling invertebrates in areas that differ in vegetation and climate from around Australia to assess the effect of fires on biodiversity.

Program C: Community Self-Sufficiency for Fire Safety

End User Leader:	**Damien Killalea, Tasmania Fire Service**
Alternate:	**Lyndsey Wright, Metropolitan Fire and Emergency Services Board**
Program Leader:	**John Handmer, RMIT University**

This program is helping communities become more resilient in the face of the threat from bushfires. It is seeking to understand what communities need to manage the risk, which varies greatly from one community to another across Australia and New Zealand. Central to this program is better understanding what drives human behaviour before, during and after a bushfire.

Overview

With the research program in its fifth year, all projects have been emphasising tangible outputs and research adoption. These consist of books, reports, bulletins, papers, presentations and book chapters that are in a form accessible to our end users, as well as publications that give scientific legitimacy to our research – and which thereby give confidence to those who draw on our results.

In addition to these tangible outputs, this Program continues to emphasise the less tangible tasks that are vital to adoption of research results; in particular demonstrating the value of research and evidence-based approaches, and providing the evidence base for agency programs.

The most important single event during the year was the publication of a book containing the results to date of all Program C (plus related Program D research) research projects. *Community Bushfire Safety* (edited by Handmer J and Haynes K, CSIRO Publishing) was launched at a high profile event in Melbourne, attended by around 100 people, including national media and CEOs or representatives from all end user agencies. The book has been very well received by the fire and emergency management industry.

Two other cross-Program books have been published this year: *The handbook of disaster and emergency policy and institutions* (Handmer J and Dovers S. London: Earthscan) and *Communities living with hazards* (King D and Cottrell A. Disaster Studies Centre, James Cook University).

Specifically cross-program papers published covered climate change, challenges for the sector, and the issue of uncertainty. In addition, a large number of project specific reports, papers and book chapters were produced by Program members during the reporting period.

Research Adoption

In addition to a range of research publications written for users, the Program assisted with research adoption through workshops and presentations. The Program held a major workshop with all researchers, Bushfire CRC management and a large number of end users from across Australia at a Bushfire CRC workshop at the EMA Institute at Mt Macedon in December. The Bushfire CRC also organised and ran workshops on Program C research at the Bushfire CRC/AFAC Annual Conference in Hobart, which was very well attended by many leaders in end user agencies. They attended in order to take the knowledge of the workshop to their agency. Individual projects also developed and ran workshops specific to their research for the industry.

Strategic efforts

The Program has also supported the strategic development of Australian fire research. In addition to supporting the bid for a new CRC by playing a key role in the development of the economic case underpinning the bid, this program has worked with AFAC, the Bushfire CRC and other fire agencies and universities from across Australia to develop and submit a proposal to host a network for Climate Change Adaptation research on fire and emergency management. The application was based on the Bushfire CRC network but has been expanded to include others. The exercise is part of the National Climate Change Adaptation Research Facility's program.

Other highlights from the research projects

Arson

Nine new Bushfire Arson Bulletins, to take the total number of issues to 53.

Three *Trends and Issues* papers published out of the Australian Institute of Criminology:

- Fatal fires: fire-associated homicide in Australia, 1990-2005 http://www.aic.gov.au/publications/tandi2/tandi348.html
- Offending and reoffending patterns of arsonists and bushfire arsonists in New South Wales http://www.aic.gov.au/publications/tandi2/tandi350.html
- Deliberately lit vegetation fires in Australia.

Bushfire economics

Significant work has been completed on the economic value of volunteers with finalisation of a report on their value, and another report comparing methods of communities valuing volunteers. The project is also working on extending the research into the economics of aerial suppression.

Another paper, 'The cost of fire now and in 2020', was presented by program leader Professor John Handmer and well received as world leading research at the III International Symposium on Fire Economics, Planning and Policy: Common Problems and Approaches, at Carolina, Puerto Rico, in April.

Research reports from this project have been used by agencies to support budget related issues. The 'Cost of Fire' work has been undertaken in active cooperation with end users. Related work is proceeding in close collaboration with end users to develop an economic assessment framework.

Stay and Defend or Go Early

The book, *Community Bushfire Safety*, was compiled and edited under this project.

Two reports were presented to fire agencies – one on the NSW Community Fire Units for the NSW Fire Brigades, the other on community actions during the Hobart fires of 2006 for the Tasmania Fire Service.

Project title	Project Leader	Objective
C1 Understanding communities	Alison Cottrell and Judy Newton	To contribute to the understanding of community needs, expectations, behaviours and attitudes to bushfire risk, response and recovery.
C3 Bushfire arson	John Beale	To reduce the impact of deliberate and negligent fire lighting in Australian bushland environments.
C4 Effective risk communication	Douglas Paton, Peter White and Peter Hughes	To investigate the factors in a risk communication program to promote readiness for bushfires and to respond effectively on receiving warnings.
C5 Bushfire economic costs	John Handmer	To coordinate research in Australia to increase the self-sufficiency of communities in managing the risk from bushfires.
C6 Stay and Defend or Go Early	John Handmer	To identify impediments to the full implementation of the "prepare, stay and defend or leave early" policy.
C7 Development of an evaluation framework for community safety policy and programs for bushfire	Gerald Elsworth	To develop an evaluation framework and associated methodology for the community safety approach to bushfire risk.

THE COMMUNITY

CENTRAL TO FIRE MANAGEMENT

Completed

- *Community Bushfire Safety* – this book is a comprehensive summary of findings from all the community safety projects in the Bushfire CRC, drawing from the social sciences, economics and law. It provides a sound basis for the operational planning of fire agencies and other government and non-government organisations dealing with communities facing the bushfire threat.
- *Communities Living with Hazards* – this book features Bushfire CRC researchers at the Centre for Disaster Studies, James Cook University. It provides new knowledge on how communities understand and respond to the bushfire threat.
- A report on newly arrived Sudanese refugees in Queensland and their understanding of fire hazards assisted the QFRS in dealing with communities from a non-English speaking background.
- A report on bushfires and how they are understood by communities compared the responses of a number of communities across Australia.
- A literature review on bushfire arson showed the current state of knowledge; its links to urban arson, the age and background of arsonists, and the times and places of offences. This review is essential reading for fire agencies and law enforcement authorities attempting to combat arson in bushfire areas.
- Bushfire arson – 53 bulletins have been published to date and are publicly available for discussion and advice. This series is building the knowledge of all aspects of bushfire arson; who lights fires, why they do it, and what the authorities can do about it.
- A review of the legal underpinning of the Prepare, Stay and Defend or Go Early policy analysed the shift in risk and responsibility between the homeowner and the authorities. This legal analysis is an essential complement to the broader research project on this policy and is aimed at managers responsible for implementing this policy into practice.
- A further part of the review of the effectiveness underpinning of the 'prepare, stay and defend or go early' policy has looked at historical trends in Australian bushfire fatalities to see how, when and why people die in bushfires. On this analysis, the policy is shown to be well-grounded in the available evidence.
- A report on the nature and effectives of intervention programs for juvenile arson has been distributed to fire agencies and law enforcement organisations.
- A comprehensive review of trends in deliberately lit vegetation fires across Australia was distributed to AFAC Groups and individual agencies to better understand the nature of bushfire arson.
- A report on better engagement between fire agencies and the media has been used by agencies to better plan their media communications during bushfire incidents.

