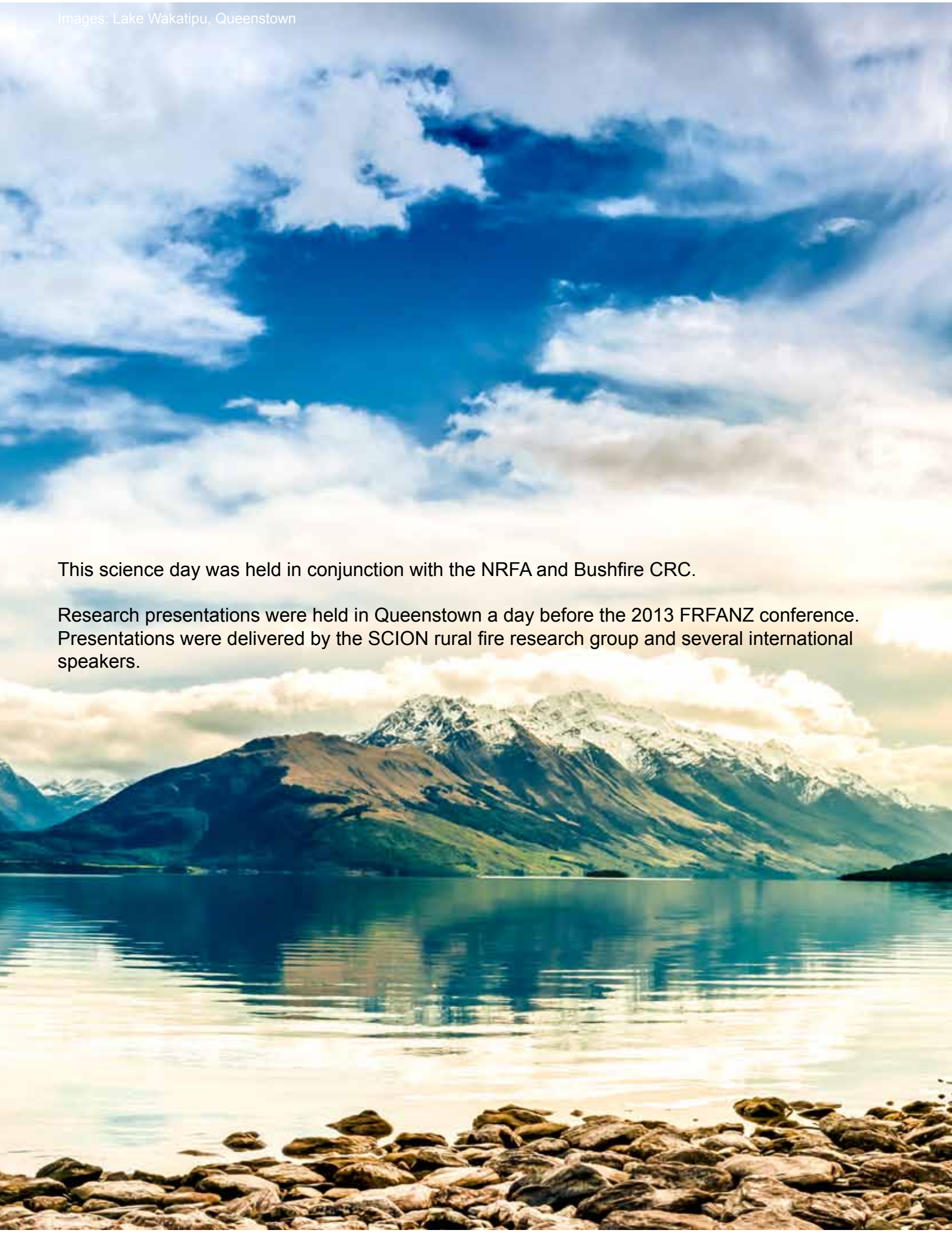
Pre-FRFANZ Science Day
Proceedings

Milennium Hotel, Queenstown
Tuesday, 30 July 2013

WWW.SCIONRESEARCH.COM/FIRE



Images: Lake Wakatipu, Queenstown

This science day was held in conjunction with the NRFA and Bushfire CRC.

Research presentations were held in Queenstown a day before the 2013 FRFANZ conference. Presentations were delivered by the SCION rural fire research group and several international speakers.

Contents

Scion, Bushfire CRC & NRFA Science Day

9:00 - 16:30, Tuesday 30 July 2013
Millennium Hotel – Queenstown

Science Day Program:

Time		Presenter	Topic
9:00	9:15	Murray Dudfield (NRFA) / Gary Morgan (BFCRC) / Richard Parker (Scion)	Welcome & Introduction
9:15	10:00	Ruth Beilin (Uni of Melbourne & BFCRC)	The social construction of fire and fuel: locating resilience, home, memory and risk in the landscape
10:00	10:30		
10:30	11:00	Karen Bayne (Scion)	Fire as a Land Management Tool: pilot interview findings
11:00	11:30	Veronica Clifford (Scion)	Fire hazard in wilding conifers
11:30	12:00	Tara Strand (Scion)	Development of an Australasian "BlueSky" smoke modelling framework
12:00	12:45		
12:45	13:45	Chris Bearman (C.Qld Uni &BFCRC)	Negotiating the safety space during major fire events: breakdowns and coping ugly
13:45	14:15	Dave Thomas (Renoveling, USA)	Perspective on NZ fire manager "Deep Smarts" interviews
14:15	14:45	Richard Parker (Scion)	Potential applications of UAVs in rural fire
14:45	15:15		
15:15	16:00	Liam Fogarty (DEPI, Vic)	Role of science in reducing uncertainty & achieving better bushfire risk management
16:00	16:30	Richard Thornton (BNHCRC)	New Bushfires & Natural Hazards CRC
16:30	16:35	Murray Dudfield (NRFA)	Closing

This science day is directly followed by the 2013 FRFANZ CONFERENCE

Also held at the Millennium Hotel, Queenstown
Tuesday 30th July – Friday 2nd August

Visit for details: http://www.frfanz.org.nz

ABSTRACT only

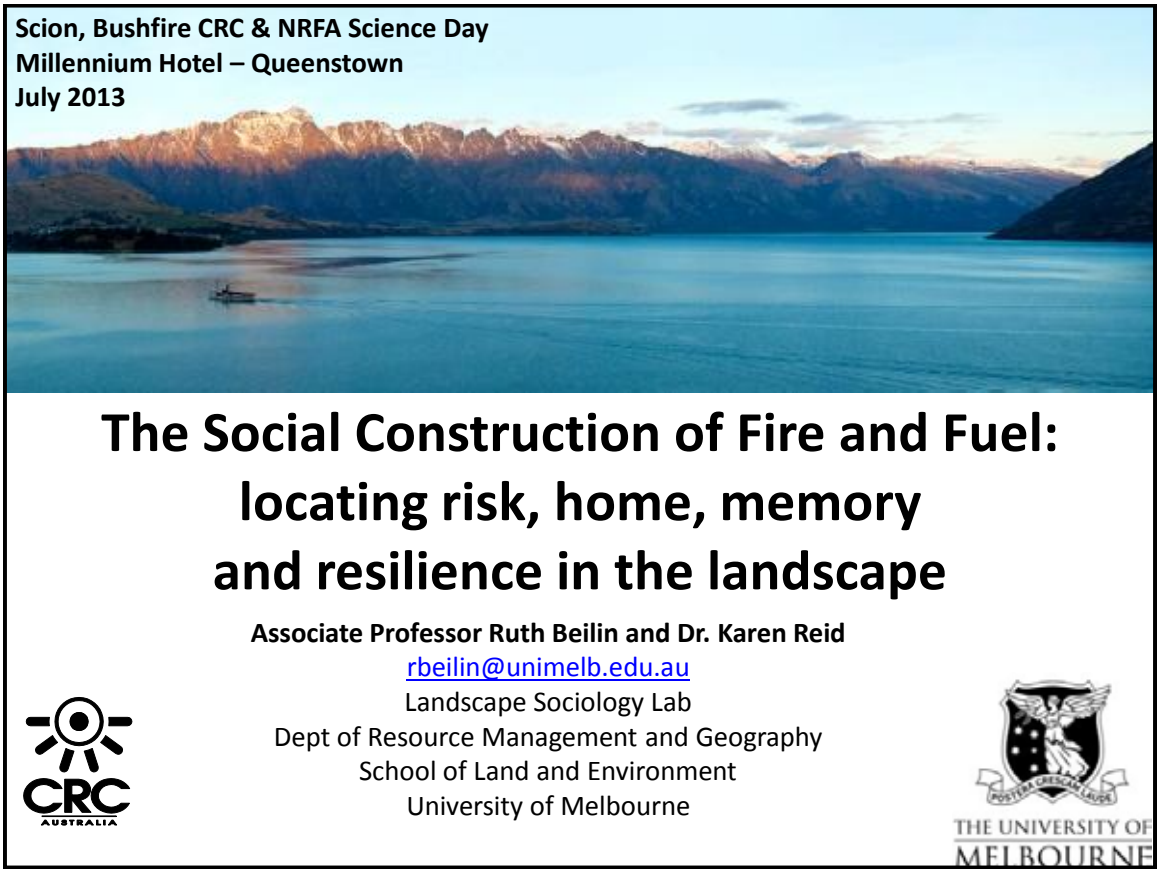
Ruth Beilin

University of Melbourne & BFCRC

Presentation title: The Social Construction of Fire and Fuel: Locating Resilience, Home, Memory and Risk in the Landscape

In 2010 the Landscape Sociology lab began researching the social construction of fire and fuel in the non-urban landscape. We began with a small project in Hall's Gap Victoria about the non-compliance of residents on a 'catastrophic' fire day. The results led to an ARC on the integration of fire science into the everyday implementation of this knowledge as part of regional Strategic Partnerships and Fire Risk Landscape planning and practice.