Ongoing

- How do we communicate with the unaware, the disinterested, the elderly, the anti-social, the newcomers, and at the interface?
- A range of risk related communication projects are finding out how agencies can deliver better preparedness and warnings messages to diverse communities.
- Educating children about bushfire risk – this study is looking at how children understand bushfire.
- What makes communities resilient to bushfires? A study in the high country of Australia is finding out how people prepare, face and recover from bushfires.
- Bushfire education, awareness and engagement programs: researchers are conducting an evaluation of a range of programs to assess what is the most cost-effective model.

Program D: Protection of People and Property

End User Leader: **Noreen Krusel, Country Fire Authority**
Alternate: **Tim Anderson, NSW Rural Fire Service**
Program Leader: **Bob Leicester, CSIRO**

This program is examining methods to increase safety at the interface between people, property and the natural bushland environment.

It is focused on the health and wellbeing of the community and firefighters through research into building protection, firefighter health and safety, safe behaviour and decision making and the trends and motivations in volunteerism.

Overview

The Program highlights for the year were the pre-conference workshop held in conjunction with the Bushfire CRC/AFAC annual conference in Hobart and the public release of research into burnovers of civilian passenger vehicles and the subsequent refining of national guidelines for people trapped in vehicles during bushfires.

Researchers from two projects, Firefighter Health and Safety and Air Toxics Exposure and Management, participated in the Program A-led experimental fire exercise at the Ngarkat Conservation Park in South Australia.

Highlights

Probably the most spectacular research has been that related to the use of vehicles as a safe haven when under bushfire attack. The Bushfire CRC research initiated by the NSW Rural Fire Service with CSIRO scientists tested seven cars under simulated bushfire conditions and found, among other results, that the greatest risk was the release of toxic gases, rather than heat radiation. The research gained much media attention and was used by AFAC to refine the public guidelines related to the safety of car occupants.

Physiological aspects of firefighting

The project teams have been very active in interacting with agencies. They have made 46 presentations to a host of agencies including CFA, QFRS, FESA, TFS, MFB, DPI, DSE, Vic Forests, Parks Victoria. They also made a presentation to both the AFAC Occupation Health and Safety and Operations committees. These presentations provided an understanding of how the physical demands of bushfire suppression can impact on a firefighter's health.

Lead researcher Dr Brad Aisbett transferred from the University of Melbourne to be part of the staff at Deakin University and has taken the rest of the research team with him (including PhD students Matt Phillips and Jenni Raines).

The Project has a strong reference group, has been highly active in presenting seminars around Australia, and the research is well promoted within agencies.

Incident management teams

The findings of this research have been developed in real-time exercises that have involved many fire fighting agencies around Australia. Research has been presented at several workshops and to the AFAC Australasian Inter-Service Incident Management System (AIIMS) working group.

The project has been successful in engaging a range of stakeholders, including land management agencies, rural fire agencies, urban fire agencies and emergency services organisations. The reports prepared for the Victoria Department of Sustainability and Environment, for example, identifies 33 strategies to improve information flow in emergency response that can be used in a range of contexts. The outcomes of this component of the research will be of significance to both the state of Victoria and nationally.

Volunteers

The volunteerism project continued with its steady output of reports and presentations to key stakeholder groups and broader industry conferences.

As a fine example of cross-program and multi-disciplinary work, the researchers were invited to contribute a chapter on recruiting and retaining fire service volunteers for community protection to the Program C *Community Bushfire Safety* book. Another significant output for the year included the report 'An Annotated bibliography summarising material related to fire service volunteering by people from Non-English Speaking Backgrounds (NESB) and Cultural and Linguistic Diversity (CALD) backgrounds'.

Continuing work included preparation of a survey of employers of volunteers in NSW on the impact to their businesses and a study in Victoria looking at the impact of volunteering on the wider family and how this influences recruitment and retention.

Project title	Project leader	Objective
D1.1 Building and occupant protection	Justin Leonard	To improve awareness and understanding of the issues surrounding building loss in bushfires, through research, communication and education.
D2.1 Firefighter health and safety	David Nichols	To improve the safety, health and general well-being of volunteer and career firefighters in their firefighting duties.
D2.2 Personal exposure of firefighters to air toxics and OHS risk management strategies	Steve Brown (until December 2005), Donavan Marney (from January 2006)	To develop and apply capabilities for measuring the personal exposures of bushfire fighters to a wide range of air toxics in different fire scenarios.
D2.3 Safety in decision-making and behaviour	Mary Omodei	To identify the human factors that lead bushfire fighters to make decisions that place themselves or others at risk.
D2.4 Safe, cost-effective equipment for reduced firefighting risks to firefighters	David Nichols	To increase the safety of firefighters through improvements in equipment, vehicles and processes.
D3 Enhancing volunteer recruitment and retention	Adrian Birch	To carry out joint research with fire agencies that will assist them to maintain sufficient numbers of volunteers and brigades to meet community needs.
D4 Respiratory health of firefighters	Phil Weinstein, Angus Cook, Phil Thompson, Brian Devine	To investigate the respiratory health effects of occupational exposure to combustion products from bushfires as well as the efficacy of the protective filters on firefighters' masks.
D5 Optimising information flow through collaborative work performance: Enhancing emergency incident management team effectiveness and organisational learning	Christine Owen	To improve teamwork effectiveness and subsequent organisational and cross-organisational learning.

SMOKE

MANAGING THE UNAVOIDABLE

Completed

- A report into the effectiveness of several types of smoke masks for fire fighters compared their performance under bushfire conditions. This report was used by the Fire and Emergency Services Authority in Western Australia to endorse the use of a particulate/organic vapour/formaldehyde filter for its career firefighters.
- A literature review has been completed on current smoke sampling and analytical techniques.

Ongoing – managing smoke exposure

- Researchers are comparing the impacts of prescribed fire and wildfire, taking in factors such as the contents of the smoke, implications for public health and the impact of releasing greenhouse gases.
- A project looking at firefighter exposure to air toxics is identifying and measuring the toxicity of bushfire smoke.
- The results of these projects can be used by fire managers to regulate firefighter exposure to smoke during both bushfires and prescribed burns. Also, a better understanding of what is in the smoke can lead to better advice to communities on how to deal with smoke exposure.

FIREFIGHTER HEALTH, SAFETY AND FITNESS

Completed

- Fighting fatigue while fighting bushfire – this research has published an overview of factors contributing to firefighter fatigue during bushfire suppression work.
- Fighting with fire – this is a report on how bushfire suppression can impact on firefighters' health.
- The research in this area is determining the effect of fatigue, stress, fitness and crew management on the health and safety of firefighters and identifying how this impacts on decision-making ability. It is providing excellent baseline data for agencies to develop fatigue, hydration and fitness guidelines.

Ongoing

The fireground is a workplace, what are the appropriate standards of safety?

- Researchers are looking at safe behaviour and decision making – what are the human factors that influence decision making on the fireground – such as physical and mental stress, group pressures at crew and management level, and the individuals on thought processes? Early results have been discussed at several Research Adoption workshops.
- Research is looking at how fire managers and firefighters consider worst case scenarios – how are they best used to improve decision making and, importantly, how they can be included in training programs.
- Researchers are studying how to make interagency Incident Management Teams more effective with information flows. The results will aid IMTs, both in the rural and urban context, in better understanding how IMT members can work together and how training programs can be structured accordingly.
- Research is quantifying the work demands of tanker-based fire suppression. This will enable fire managers to better allocate resources for crew management on the fireground.

Research collaborations

During the year the Bushfire CRC continued to build on formal and informal research collaborations both nationally and internationally.

The Bushfire CRC has built upon established links with other CRCs, including its Memorandum of Understanding with Spatial Information CRC, which was signed in 2005.

During the reporting period a number of collaborations were undertaken.

- The Bushfire CRC has entered into a formal MOU with the University of Chile to explore research in areas of mutual benefit. This is important as many of the South American countries have similar fire issues to Australia, and through these types of collaborations the Australian fire community can benefit from the expanded knowledge base of other countries.
- The Bushfire CRC has entered into a number of consultancies during the year, mainly with its existing end user partners. The primary aim of these is to help to customise and build upon the core research of the Bushfire CRC. Two of the most significant have been with the Victorian Department of Sustainability and Environment, which has invested in the development of phase 1 of a fire climatology for Victoria, and in a mapping of the information flows in Incident Management Centres.

- The Bushfire CRC is in discussion in formally joining with the Tropical Savannas CRC in producing a linked project as part of the two re-bid proposals of each CRC. This has been critical to ensure that there is no duplication of research effort in the two CRCs and that the benefits to communities are maximised.
- The US Department of Homeland Security approached the Bushfire CRC through the Australian Department of Prime Minister and Cabinet to provide advice and to discuss areas of research that could help the US deal with the problem of mounting house losses to bushfires in California. Similarly, the Bushfire CRC was also approached by the US Department of Government Accountability Office (GAO) to discuss the role of insurance in protection of houses during a bushfire. The Bushfire CRC also retains extensive links with the USDA Forest Service at senior levels to share information and research direction.
- The Bushfire CRC has been an integral part of the development of the Voluntary Guidelines for fire management through participating in drafting the Guidelines and becoming a founding member of the United Nations Fire Management Action Alliance supporting the Guidelines within the United Nations Food and Agriculture Organisations.
- The Bushfire CRC has acted as secretariat for the development of a national policy on fire management in forests and rangelands overseen by the Forest Fire Management Group and the Natural Resource Management Ministerial Council.
- The CEO of the Bushfire CRC is a Board member on the International Association of Wildland Fire and a member of the international liaison committee for the International Wildland Fire Conference.
- The Bushfire CRC has developed close links with the European Fire Paradox Project currently being undertaken by the European Union, with researchers Jim Gould and Justin Leonard participating in the Steering Committee and technical advisory committees respectively.

Continuing research collaborations

- Albert-Ludwigs University, Freiburg (Highfire Project)
- ACTEW (Highfire Project)
- Bluescope Steel Ltd (Project – Building and Occupant Protection)
- Bushfires NT (Project – Burning for Biodiversity)
- Desert Knowledge CRC (Education, Project – Behaviour of Smoke Plumes)
- Desert Research Institute , Nevada (Project – Fire Weather Fire Danger and Project – Behaviour of Smoke Plumes)
- Fraunhofer Institute for Atmospheric Research, Garmisch (Highfire Project)
- Monash University (Highfire Project)
- Southern Cross University (Education)
- Territory Wildlife Park , Darwin (Project – Burning for Biodiversity)
- Tropical Savannas Cooperative Research Centre (Project B3.2 and Education)
- Spatial Information CRC

Communications

The communications strategy promotes the research and activities of the Bushfire CRC among stakeholders and to the broader community. The strategy complements the communications objectives of all the stakeholder fire and land management agencies and research organisations. One of the main priorities is to maintain a close working relationship at appropriate levels within these organisations.

Progress continues on a range of communications activities that are aligned to the strategic direction of the Bushfire CRC. To enable the CRC to better communicate with its partners, government and the wider community the activities are focussed on priority areas, including:

- online communications
- publications
- media
- events

Online communications

The Bushfire CRC website is a prime communications tool for both internal and external audiences. It received a steady increase in hits over the year with demand particularly strong around major activities and bushfire events, and with the launch of new research.

Bushfire CRC online

The Bushfire CRC website is attracting an average of 4000 visits a week, which includes around 5000 documents downloaded each week. Visitors are coming not just from Australia but from the US and Europe as well. This shows a growing trend as at the same time last year the site was averaging 3500 visits and 4000 document downloads each week. Visitation to the site was particularly high after the release of the study into burnovers in passenger vehicles in early January. Papers from the annual conference in Hobart continue to be popular, along with several major research reports.

The Bushfire CRC opened a site on *You Tube* that features videos of Bushfire CRC research in action. *You Tube* provides a simple mechanism of promoting Bushfire CRC work to Australian and international audiences with short (less than two minutes) videos. Importantly, these videos are linked to the main Bushfire CRC website. New content is being progressively uploaded as it becomes available. See http://www.youtube.com/bushfirecrc

Fire Knowledge Web

The online component of the Fire Knowledge Network was handed over to the peak fire industry body AFAC as part of the Bushfire CRC's knowledge transfer to the industry and extended as the AFAC Knowledge Web (launched to the industry in beta format, September 2008). This site contains fire research information gathered from around the world, with the Bushfire CRC content featuring prominently. This project is still in its early days and Bushfire CRC content will increase in the following years.