With the Bushfire CRC, we were offered a discrete two year, one postdoctoral research funded position to pursue this area in particularly risk prone areas. The SCION presentation builds on these projects to consider how ideas about resilience, home (assets), and how local understandings of the way social and ecological memory influence decision making can connect with managing fire risk in these landscapes.



Want to know more?
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Karen Bayne
Scion

Fire as a land management tool – pilot interviews

Karen Bayne, Brenda Baillie, Veronica Clifford, Grant Pearce

Fire use in the rural landscape

- Useful tool
  - Maintain productive ecosystem
  - Manage fuel loads
  - Clear debris and rubbish
  - Sterilise soil pathogens
- Some concerns around the practice:
  - Regulatory hurdles and increasing liability
  - Knowledge and experience level
  - Impacts from land use change
  - Environmental concerns
- Lack of defined national guidelines or protocols as to safe and effective practice

Why the need for guidelines?

- No formal overview
- Extent of risk not well understood
  - Extent of burning
  - Types of burning undertaken, and WHY
  - Likely change in burning practice, and drivers

Aims and objectives

- Quantify and qualify rural fire use practices
- Better understand and identify risks and benefits
- Determine drivers for and against fire use
- Establish best practice guidelines
- Guide further research to improve safe, sustainable and effective fire-use practices

National survey of use of fire as a land management tool

Pilot interviews

- Interviewed 18 stakeholders – RFO; rural sector (farmers, horticulturalists, foresters); Govt agencies (DoC; NZDF; MPI); Lobby groups and LG (Councils)
- Asked about:
  - When and where fire was used to manage land
  - Alternative options available
  - Perceptions about the benefits and risks of using fire; and using alternative options
  - Experiences (positive and negative) with using fire
  - Changes in rural fire use over time

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Where and why fire is used

RURAL CLEAN UP
-Hedge clippings and green waste
- Stump removal
- Offal and rubbish pits
- Hedgerow removal for dairying
- Orchard pruning

Why burn?
- Amenity
- Convenience
- Sanitation and disease
- Extremely cost effective

Re-ignition
Smoke hazards

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CAMPFIRES AND BONFIRES
- Cooking; Heating
- Ambience/ social
- Fuel reduction

Alcohol consumption
Unattended fires/ not-extinguished properly
Remote areas
Near vulnerable ecosystems (sand dunes/ DoC reserves)

HIGH COUNTRY

Controlling rank feed
Regenerates seed
Opening up pastureland
Reducing fuel loads

Escape into vulnerable areas (DoC; lifestyle blocks)
Resident and tourism perceptions of burnt area and smoke
Moving fire

Killing soil pathogens
Quick and effective
Regenerates seed
Low risk of escape

CROP STUBBLE

Re-ignition with wind change
Resident and tourism perceptions of smoke
Moving fire

FROST POTS
- Warming air – diesel
- Energy efficient means
- Minimal fire risk

MARGINAL SCRUBLAND
- Cost effective over spray
- Regenerate grazing areas
- Controlling heavy infestations
- Lack of accessibility (steep gullies etc)

Deviating from proposed path - escape
Perception of high fuel load

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Alternative options

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Situations where fire is no longer used

- **Agricultural cropping**
  - Organic matter considered better than ash
  - Burning may lose soil nutrients and expose topsoil to wind erosion
  - Pathogen spraying
  - Technology advances – direct drilling

Contributing factors – successful burning

Common themes

Good relations

•Proactively working with rural sectors to plan burns
•Joint training sessions
•RFO knowledge of locals and their experience level with fire
•Up-skilling of landowners

Flexibility

• Flexibility and pragmatism around fire use- both ways
•Encouraging landowners to take turns conducting burns
•Delaying non-urgent burning until conditions are right

Preparedness and resourcing

•Burn plans followed
•RFO site visits
•RFO experience of large escape fires
•Having equipment of hand
•Taking preventative measures so not needing to burn as much, or as often

Contributing factors – escape burning

Common themes

Lack of planning and foresight

•Inadequate equipment used
•Lack of communication with neighbours and RFO
•Inadequate firebreaks
•Reactive rather than proactive planning
•Not reporting fire, or trying to deal with it yourself

Lack of respect for fire

• Inexperienced landowners
•Limited experience and training of rural fire sector
•Seeing fire as innocuous, or a panacea
•Lack of ownership when fire escapes
•Repeat offenders – 'idiots'

Lack of fire experience

• Burning green trimmings
• Burning wrong fuel types
• Illegally burning
• Not ensuring fire is out-inadequate dousing
• Newcomers to district

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National survey instrument

- Determine state of knowledge surrounding fire impacts on the landscape – lit review
- Online survey
- Targetting four key audiences:
  - Rural productive landowners
  - Rural residents (non-productive landowners)
  - Policymakers or local authorities
  - Rural fire officers
- Aiming to marry perception and fact, where possible; and identify areas where differences in perceived risks and benefit are present

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Survey scope – Rural land owners

- Description of land
- Land operations undertaken
- Use / non-use of fire to undertake land operations
- Attitudes towards use of fire for land operations
- Extent of burning
- Confidence in using fire to manage land
- Impacts from the use of fire – [perceived good and bad impacts]
- Level of risk associated with fire use
- Major concerns regarding increased/ decreased use of fire
- Perceived ways to reduce the risk of wildfire
- Changes in fire use over time

Survey scope – Rural residents

- Awareness of fire use in local district
- Individual use of fire on their property
- Lifestyle impact from use of rural fire
- Attitudes towards use of fire for land operations
- Level of risk associated with fire use
- Major concerns regarding increased/ decreased use of fire in their district
- Changes in fire use over time

Survey scope – Policymakers and RFA

- Land operations undertaken in RFA area
- Extent of prescribed burning
- Types of prescribed burning undertaken in RFA
- Extent of escape fires and contributing factors
- Attitudes towards use of fire for land operations
- Perceived long term impacts from prescribed fire
- Perceived level of risk associated with use of rural fire
- Impacts from the use of fire – [perceived good and bad impacts]
- Major concerns regarding increased/ decreased use of fire
- Perceived ways to reduce the risk of wildfire
- Changes in fire use over time

National survey

- Instrument piloted with small advisory group of 8 stakeholders
- Planning to distribute survey in stages over next 12 months
  - Regions
  - Land operations
  - Stakeholder groups
- Preliminary results will be disseminated - dialogue welcome!
- Collaborative efforts welcome!

Acknowledgements

- Thanks to all those involved to date!
- NRFA; DoC; NZDF; Fed Farmers
- MBIE as funders

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Want to know more?
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Veronica Clifford
Scion

Wilding fire hazard

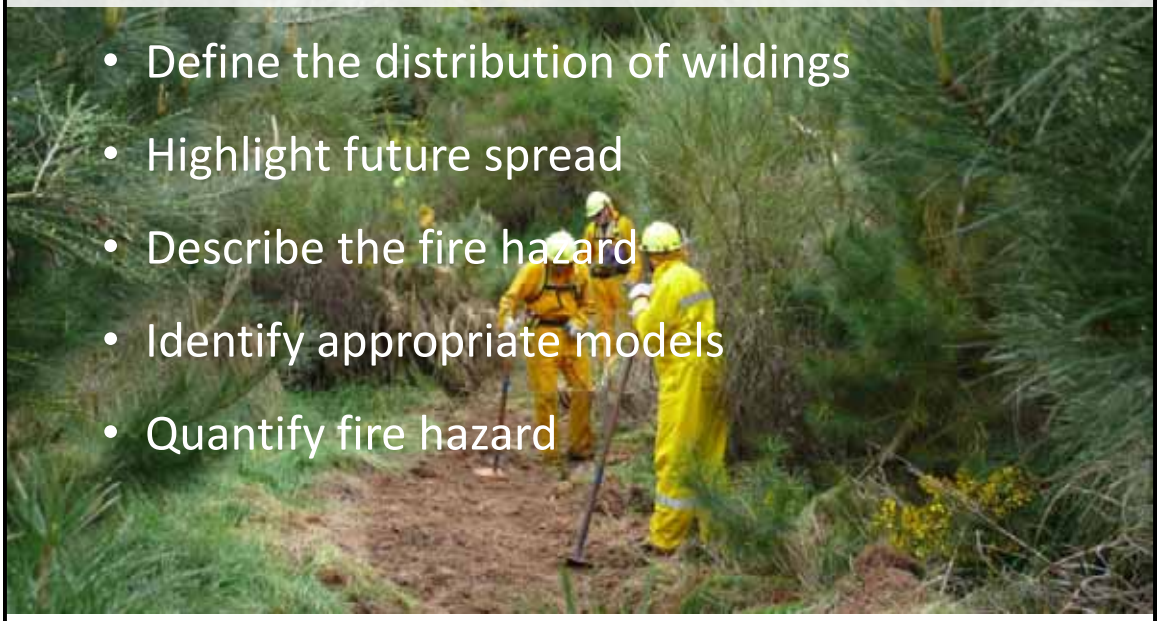
Science Day, Queenstown, 2013

Veronica Clifford, Scion Rural Fire Research

Introduction

- Presence of wildings has implications
- The perception is that wildings increase the hazard
- Lack of studies on wilding fire hazard
- Much less is known on fuel loads & fire behaviour
- Case study identified current models not suitable

Objectives:

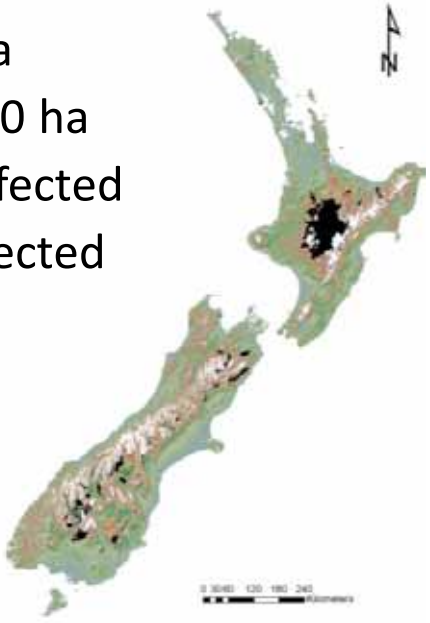


- Define the distribution of wildings
- Highlight future spread
- Describe the fire hazard
- Identify appropriate models
- Quantify fire hazard

Current extent

- Wildings cover ~ 320,000 ha
- Dense forests cover ~ 16,000 ha
- 180,000 ha of grasslands affected
- 81,000 ha of scrublands affected

- In past 10 years:
  an increase for the south,
  an decrease for the north



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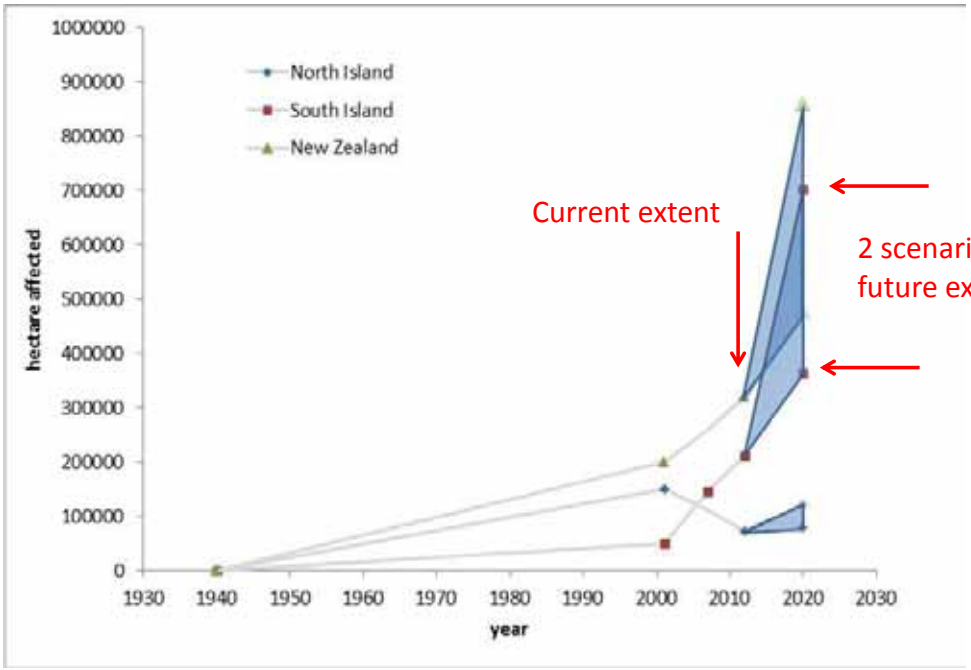
Future extent



Identifying fire hazard stages

- We identified nine fuel stages

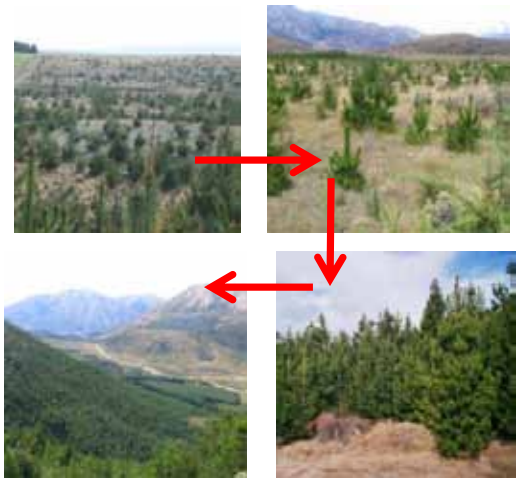
Identifying suitable models

Summary Table of suitable international models for fire behavior in wildings.

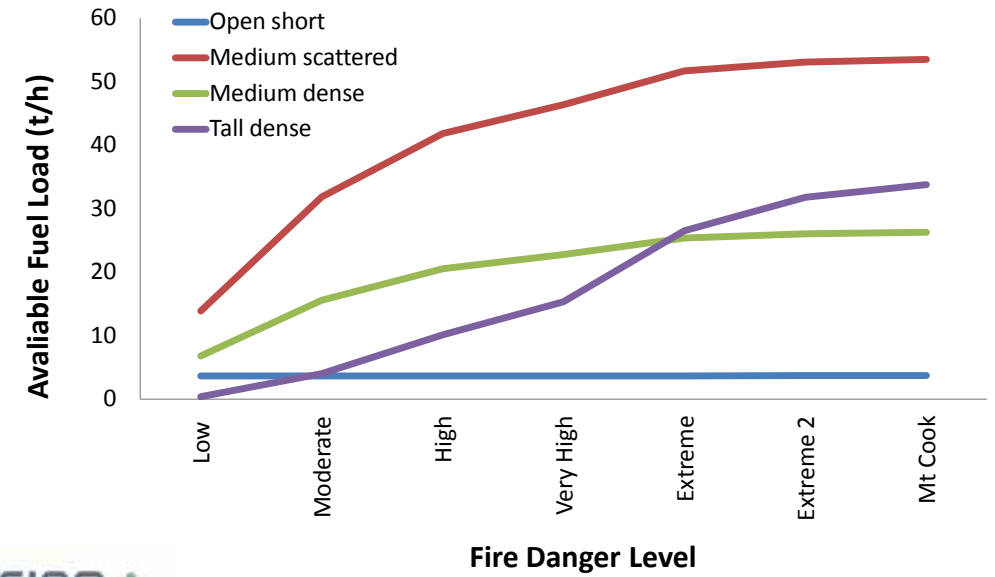
Fuel model	AFL	ROS	Intensity
Open grassland with short scattered seedlings:			
Ungrazed pasture NZ – Pearce et al. (2012)	light	extremely fast	very high
O-1b: Natural standing grass Canada - FCFDG (1992)	light	extremely fast	very high
PRAD 01: First Rotation (0-3 yrs) Australia - Cruz, de Mar et al. (2011).	moderate	extremely fast	extreme
Fire behaviour fuel model 2 US - Anderson (1982)	moderate	extremely fast	extreme
Short dense stands seedlings:			
Immature pine, age 1-4 (1st rot.) NZ – Pearce et al. (2012)	light	extremely fast	very high
Fire behaviour fuel model 5 US - Anderson (1982)	moderate	moderate	moderate
Medium height, scattered stands:			
Immature pine, age 1-4 (1st rot.) NZ – Pearce et al. (2012)	light	extremely fast	very high

Fire Hazard Scenario

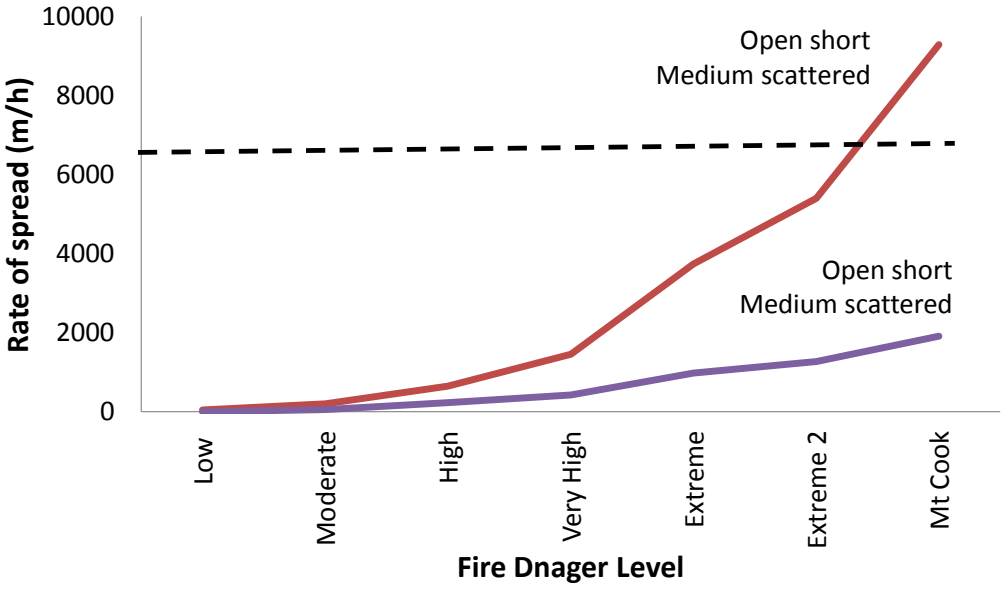
Fire Danger level	ISI	BUI	DoC %
Low	2	10	52
Moderate	5	30	65
High	9	50	70
Very high	12	65	80
Extreme	20	100	90
Extreme 2	25	120	95
Mt Cook 2008	56	129	90