Publications

Fire Australia

The *Fire Australia* journal continues to provide a vehicle for the promotion of Bushfire CRC research and activities to the broader fire industry. The journal is a joint publication of the Bushfire CRC, AFAC, Fire Protection Association Australia (FPA Australia) and the Institution of Fire Engineers Australia (IFE Australia). *Fire Australia* is published four times a year with a distribution list of 6000 that includes all Bushfire CRC researchers and end users, AFAC members, the fire protection industry, academic libraries, and selected local, state and federal members of parliament.

Research Briefs

One-page Bushfire CRC *Fire Updates* and four-page *Fire Notes* on research projects were emailed to end users and researchers on a regular basis throughout the year. *Fire Updates* serve as a brief summary of the project designed to keep all Bushfire CRC members abreast of current developments. *Fire Notes* are more in-depth summaries of issues important to the industry. These publications are also available online for general access.

Newsletter

The CEO distributed 14 newsletters to Bushfire CRC end users, researchers and students.

Special editions

- The Bushfire CRC and the US Wildland Fire Lessons Learned Centre produced a joint edition of the US-based *Scratchlines* newsletter on the experiences of firefighter exchange programs between the two countries. This online newsletter is on the Bushfire CRC website and has been distributed to Centre members across North America and Australasia. An extract of the edition was reprinted in *Fire Australia*.
- The CFA dedicated its June edition of the printed publication *Business Update* to research. The four page large-style format publication featured a range of Bushfire CRC research projects and their impact on the CFA. The articles had input from the Bushfire CRC but were written by CFA staff and aimed directly at their own audiences.

Involvement with SMEs

The Bushfire CRC Annual Conference 2007 in Hobart provided an opportunity for small operators within the broad fire industry to attend the sessions, network with Bushfire CRC partner fire and land management agencies, and to display their business in a substantial Trade Expo. Almost 100 SMEs took up this opportunity to participate in the conference.

Media

Highlights of the Bushfire CRC media coverage over the period include:

- The annual conference in Hobart in September attracted much media attention, particularly from radio, television and print in Tasmania, with interviews with Bushfire CRC Board Member John Gledhill, CEO Gary Morgan and many researchers. Three television networks attended the conference, ABC Radio broadcast its morning program live from the conference, and the *ABC Country Hour* interviewed researchers for broadcast around Australia over the following months.

- The *Sydney Morning Herald* ran a front page article on bushfire arson in October with reference to Bushfire CRC research.
- ABC Radio program *AM* broadcast a national report in October on Bushfire CRC work on attracting female fire service volunteers.
- The Climate Institute issued a Bushfire CRC commissioned report on bushfires and climate change in September. The study was reported extensively in the media across Australia.
- In September, ABC Radio *Background Briefing* broadcast an extended special on bushfires in Australia based in part on information supplied by the Bushfire CRC and interviews with researchers John Handmer, Ross Bradstock and Jim McLennan and with Bushfire CRC Board member Naomi Brown.
- Bushfires in California prompted the media to seek broader comment. Mark Adams was interviewed on ABC Radio *PM* on the link between bushfires and climate change. See: http://www.abc.net.au/cgi-bin/common/printfriendly.pl?http://www.abc.net.au/pm/content/2007/s2069499.htm
- John Handmer was quoted in the *New York Times* newspaper on the "shelter in place" policy. See: http://www.nytimes.com/2007/10/28/weekinreview/28odonnell.html?_r=2&oref=slogin&oref=slogin
- A report on the work of PhD student Sean Cowlishaw on the family pressures faced by volunteers was reported in the *Herald Sun* in October and followed up in the same publication the next day as an Editorial. See the Editorial: http://www.news.com.au/heraldsun/story/0,21985,22668401-24218,00.html
- Research into face mask filters by PhD researcher Annemarie De Vos was recognised at the Cooperative Research Centres Association conference in May and attracted media attention in radio and print.
- A Bushfire CRC community event in western Victoria attracted much local media coverage, both prior to the event and after.
- The Eyre Peninsula Coronial finding in late December promoted comment in the media by both AFAC and the Bushfire CRC, including a segment on ABC TV national *7.30 Report* that featured both Bushfire CRC CEO Gary Morgan and Bushfire CRC Board member and AFAC CEO Naomi Brown.
- Research into burnovers in civilian passenger vehicles was released in early January and attracted widespread coverage in print and television. Videos of the research were popular on *You Tube* and on the Bushfire CRC website. The release followed the December decision by AFAC to refine the guidelines for people in vehicles during bushfires based upon this Bushfire CRC research.
- *The Australian* Higher Education pages published a lengthy opinion article written by Bushfire CRC CEO Gary Morgan on the lessons learnt from the February Ash Wednesday fires of 25 years ago. See the opinion at: http://www.theaustralian.news.com.au/story/0,25197,23241106-25192,00.html
- The experimental burns at Ngarkat Conservation Park in South Australia in March were reported by a number of media outlets, particularly media from that region.
- *Community Bushfire Safety*, a book on all the community safety research underway at the Bushfire CRC, attracted media interest with ABC Radio attending the launch.
- ABC TV science program *Catalyst* screened a special on "Fire, Flood and Acid Mud: The Murray Darling in Crisis" in May. The program featured Bushfire CRC researchers Professor Mark Adams and Dr Geoff Cary talking about how bushfires in the alpine and catchment regions impacted on water yields. A special interactive website was set up for the program with extended interviews at: http://www.abc.net.au/catalyst/murraydarling/
- An opinion article by Prof John Handmer, Program C Research Leader, appeared in the US magazine *FireRescue1*. It is online at: http://www.firerescue1.com/urban-interface/articles/398216-Stay-or-Go-Australian-approaches-to-wildfire/

Events

Conferences and Workshops

Communications support was provided at numerous workshops and seminars at both a CRC-wide level and at program level. This included support in media liaison, speaker presentations, research poster coordination and display, event branding, photography, online promotion and archiving, and conference booth design, setup and attendance.

Annual fire industry conference

The annual joint AFAC/Bushfire CRC conference in Hobart in September was attended by around 900 national and international delegates, with more than 30 Bushfire CRC presentations, a pre-conference workshop and almost 100 trade exhibits, including a Bushfire CRC booth.

Community Forums

Community forums continued in line with the Federal Government's requirements for Program F: Community Outreach and for the Fire Knowledge Network.

- In August the Bushfire CRC hosted a community forum at the historic Stawell Entertainment Centre in western Victoria. The Federal Member for Wannon and then Speaker of the House of Representatives, The Hon David Hawker, and local dignitaries spoke about the importance of ongoing bushfire research in the region. The event attracted good pre and post media coverage throughout the region. Four Bushfire CRC researchers spoke about their research and how it directly related to the region.
- The Bushfire CRC shared a prominent public stand with the CFA at the National Firefighters Championships at Lakes Entrance in October, which attracted hundreds of fire service staff and volunteers from around Australia.