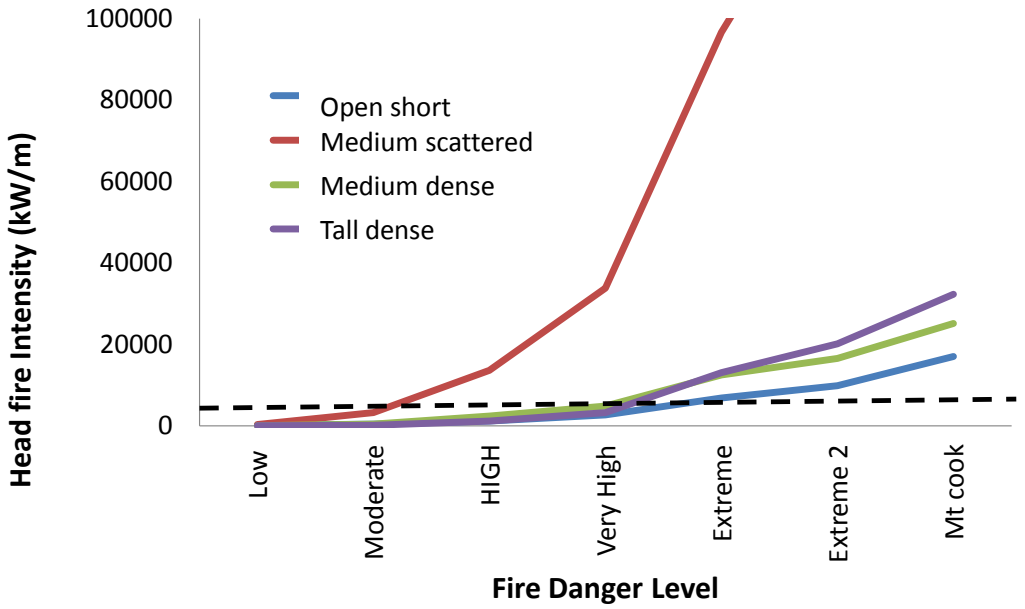
Wilding fire behaviour - AFL



Wilding fire behaviour - ROS



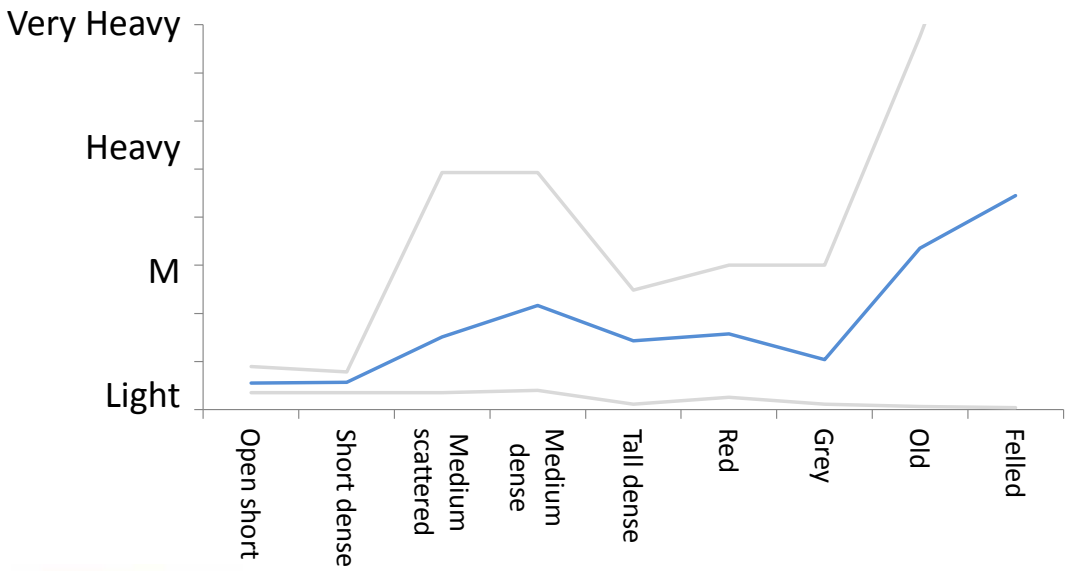
Wilding fire behaviour - Intensity



Transition of fire hazard:

- Scenario created using extreme conditions to illustrate potential changes in fire hazard
- This time we used both NZ and international models for each fuel stage
- Conversions for different weather & fuel moisture measurements
- Change in hazard using extreme fire danger class

Transition of fire hazard - AFL



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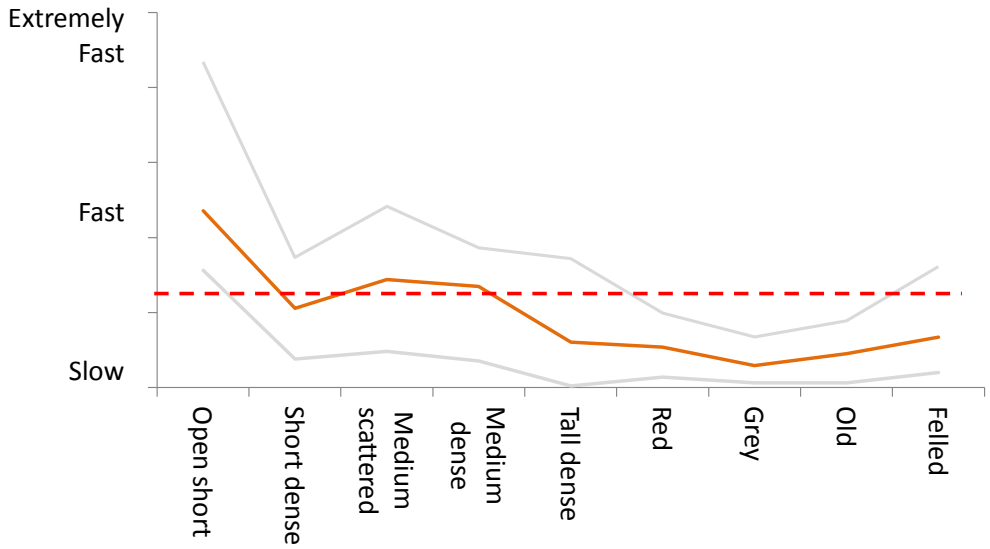
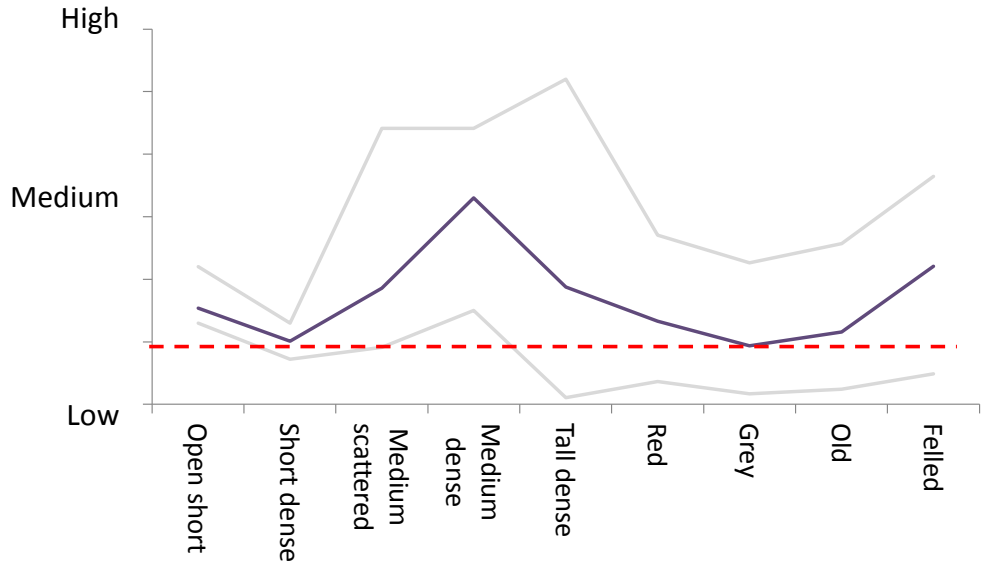
Transition of fire hazard - ROS



Transition of fire hazard - Intensity



Future work

- Better understanding of current & future spread
- A way forward for predicting fire hazard
- Recommendations:
  - Validate with ground truthing & remote sensing
  - Develop new models - Collecting fuel data (moisture and loading) and fire behaviour observations
  - Or utilise existing models and reverse engineer

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Future work

Goal:

- New wilding fire behaviour models incorporated into the fire behaviour tools

Want to know more?
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Tara Strand
Scion

Fire and smoke tools: their uses

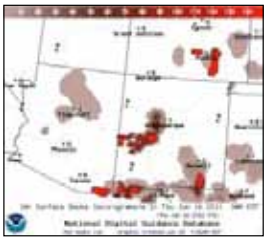
Real-Time	Retrospective	Future
• Managing a burn – what is happening? • Lighting a burn – what will happen? • Managing an airshed – what is/will happen?	• Case studies – Diagnosing an event – What caused the incident?	• Near-term Planning – Wildfire resource placement • Long-term Planning - Climate what if

Several types of smoke tools possible

- Modelling Framework is the computation 'engine' that allows for several types of tools

Google earth fire location and smoke

Impact blobs



Threshold smoke shades

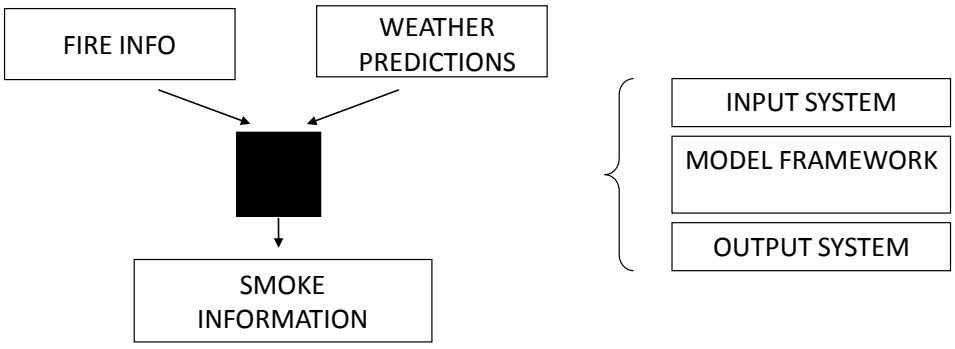
Expert smoke interpretation for media release

What is needed

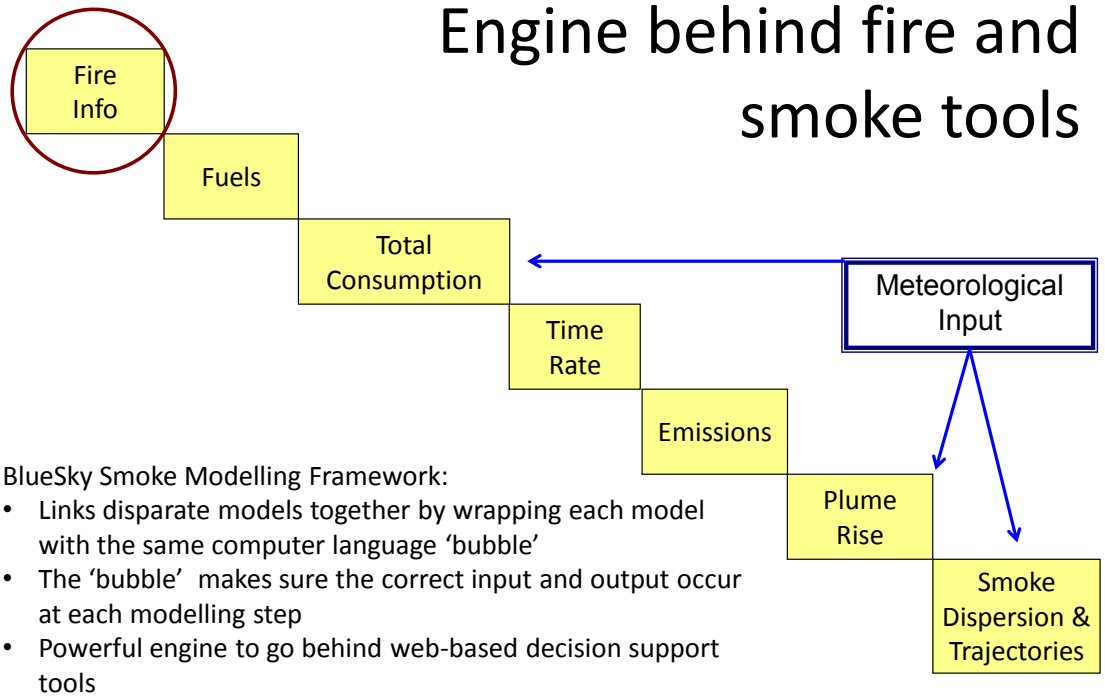
Key pieces of information

Real-time wildfire information (location, size)

Daily weather predictions



Engine behind fire and smoke tools



BlueSky Smoke Modelling Framework:

- Links disparate models together by wrapping each model with the same computer language 'bubble'
- The 'bubble' makes sure the correct input and output occur at each modelling step
- Powerful engine to go behind web-based decision support tools

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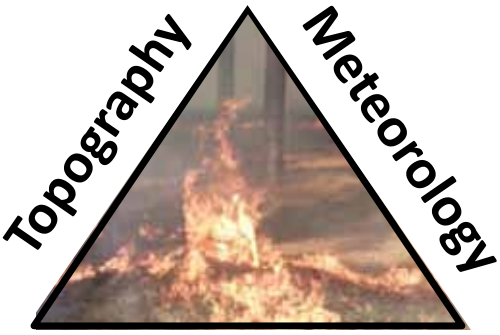
The fire environment



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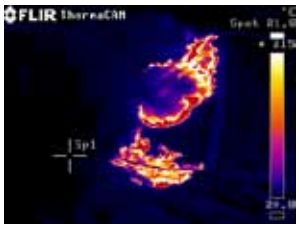
Fire and smoke: fuels



Fuel type, arrangement, and moisture influences fire intensity, which determines the type (i.e., CO_2, CO) and quantity (i.e., particulates) of smoke emissions

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Fire and smoke: meteorology

Plume rise is coupled to fire intensity, fire induced meteorology and surrounding meteorology

Plume rise places the smoke in a transport layer, the layers vary in wind speed and direction and move the smoke away from the fire

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Fire and smoke: terrain

Terrain (slope, aspect) influences the quantity of energy available during a fire

Terrain facilitates atmosphere and fuel energy sources and plume rise/collapsing

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Terrain: Valley flows and smoke transport layers

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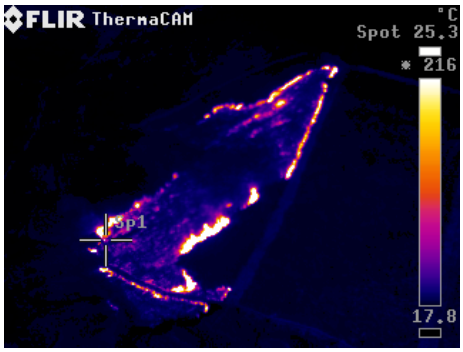
Smoke and fire behaviour are linked



Photos from NZ Fire behavior experiments in Shrubland Fuels (FuSE) research burns.

Fire shape, rate of spread, and heat intensity all contribute to smoke plume shape, rise, and transport characteristics.

Understanding near-fire smoke behavior is necessary for model development for useful NZ smoke tools.

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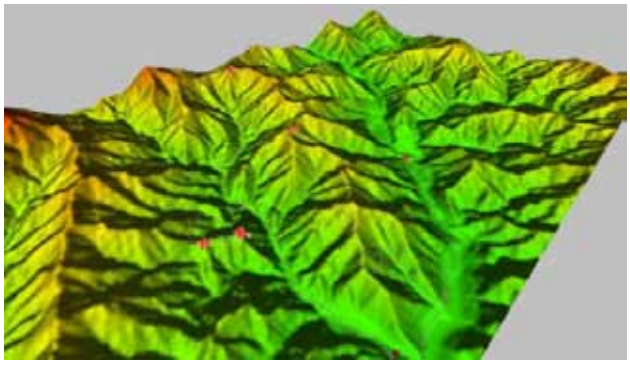
Research burn: looking at fire and smoke



Designed to measure fire behaviour and smoke plume development

- Obtaining data to correlate fire spread to smoke plume behaviour
- Fuel type and rate of spread
- Testing field design

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Research burn: Fuels and smoke

- Moisture changed throughout the day leading to a variety of smoke plume types
- Did not supply strong amount of energy

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Research burn: Terrain and smoke

- Facilitated plume rise and sinking into the valley
- Allowed for hot cores to merge
- Created interesting flow fields (smoke funnel)

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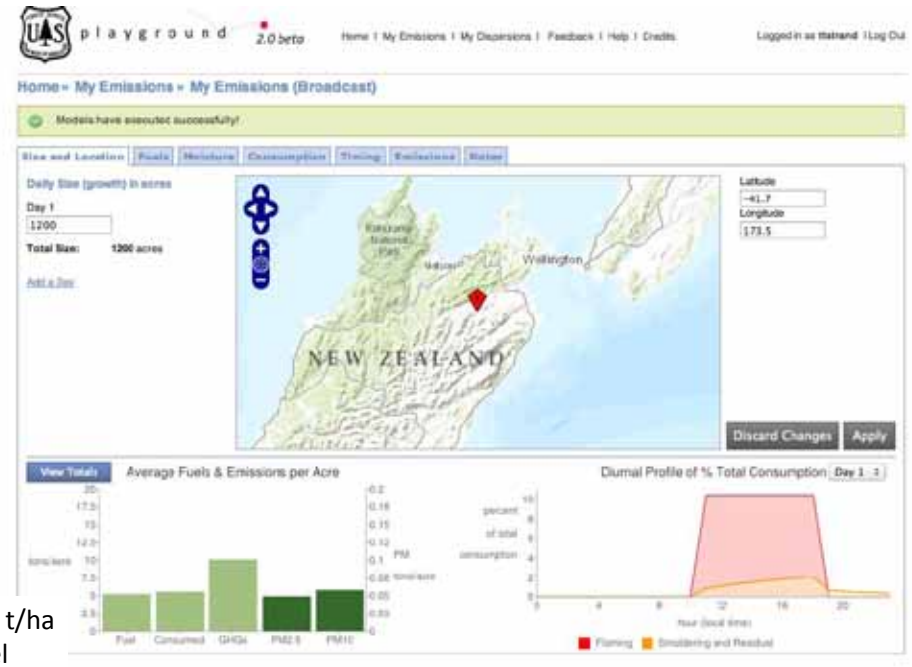
Research burn: Atmosphere and smoke

- Supressive atmosphere
- No energgy added to fire
- Outside of hot spot plume tended to sink