New facility

The Bushfire CRC has entered into a sub-lease arrangement with the Metropolitan Fire Brigade to occupy the back half of the 2nd Floor at 340 Albert St, East Melbourne – the same building housing the head offices of both the Bushfire CRC and AFAC. This is an excellent low-cost option for the Bushfire CRC and AFAC to hold meetings and workshops for large groups of people. The MFB has also kindly provided tables, chairs and other furniture to make the facility readily usable for Bushfire CRC activities.

Book launch

Community Bushfire Safety, a book on all the community safety research being undertaken within Program C of the Bushfire CRC, was launched in April before 97 invited guests from the fire industry and the media. Andrew Reeves, Special Adviser to Senator Kim Carr, the Minister for Innovation, Industry, Science and Research, attended the launch on behalf of the Minister.

The launch was featured online on several Bushfire CRC partner websites including: http://www.rmit.edu.au/news and http://www.cfafireflyer.blogspot.com/

VOLUNTEERS

IN A 'TIME POOR' AND INDIVIDUALISTIC AGE

Completed

- A study of new recruits to the CFA in Victoria identified issues of recruitment and induction after six months in the service, and issues regarding rewards and retention after 12 months. A CFA volunteer recruitment campaign was implemented based upon these findings.
- The QFRS 2007 recruitment campaign also used Bushfire CRC research to guide its direction and to develop written materials and advertising.
- A study of the impact of mandatory fitness standards on TFS operational volunteer firefighter numbers found more than a third of its members may not meet the fitness standard if it were to be introduced. The report recommended that agencies recruit and retain more younger volunteers, increase the fitness levels of current volunteers, and review the roles and tasks of operational volunteers.
- A study of RFS volunteers in NSW uncovered the barriers to volunteering and led to recommendations on making volunteering more attractive and supported.
- A study of recognition and awards for volunteer firefighters provided a comparative guide to what is being done across Australia's fire services to recognise volunteers services and, ultimately, to minimise attrition.
- Separate surveys of women volunteers (ACT Rural Fire Service and South Australia Country Fire Service) found a range of barriers to female volunteers that agencies could address. Some barriers were external (family and work responsibilities, concern about physical demands), others internal (male-designed protective clothing, lack of female toilets, high storage of heavy equipment, some male colleagues not supportive of female volunteers, others overprotective).

Ongoing

How do we sustain and build the volunteer numbers?

- Employers of volunteers in NSW are being surveyed on the impact to their businesses and on how they can be better educated and supportive of their staff who are volunteers.
- A study in Victoria is looking at the impact of volunteering on the wider family and how this influences recruitment and retention.
- A study is providing information to agencies as they prepare campaigns to recruit and retain volunteers from non-English speaking backgrounds.

End user involvement

The Bushfire CRC end users are involved in a wide range of activities at both the formal and informal level.

The Stakeholder Council comprises a representative from each of the Bushfire CRC partners. Those partners that contribute at least $100K each year have voting rights and also have the right to nominate a Governing Board Member. The Council meets twice a year to receive updates on the progress of research, communication and commercialisation activities and to provide strategic advice and direction to the Governing Board. This Council provides advice at an executive level on the needs of stakeholders and appropriate stakeholder membership of the Governing Board.

The Governing Board governs the Bushfire CRC. This Board consists of the independent chairman and eight skills-based members, with the majority being end users representing stakeholder interests.

All research programs and individual research projects have an end user leader, along with a research leader.

Education and Training

The Bushfire CRC Research Adoption and Education program is working to ensure the industry benefits fully from the research outputs through an effective research adoption process. To this end a Research Adoption Strategy and implementation process was approved by the Board in February and includes working closely with the peak industry body, the Australasian Fire and Emergency Service Authorities Council (AFAC). The key principles of the Strategy as outlined below are to ensure maximum industry uptake and to build the capacity of the industry:

- Use adult learning principles.
- Conduct a dual process of informing users through an extensive communication strategy and engaging them to explore the impact of the research.
- Organise research into targeted outcome areas: firefighter safety, community safety and engagement, aerial suppression and prescribed burning.
- Project manage the rollout of the implementation during and post Bushfire CRC.
- Priority access to research adoption products and initiatives for Bushfire CRC members.

The period of 2008-2010 will see an increasing number of completed research projects that will proceed to research adoption implementation.

Education

The Commonwealth Agreement stipulates that the Bushfire CRC commit to 30 postgraduate scholarships – currently there are more than 40 postgraduate scholarships.

All scholarship students are sponsored by an industry agency and have regular contact with end users to ensure the research meets targeted industry needs. Each postgraduate student has an industry supervisor who works in combination with the university supervisor.

There have been four scholarships completed in the year, with scholars gaining employment with the Commonwealth Department of Agriculture, Fisheries and Forests, Great Southern Plantations Ltd, Bushfires NT and Asthma CRC.

The Bushfire CRC has developed retention strategies to encourage the industry to capture the scientific capacity built up through the scholarship program, and the following are some examples:

- Emerging Researcher profile: An online survey of all postgraduates regarding their intentions on completion; areas of employment interests and their geographic preferences was undertaken and will be used for an online skills portal. The portal will allow agencies to search for skills that are needed and for postgraduates to search for employment opportunities. Informal facilitation of long and short-term employment opportunities by linking postgraduates with Bushfire CRC stakeholders and AFAC member agencies is increasing through the Education Manager. [See Appendix A – a list of postgraduate students with employment details.]
- Conference opportunities: The 2007 Bushfire CRC Annual conference in Hobart had 60 posters and 10 presentations by postgraduates. A number of postgraduates have presented at overseas conferences. Conferences provide a strong opportunity for representing the Bushfire CRC; networking with the wider scientific community; and concentrated opportunities to showcase emerging researchers' work.
- Use of new researchers in research adoption as specialist writers and participants in adoption project groups. This will increase collaboration opportunities and industry experience. For example a postgraduate worked with the Department of Environment and Climate Change – NSW to produce a technical paper to assist the agency to adopt research specific to the Sydney basin region.
- Communication strategies to showcase new researchers' work using industry-wide and mainstream media opportunities, other conferences, workshops and Stakeholder Council meetings. For example, all postgraduates will produce a *Fire Note* or *Fire Update* on completion. During the year, two applications were submitted for the CRCA New Scientist Award in May.

Future planning

The Bushfire CRC is undertaking an industry survey to determine the needs of the industry for professional development or formal courses. A key priority is to build the Bushfire CRC research into existing undergraduate courses similar to the existing example of the Australian National University that delivers an integrated fire ecology undergraduate course using Bushfire CRC researchers and postgraduates from various disciplines to deliver the course. (See Appendix B).