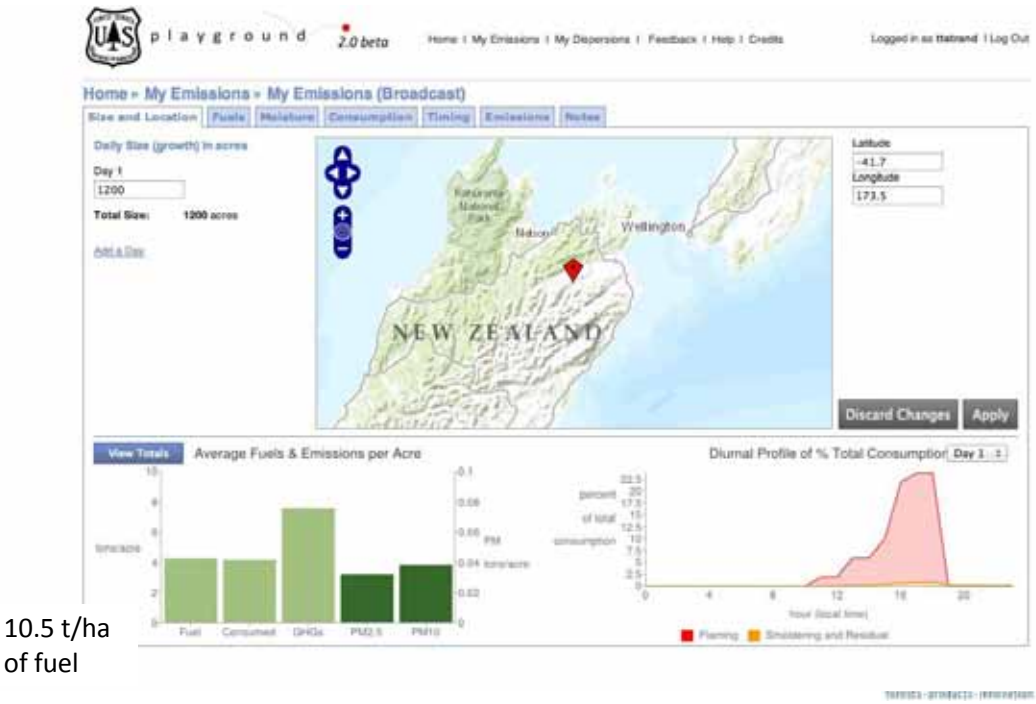
playground.airfire.org

Existing smoke tools



12.88 t/ha of fuel

Have to modify for NZ fuels



10.5 t/ha of fuel

Make it New Zealand's

- Smoke issues for NZ
  - Safety of response crew (air and ground)
  - Near-fire visibility
  - Shift in plume nature (i.e., plume collapse)
  - Fire-meteorology shifting the fire behaviour
- Research results in the BlueSky system
  - Fuel and fire behaviour results from FuSE
  - NZ Prometheus model
  - Research burns
- Cutting edge research required
  - Near-fire plume dynamics largely ignored by large fire-prone areas, although equally needed

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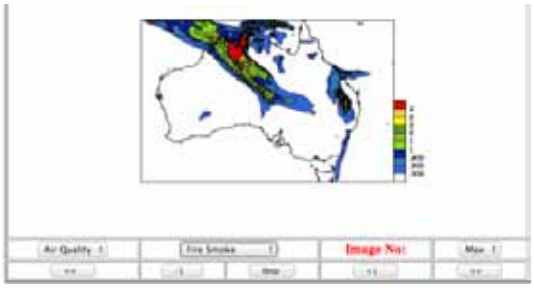
Make it Australia's

- Smoke issues for Australia
  - Wildfire resource placement
  - Vineyard smoke exposure
  - Long range smoke transport
  - Fire-meteorology shifting the fire behaviour
- CSIRO and Bureau of Meteorology doing this for Victoria
  - Putting the framework behind existing Australian Air Quality Forecasting System

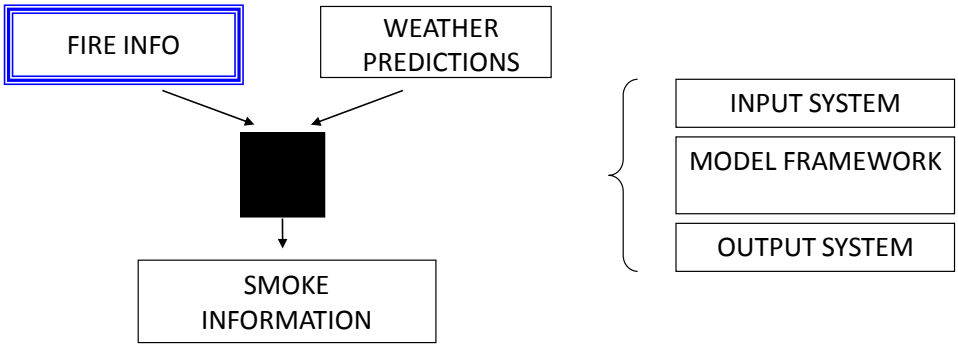


What is needed

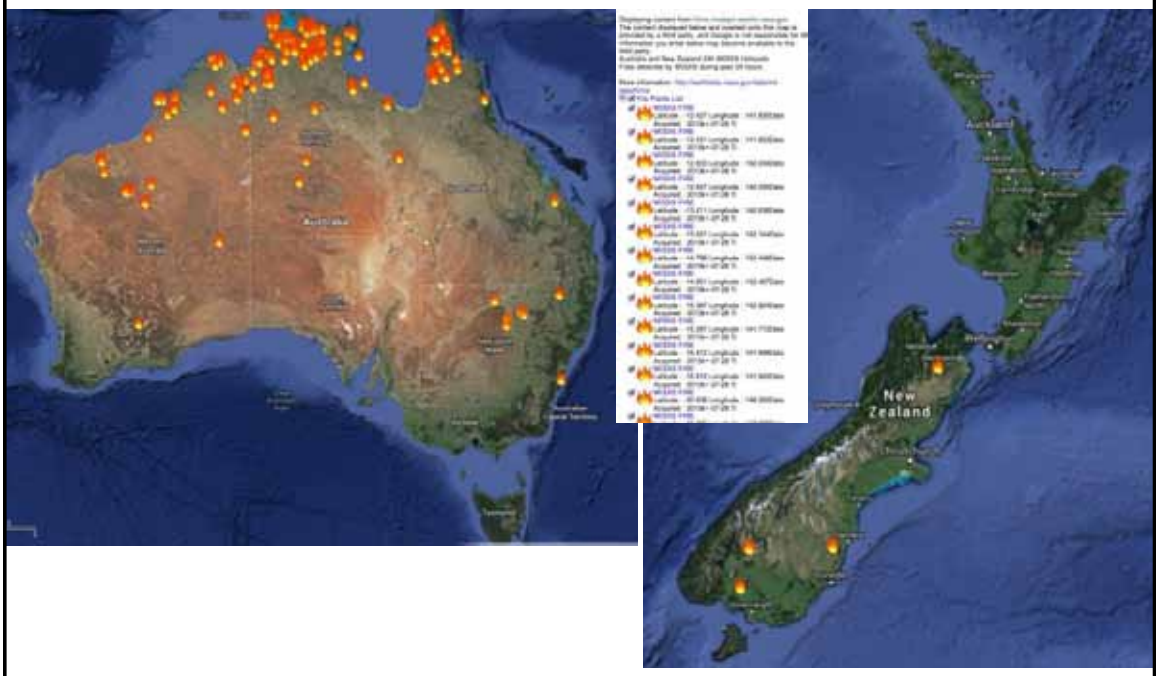
Key pieces of information

Real-time wildfire information (location, size)

Daily weather predictions



Satellite fire detects help but are not the full answer



Australian fire databases

- No size information

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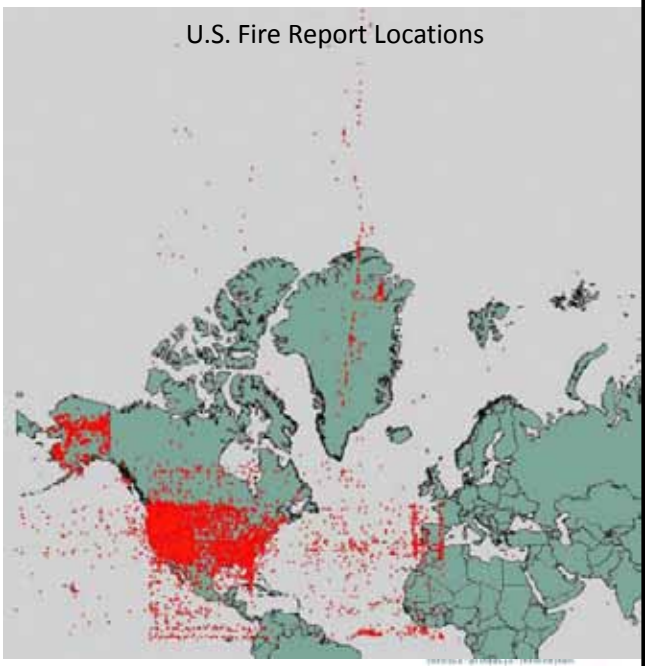
Lessons learned from overseas

Real-time fire information is necessary to advance fire and smoke science and tool development

-- despite potential for human error



Courtesy Tim Brown, DRI

Fire information needed

- National Rural Fire Information database/webpage
  - Will advance both research and tool development
  - *Must be separate from 111 calls*
  - *Must be updated in real time*
  - *Must be easy to use*
- Smoke tools depends explicitly on fire area, location, and timing
- Satellite information available but limited for NZ
  - Due to poor line of 'sight'

Thank you

- Trevor Tidy
- Richard McNamara (Mac)
- Rural Fire Research Team
- Tobias Schulmann
- University of Canterbury
- USFS AirFire Team and the BlueSky Consortium


Great Barrier Fire, tvnz.co.nz


Great Barrier Fire, stuff.co.nz

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Rural Fire Research

Want to know more?
CONTACT: tara.strand@scionresearch.com

Chris Beaman
Central Queensland University & BFCRC

Negotiating the Safety Space in Large Scale Fire Events

Dr Chris Bearman
Central Queensland University, Appleton Institute, Adelaide Campus

Acknowledgements

* Dr Benjamin Brooks
* Dr Christine Owen
* Jared Grunwald
* Liam Fogharty
* Bushfire CRC

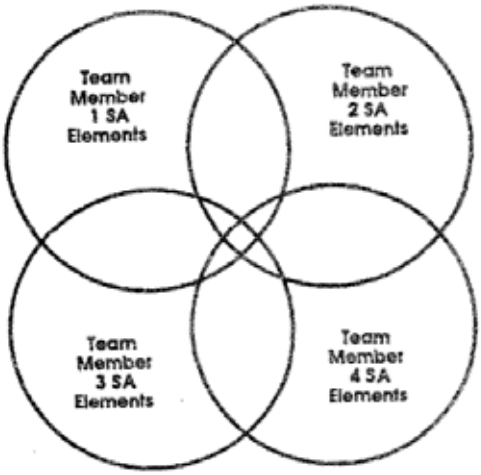
"The flow of information concerning fires was slow and in some cases non-existent" p. 258

"It is obvious that the timely flow of accurate information is critical to effective emergency response. The current lack of clarity about responsibility of information flow should be addressed" p. 271

(Royal Commission of Inquiry)

Shared Mental Models

- A mental model is a cognitive structure that a person uses to signify objects, actions, situations and people (Johnson-Laird, 1980)
- A shared mental model "enables team members to have more accurate expectations and a compatible approach for task performance" (Salas & Cannon-Bowers, 2001, p. 87)



Breakdowns

"The CFS officers …were finding it extremely difficult to obtain any relevant information about the fire, its status and its size…There was a large measure of frustration experienced in Port Lincoln about the adequacy of information from the fire ground.