Seminars/workshops/courses run for industry

- Four pre-conference workshops in Hobart – with over 120 industry personnel attending and more than 4000 downloads of workshop material from the Bushfire CRC website.
- Program C: Community Self-Sufficiency for Fire Safety workshop – conducted over two days.
- Vesta Fire Behaviour awareness workshops – two.
- Phoenix fire spread workshops were conducted pre-summer for the agencies to educate their personnel on the model and its attributes for validation during actual bushfires.
- Institute of Australian Geographers Conference, May, Hobart – seven Bushfire CRC researchers, including four postgraduates, presented.
- Bushfire CRC researchers at the Bureau of Meteorology conducted one southern and one northern seasonal outlook fire weather workshop to assist agencies predict the coming fire season's fire risk.
- Fire fighter health and safety and safe decision-making workshops (4) to agency staff in Brisbane, Melbourne and Bendigo (more than 50 people in each workshop).
- Stay and Defend or Leave Early for FESA, Western Australia, two workshops on policy implications.
- Arson workshop in May facilitated by the AFAC Community Education Group.

Bushfire CRC Postgraduates 2007/2008

PhD Students	38
Masters Students	1
Vacation Students	4
Total	**43**

Looking forward 2020

2020 and beyond

Much of the work of the Bushfire CRC is aimed at finding ways of reducing the level of bushfire risk for given levels of investment and resourcing by governments and the wider community. While much has been learnt over the last few decades about the management of fire in eucalypt dominated ecosystems, and in grasslands, much remains to be understood.

Our problem in Australia and New Zealand is that existing fire management practices at all levels are not sustainable in today's changing world.

In much of Australia, and in parts of New Zealand, fire, park and forest management agencies are confronting increasing urbanisation, prolonged drought and global warming, increasing strains on forested water catchments, and concerns about their continued ability to adequately manage fire.

As science beings to better understand the probable impacts of global warming it seems increasingly futile in Australia to develop policies in areas ranging from water and biodiversity conservation, to urban planning, carbon sequestration, and the maintenance of key aspects of indigenous culture, without first critically analysing fire management considerations.

The current financial year sees the completion of the sixth of the seven-year life of Australia's first attempt to focus nationally on the bushfire related research needs of its fire and land management agencies. Together with its 21 core partners and 11 Associate Partners the industry is now benefiting as a number of current research projects reach advanced stages, while others with longer term horizons are now comprehensively established.

The final phase of the Bushfire CRC will provide Stakeholders with much knowledge for utilisation.

A CRC for Fire – Environment and Society

A new CRC bid for Commonwealth funding will be submitted in March 2009, with successful applications expected to be announced in July 2009.

The *Fire – Environment and Society CRC* will build on the work of the current Bushfire CRC and conduct research that confronts the issues of the next two decades. It will also continue to build a new generation of researchers for the industry.

The industry and the Bushfire CRC Board are now seeking expressions of interest from potential new participants to be involved in this post-Bushfire CRC venture.

Detailed planning work for a new bid is now well advanced and a series of AFAC workshops have defined the high level knowledge gaps based upon emerging drivers of change across the industry – climate change and drought, demographic change, workplace health and safety, changing technology, and changes in legislation and policy.

The workshops produced four major research programs and two supporting programs:

- **Risk Assessment** – an integrated decision support tool for optimising risk.
- **Living with the threat of fire in a changing world** – enhancing the community's ability to live with threats in an environment of significant global change.
- **The role of people, technology and systems in managing incidents** – ensuring the right people, equipment and systems are available at the right place at the right time.
- **Fire's future role in delivering sustainable ecosystems and enhanced environments** – environmentally sustainable solutions for industry, fire and land management.
- **Education** – skilled people for the fire industry.
- **Knowledge management and research adoption** – maximisation of benefits from research.

The next steps in the new CRC submission include:

- Development of funding plan for the new CRC.
- Submission to Australian Government by 20 March 2009, including a signed Participants Declaration form.
- Interviews with bidding teams June to July 2009.
- Announcement of successful CRC bids July 2009.

Appendix A

BUSHFIRE CRC Postgraduates: Scholarship holders with employment			
Student	**Project**	**Completion date**	**Employer**
Phil Lacy, PhD	Burning under young eucalypts	6/2008	NSW Forests
Madeline Osborn, PhD	The role of fungi in fire prone forest communities	complete	Employed by Dept Ag, FIsheries and Forests, ACT
Francesca Harris-Spence, PhD	Catchment management groups – volunteer community organisations and bushfire management	6/2008	Employed by Dept Ag, Fisheries and Forests, ACT
Alan Rhodes, PhD	Evaluation of the stay or go policy and community preparedness	2008	Employed by CFA
Phil Zylstra, PhD	Plant species contributions to fire intensity – towards a total fuels model	11/2008	Working in fire management Cooma – NSW NPWS–DECC
Rohan Sadler, PhD	Long term monitoring & modelling in quantifying the role of fire in grasslands	complete	Working at UWA – Research Associate
Brendan Pippen, PhD	Predicting factors affecting fire behaviour in heathland vegetation.	complete	Employed by Great Southern Plantations
Annemarie De Vos, PhD	Health effects of occupational exposure to bushfire smoke in WA	complete	Employed by Asthma CRC
Karyn Bosomworth, PhD	Does current bushfire risk management policy and practice support community and natural resource resilience to climate change?	2009	Employed at DSE – VIC
Adam Leavesley, PhD	Impact of fire mosaic on birds in mulga woodlands of central Australia.	complete	Employed at Bushfires NT
Paul Fox Hughes, Ma	A meteorological investigation of the "springtime bump" in Tasmania.	2009	Employed at the Bureau of Meteorology, Tasmania
Laura Kelly, Ma	Community resilience to and recovery from wildfire in New Zealand	complete	Working in the UK
Rob De Ligt, Hons	Determining the risk profile for unplanned fires in the Sydney region	complete	Employed at ANU with Geoff Cary
Josh Whittaker, PhD	Adaptive capacity and social resilience to bushfires in Southeast Australia	complete	Employed at RMIT – fire & emergency management policy
Luke Balcombe, Ma	The perceptions of bushfire hazard in urban fringe areas of tropical Australia	complete	Employed as environmental scientist in private firm. And undertaking a PhD, Griffith University
Bevan McBeth, PhD	Soil, fire & physiological processes & dieback in coastal eucalypt forests	2009	Employed at Southern Cross University

Sonia Whiteley, PhD	Preparing for the worst: measuring the outcomes of community bushfire safety programs	2009	Employed at the Department of Justice, VIC
Meaghan Jenkins, PhD	Carbon budgets and implications for fuel load and flammability of shrub-dominated ecosystems in the high country	2009	Will likely be offered post doc at USYD pending CRC funding