Breakdowns

"Mr <A> stated in evidence that he attempted to contact the Kilmore ICC to pass the information on, without success. He did not know whether the Kilmore ICC was releasing this type of information."

Breakdowns and Disconnects

- Breakdown = “a failure in coordination, cooperation or communication that leads to a temporary loss in the ability to function effectively.”
- Disconnect = “individual instances of disagreement between participants.”

Disconnects

- *Operational disconnects*
  - a difference between the actions of one party and actions expected by the other party, or
  - a mismatch in the plans that each party has about the physical operations of the response

Disconnects

- *Informational disconnects*
  - a difference in the information that each party possesses.
- *Evaluative disconnects*
  - a difference in the evaluation or appraisal of information that is available to both parties

Breakdowns in 3 Fires

- Wangary (2005)
- Canberra Firestorm (2006)
- Kilmore East (2009)

Bearman et al. (2012) Presentation to AFAC Conference

Method

- Identified situations that *prima facie* contained a breakdown
- A random selection of these situations were analyzed further for
  - Types of Disconnects
  - Causes of Disconnects
  - Resolution

Results

- 44 breakdowns yielded 84 disconnects
- Types
  - Operational = 32
  - Informational = 41
  - Evaluative = 11

Example of a Breakdown

"There is in the evidence some conflict about whether or not it was agreed at the meeting that using the Baldy Range trail as the eastern containment line would be reconsidered the following morning. Mr <A>'s memory was that they were going to try to use the Baldy Range trail as the first option, the fall-back option being Dingo Dell Road. He was definite that at no stage did he convey any opinion that, on the basis of the information he had from Mr <B>, the Baldy Range trail could not be used as a containment line because of the intensity of the fire burning across it."

"Ms <c> did not remember anyone saying at the meeting that the fire on the Baldy Range was containable. Her memory was that it was reported, 'They are there. It is across the track and we are getting out'. Hence, on the basis of her understanding of the information provided to her at the meeting by those who were observing the Baldy spot fire at the time, Ms <C> formed the view that the Baldy trial had been lost as a possible eastern containment line."

Disconnect Chain

Causes of Operational Disconnects

- Assumptions that work will be carried out (16)
- Procedures or responsibilities unclear/ambiguous (9)
- Going against set procedure (5)
- Disagreements about the interpretation of fire information or duties (5)
- Plans not satisfactorily carried out (1)

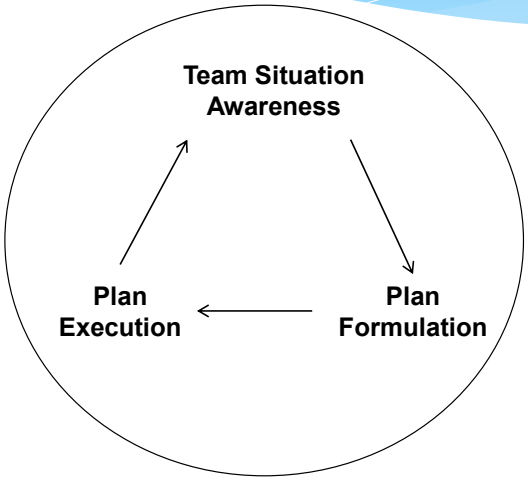
Causes of Informational Disconnects

- Lack of feedback (4)
- Difficulties in sending/receiving information (7)
- Information not shared/distributed (30)

Causes of Evaluative Disconnects

- Wanting to go against procedure (4)
- Disagreement about operational deployment (7)
- Different understanding of information (1)

Cycle of Team Activity



The Safety Fish

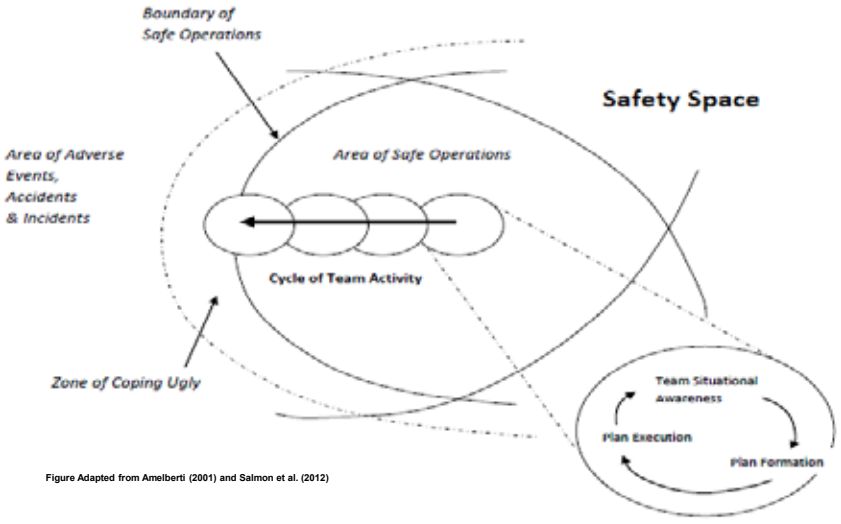


Figure Adapted from Amelberti (2001) and Salmon et al. (2012)

How Regional Controllers Identify and Resolve Breakdowns

* "So it's difficult to spot when people are doing something wrong, cause I don't know what all those people in there are meant to be doing."

Method

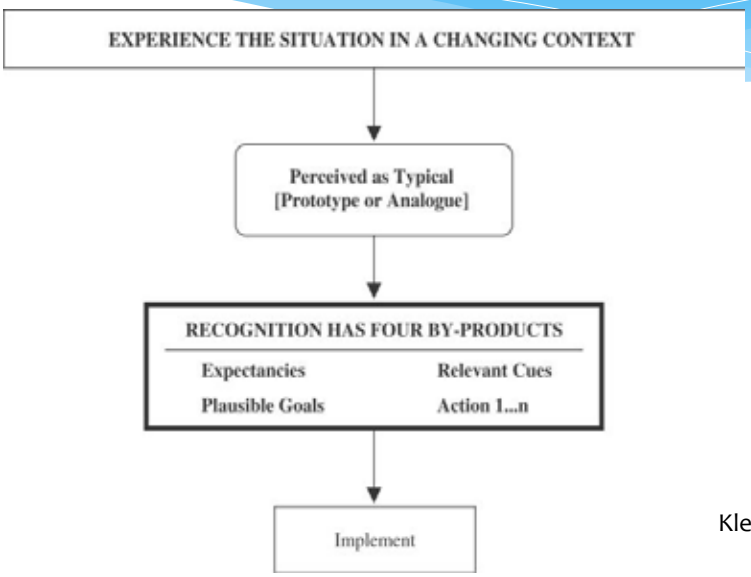
* Contextualized semi-structured interview
  * Eleven regional coordinators participated
  * Experience ranged from 3-12 years (m=5.90)
* Critical Decision Method/Semi-structured interviews
  * Fourteen people with experience of IMT and above
  * Experience ranged from 5-21 years (m=12.25)

Detecting a Cue

* Inconsistent Information
* Intuition
* Network
* Proxy-Based

Grunwald & Bearman (2013)

Recognition-Primed Decisions



Klein, 1998

Resolution Strategies

* Providing Assistance
* Negotiation
* Delegation
* Sending a Representative
* Mentoring
* Using Authority
* Replacement

Grunwald & Bearman (2013)