Scholarship holders seeking employment on completion

Student	Project	Completion date	Supervisor
Tim Prior, PhD	Community responses to bushfire threat	12/2008	Prof. Douglas Paton UTAS
Jaymie Norris, PhD	Microbial clues for ecological sustainable management of fire prone landscapes	10/2008	Dr Pauline Grierson UWA
Mae Proudley, Ma	Reducing bushfire risk through improved household decision making	09/2008	Prof. John Handmer Also working with bushfire agency in Victoria
Ken Scott, PhD	Fire & savannah grass ecology	complete	Seeking work in natural resource (NT, QLD) or ecological research
Matt Phillips, PhD	Physiological demands of Australian volunteer firefighters during bushfire suppression	12/2008	Dr Brad Aisbett, Deakin
Kerryn McTaggart, PhD	The effect of fire on soil microbial populations and their processes in Australian alpine ecosystems	2009	Dr Tina Bell Uni Melb,
Andrew Edwards, PhD	An alogorithm for mapping burn severity from satellite remote sensing: tropical savannahs, northern Australia	2009	Dr Lindsay Hutley CDU
Lyndsey Vivian, PhD	Determinants of variation in fire response types in the composition of montane plant communities	2009	Dr Geoff Cary ANU
Bryony Horton, PhD	Fire management and tree decline: mycorrhizal indicators of declining forest health	2009	Dr Neil Davidson UTAS
Carola Kuramotto de Bednarik, PhD	Relative importance of fir regimes, environmental gradients and climate change for rainforest distribution in the Sydney region	2009	Dr Geoff Cary ANU
Alison O'Donnell, PhD	Fire patterns and vegetation structure in semi-arid south-east western Australia	2009	Dr Lachie McCaw and Dr Pauline Grierson
Rowena Morris, PhD	The effect of prescribed burning on sediment movement in the Mt Lofty Ranges	2009	Dr Meredith Henderson SA DEH
Anne Miehs, PhD	The role of coarse woody debris in fire-prone forests: Achieving both fire management and conservation objectives	2009	Dr Alan Yo rk Uni Melb

Briony Towers, PhD	Developmental perspective on bushfire risk communication	2009	Prof Douglas Paton UTAS
Sean Cowlishaw, PhD	Effects of Fire Service Volunteering on families of volunteers	2009	Dr Jim McLennan La Trobe
Claire Johnston, PhD	Worst Case Scenarios: their role in safe decision making in bushfire fighting	2009	Dr Mary Omodei La Trobe
Dane Hansen, PhD	Characterisation of the volatile organic components adsorbed to particulates generated in bushfires	2009	Dr Fabienne Reisen CSIRO
Ian Dwyer, PhD	Communication strategies and collaborative work practices in high-reliability workplaces: A study of coordination centres	2009	Dr Christine Owen UTAS
Greg Hickey, PhD	Enhancing effective multi-agency operations	2009	Dr Christine Owen UTAS
Julian Black, PhD	Predicting the dynamic spatial pattern of fire front progress and fire destruction in the rural urban interface zone	2009	Dr Raphaele Blanchi, CSIRO
Christine Eriksen, PhD	Local environmental knowledge of bushfire management: a case study of new rural landscapes in NSW	2010	Dr Nicholas Gill, UOW
Jennifer Hollis, PhD	Coarse woody fuel availability and consumption in Australian forest fires	2010	Dr Lachie McCaw, DEC
Annette Salter, PhD	Applications of multi-media education strategies in fire behaviour	2010	Dr Christine Owen UTAS
Peter Hayes, PhD	Do teams that have worked together make better teams?	2010	Dr Mary Omodei La Trobe
Jenni Raines, PhD	Fatigue and recovery in rural Australian Bushfires	2010	Dr Brad Aisbett, Deakin

Appendix B

Education: Formal Courses

Bushfire CRC researchers play major role in bushfire course at Australian National University

Researchers and graduate students from the Bushfire CRC recently contributed to the Australian National University's "Fire in the Environment" course coordinated by Dr Geoff Cary of the Fenner School of Environment & Society. Similar arrangements over the last four years have seen Bushfire CRC research outputs presented directly to a large number of fire managers, researchers and policy makers of the future. The Fenner School gratefully acknowledges the invaluable contributions of Bushfire CRC researchers in this ongoing collaborative learning arrangement.

This year's Bushfire CRC presenters in the ANU "Fire in the Environment" course included:

Presenter	Topic
Dr Malcolm Gill	Bushfires in Australian life and landscapes
Lyndsey Vivan	Fire response of plant species
Mr Adam Leavesley	Ecology of fire mosaics
Ms Carola Kuramotto	Fire, climate change and biota
Dr Karen King	Landscape scale-modelling of fire risk
Prof. Ross Bradstock	Prescribed burning and integrated risk management
Mr Jim Gould	Project Vesta
Dr Matt Plucinski	Bushfire suppression research
Dr Colleen Bryant	Arson research
Prof. Steve Dovers	Policy and fire disasters
Dr Geoff Cary	Fire ecology, fuel dynamics, fire and climate change. Simulation models of fire regimes and biota etc.

For further information on ANU bushfire course see: http://studyat.anu.edu.au/courses/SRES3008;details.html

Appendix C: Financial Report

PITCHER PARTNERS

AUDITORS REPORT TO
THE COOPERATIVE RESEARCH CENTRES PROGRAM
DEPARTMENT OF EDUCATION, SCIENCE AND TRAINING
REPRESENTING THE COMMONWEALTH
IN RESPECT OF THE
BUSHFIRE CRC

FINANCIAL INFORMATION FOR THE YEAR ENDED 30 JUNE 2008

Scope

We have audited the financial information of the Bushfire CRC as set out in Tables 1 to 3 of the Annual Report for the financial year ended 30 June 2008. The parties to the Cooperative Research Centre are responsible for the preparation and presentation of the financial information. We have conducted an independent audit of the financial information in order to express an opinion on it to the parties to the Bushfire Cooperative Research Centre.

The financial information has been prepared on a cash basis for the parties to the Bushfire Cooperative Research Centre for the purposes of fulfilling their annual reporting obligations under clause 13 (2) of the Commonwealth Agreement and for distribution to the Cooperative Research Centres Program, Department of Education, Science and Training, representing the Commonwealth of Australia. We disclaim any assumption of responsibility for any reliance on this report or on the financial information to which it relates to any person other than those mentioned above, or for any purpose other than that for which it was prepared.

Our audit has been conducted in accordance with Australian Auditing Standards to provide reasonable assurance as to whether the financial information is free of material misstatement. Our procedures include examination, on a test basis, of evidence supporting the amounts and other disclosures in the financial information, and the evaluation of accounting policies and significant accounting estimates. These procedures have been undertaken to form an opinion as to whether, in all material respects, the financial information is presented fairly in accordance with Australian accounting concepts and standards and requirements of the Commonwealth Agreement in terms of Clauses 4 (Contributions), 5(1), 5(2), 5(3) (Application of the Grant and Contributions), 9(1), (Intellectual Property), and 7(1), 7(2), 7(3) (Financial Provisions), so as to present a view of the sources of funding and the application of funding of the Bushfire CRC, and the application of which is consistent with our understanding of its financial activities during the year and its financial position.

While we have not performed any procedures upon the estimates for the next period and do not express any opinion, thereon, we ascertained that they have been formally approved by the Commonwealth as required under the Agreement.

The audit opinion expressed in this report has been formed on the above basis.

Audit Opinion

1. The multipliers adopted by the Centre to value in-kind contributions other than salary costs have a sound and reasonable basis and each partner's component of the Researcher's Contributions for the year under report has been provided at least to the value for that year committed in the Budget as specified in the Agreement, with the following exceptions:

In Kind Contributions

Organisation	Amount Committed ($'000s)	Amount Provided ($'000s)
Core Participants		
Emergency Management Australia	186	41
Forest and Ecosystem Science Institute	1,622	1,060
Queensland Fire and Rescue Service	128	127
Tasmanian Government	181	139
WA Fire and Emergency Services	175	43
University of Tasmania	287	228
Supporting Participants		
ACT Emergency Services Bureau	33	0
South Australian Meteropolitan Fire Service	65	0

2. The total value of all Contributions for the year under report equalled or exceeded the amount of grant paid during the year (not including advances).

3. The Researcher has used the Grant and the Researcher's Contributions solely for the Activities of the Centre and in our professional opinion there appear to be no material reporting irregularities.

4. The Researcher's allocations of the budgetary resources between Heads of Expenditure that has been lower or higher than the allocation in the budget by $100,000 or 20% (whichever is the greater amount) without prior approval by the Commonwealth are detailed below.

Organisation	Amount Committed ($'000s)	Amount Provided ($'000s)
Bureau of Meteorology		
- Salaries	831.0	336.0
- Capital	0.0	200.0
- Other	283.0	213.0
CSIRO		
- Salaries	783.0	347.0
- Capital	0.0	30.0
- Other	1,455.0	672.0
Emergency Management Australia		
- Salaries	22.0	88.0
- Other	19.0	98.0
Forest and Ecosystem Science Institute		
- Salaries	271.0	357.0
- Other	789.0	1,265.0
Melbourne Metropolitan Fire and Emergency Services Board		
- Salaries	203.0	276.0
- Other	440.0	220.0
NSW Department of Environment & Climate Change		
- Salaries	96.0	62.0
- Other	59.0	30.0
NSW Fire Brigades		
- Salaries	128.0	98.0
- Other	78.0	49.0

NSW Rural Fire Authority		
- Capital	0.0	17.0
- Other	110.0	77.0
Queensland Fire and Rescue Service		
- Salaries	61.0	85.0
- Other	66.0	43.0
Tasmanian Government		
- Salaries	58.0	88.0
University of New South Wales		
- Salaries	93.0	124.0
- Other	872.0	172.0
University of Tasmania		
- Salaries	113.0	76.0
- Other	115.0	211.0
University of Western Australia		
- Salaries	0.0	119.0
- Other	474.0	349.0
Victorian Department of Sustainability and Environment		
- Salaries	123.0	36.0
- Other	171.0	28.0
Victorian Country Fire Authority		
- Salaries	194.0	68.0
- Capital	0.0	69.0
- Other	180.0	63.0
WA Department of Conservation & Land Management		
- Salaries	249.0	134.0
- Other	492.0	265.0
WA Fire and Emergency Service		
- Salaries	22.0	100.0
- Other	21.0	75.0

Supporting Participants

ACT Emergency Services Bureau		
- Salaries	0.0	18.0
- Other	0.0	15.0
Australian National University		
- Other	151.0	101.0
Charles Darwin University		
- Salaries	0.0	16.0
- Other	42.0	25.0
Country Fire Services of South Australia		
- Salaries	23.0	0.0
- Other	98.0	0.0
Forest Research New Zealand		
- Salaries	671.0	125.0
- Other	0.0	220.0
James Cook University		
- Other	459.0	307.0
La Trobe University		
- Salaries	0.0	71.0
- Other	1362.0	726.0
Royal Melbourne Institute of Technology		
- Salaries	185.0	79.0
- Other	901.0	314.0
South Australian Department of Environment and Hertiage		
- Salaries	210.0	18.0
- Other	148.0	15.0
South Australian Metropolitan Fire Service		
- Salaries	0.0	36.0
- Other	0.0	29.0
The ACT Department of Justice and Community Safety		
- Salaries	57.0	13.0
- Other	76.0	7.0

PITCHER PARTNERS

5. Capital Items acquired from the Grant and Researcher's Contributions are vested as provided in the Agreement.

6. Intellectual Property in all Contract Material is vested as provided in the Agreement and no Intellectual Property has been assigned or licensed without the prior approval of the Commonwealth.

7. Proper accounting standards and controls have been exercised in respect of the Grant and Researcher's Contributions and income and expenditure in relation to the Activities of the Centre have been recorded separately from other transactions of the Researcher.

8. The Annual Report is prepared on a cash basis.

Dated at Melbourne this 23 day of October 2008

Pitcher Partners

PITCHER PARTNERS

G E WALSH
Partner

Glossary of terms

ACTEW	ACT Energy, Water and Wastewater Services
ADFA	Australian Defence Force Academy
AFAC	Australasian Fire and Emergency Service Authorities Council
AIC	Australian Institute of Criminology
AIIMS	Australasian Inter-Service Incident Management System
ANU	Australian National University
BOM	Bureau of Meteorology
CFA	Country Fire Authority Victoria
CFS	Country Fire Service South Australia
COAG	Council of Australian Governments
CSIRO	Commonwealth Scientific Industrial Research Organisation
DEC	Department of Environment and Conservation WA
DECC	Department of Environment and Climate Change
DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment Victoria
EMA	Emergency Management Australia
ESA	ACT Emergency Services Agency
FESA	Fire and Emergency Services Authority WA
IMT	Incident Management Team
JCU	James Cook University
MFB	Metropolitan Fire Brigades
RFS	Rural Fire Service NSW
RMIT	RMIT University
SCU	Southern Cross University
TFS	Tasmania Fire Service
USDA-FS	US Department of Agriculture – Forest Service
UWA	University of Western Australia

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