Uncovering Disconnects

Operational Disconnect

Uncovering Disconnects

Operational Disconnect

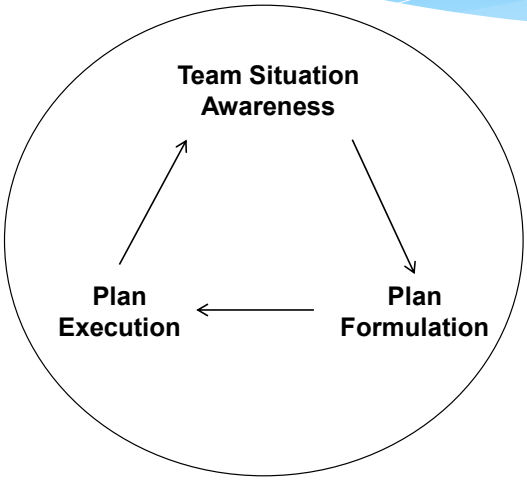
↑

Evaluative Disconnect

↑

Informational Disconnect

Cycle of Team Activity



The Safety Fish

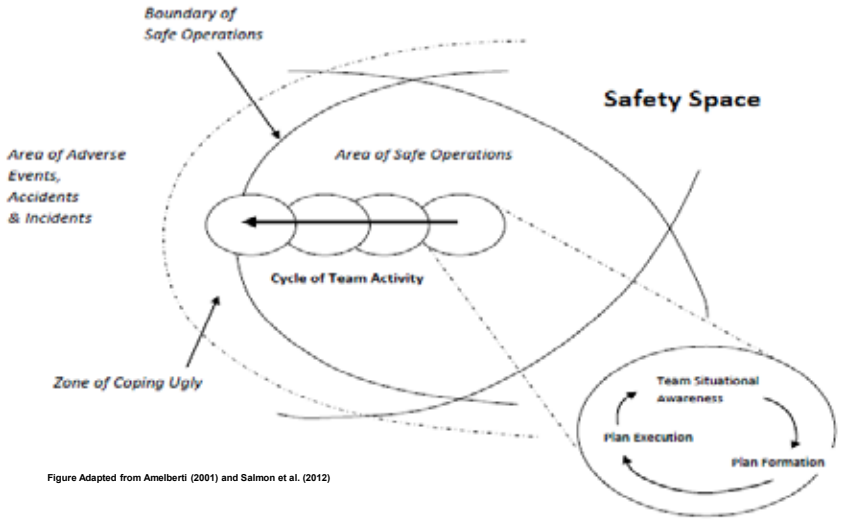


Figure Adapted from Amelberti (2001) and Salmon et al. (2012)

New Research

* Decision aids to help people in complex situations
* Strategies to better monitor teams
* Performance measurement for independent evaluators

Examples of Decision Aids

Strategies to better monitor team

Coordination Behavioural Markers

* Did team members have a common understanding of the mission, task, team, and resources available to them?
* Did team members share common expectations of the task and team member roles and responsibilities?

From Wilson et al. (2007)

Decision-Aids

* Informational
  * "Does information match my notion of how the fire should be progressing?"
* Network
  * "Are there inconsistencies in the information I'm getting from different people?"

Process measures of performance

Agencies Activities in the Area

Summary

* Incident Management as a Network
* Shared Mental Models
* Breakdowns and Disconnects
* Chains of Disconnects
* Resolution of Disconnects
* The Safety Space
* Identifying and Recovering From Disconnects
* Coping Ugly
* New Research

Questions?

Want to know more?
CONTACT: C.Bearman@cqu.edu.au

Dave Thomas
Renoveling, USA

Perspectives on the New Zealand Fire Management Deep Smarts Project

Dave Thomas
Renoveling
Ogden, Utah
Veronica Clifford, Scion

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Deep Smarts

Dr. Dorothy Leonard, Harvard Business School

DEEP SMARTS

"…expertise based on first-hand life experiences, providing insights drawn from *tacit* knowledge…deep smarts are as close as we get to wisdom…"

Dorothy Leonard and Walter Swap, "Deep Smarts."

"Joey"

Joey, Litchfield Tours, Darwin, Australia

K. Anders Ericsson

"Experts are made & not born."

Deliberate practice used to become experts

Process

Analysis Screens
HRO
Stories
Rhetorical analysis
Decision making
Leadership

Skill	Experts	Novice	Limitations
Speed of Decision-Making	Make decisions swiftly, efficiently, without reviewing basic facts	Need to review all facts and choose deliberately among alternatives	Over-confidence; expert may ignore relevant data
Context	Take context into account: knowledge is “contextualized”	Rely on rules of thumb that minimize context	Difficult to transfer contextualized knowledge; novices prefer general rules
Extrapolation	Able to extrapolate from novel situation to find a solution	Lack of receptors limits basis for extrapolation	Mental set: Expert may base solution on inappropriate pattern
Discrimination	Able to make fine distinctions	Use of rules of thumb obscure fine distinctions	Expert may not help novice who lacks receptors

"Exercising leadership is an expression of your aliveness. But your life juice—your creativity & daring, your curiosity & eagerness to question, your compassion & love for people—can seep away daily as you get beat up, put down, or silenced."

Heiftz & Linksy, "Leadership on the Line"

Transfer Mechanisms?

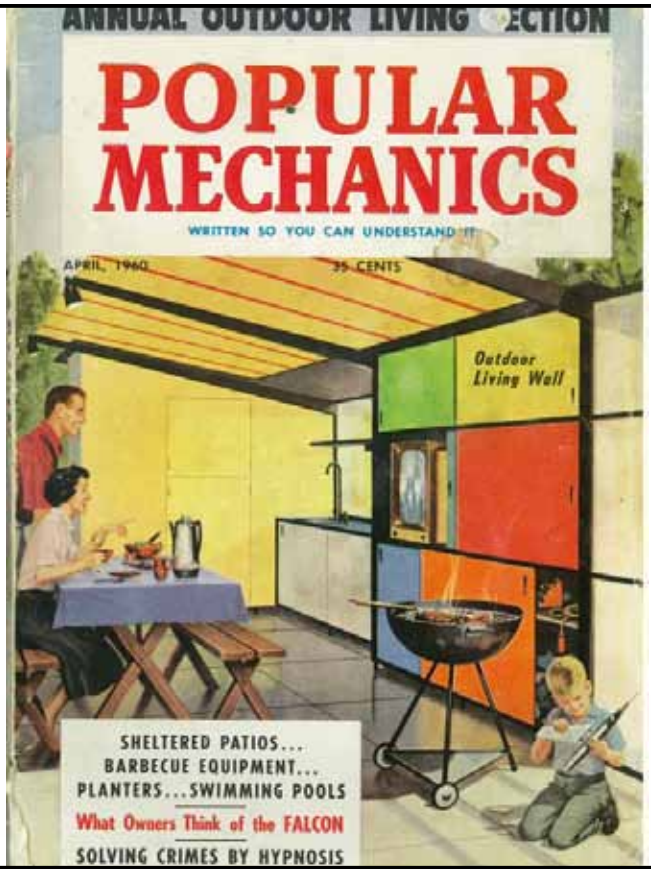
Power of stories (Weick)

1. Actions are difficult
2. Non-routine predicaments
3. Unexpected events occur
4. Situation is unusual

Want to know more?
CONTACT: renoveling@msn.com

Richard Parker
Scion

Scion Rural Fire Research Group
Uninhabited Air Vehicles



April 1960

1960 UAV technology

Research

- **Key activities:**
  1. Familiarisation with UAVs on campus and nationally
  2. Report by Spatial Engineering Research Centre - UC
  3. Member UC (NZ) UAV Users Group

UAV Trial Activity

- Power line inspection – rotary UAV
- IR Heat mapping – fixed wing UAV
- Earthquake damage assessment – both
- Control of aerial precise manoeuvres – rotary UAV
- Maritime surveillance – fixed wing UAV
- Fire Service* – rotary UAV
- ESR* - rotary UAV

Spatial Engineering Research Centre

- Aaron Marburg
  - MSc, Aeronautical Engineering, Stanford University
  - Worked with MIT Autonomous Underwater Vehicles Lab
  - PhD candidate, University of Canterbury
- Report
  - Current technology and limitations
  - Regulations
  - Rotary vs fixed wing
  - Sensors for fire operations
  - Possible uses

Report - Uninhabited Air Vehicles and Systems for Rural Fire Operations

- Regulation CAA
  - Private Pilots licence
  - Under 400 feet altitude
  - Within unaided vision of operator
  - More than 150 m from settlements or people
  - Seek permission to operate in segregated airspace

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- Technical overview
  - Rotary

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- Fixed wing

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Big UAVs

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- Sensors
  - Infra-red, near infra-red
  - Multispectral imaging
  - Radar
  - Lidar
- Radio communication
  - Analogue, digital
  - Line of sight
- Ground control
  - Radio control

- Low-cost PathFindIR from FLIR Systems provide basic thermal imaging at low resolution
  - not designed or calibrated to provide the precise temperature of viewed objects.
- High-grade unit like the FLIR T600 has been calibrated to estimate the temperature of objects viewed by the imager.

Left: Low-cost PathFindIR from FLIR Systems. Right: FLIR T600 series. (FLIR Systems)

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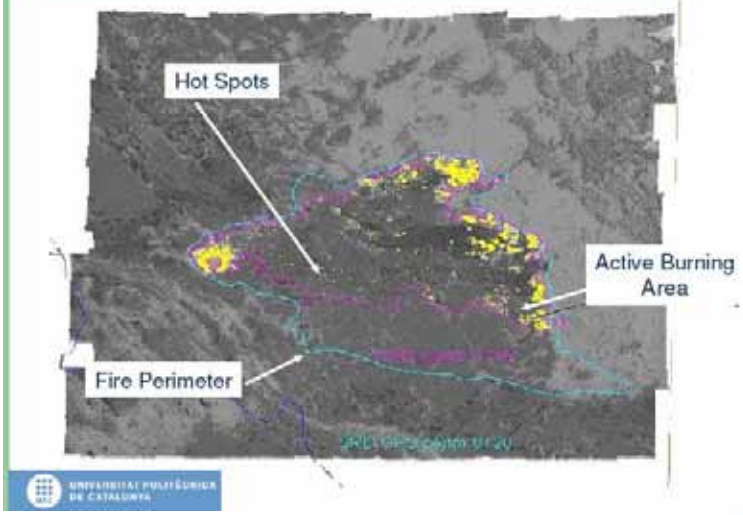
Application domains

ICARUS



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Barnard Microsystems

SCION
Next generation biomaterials

- Costs
  - Draganflyer
  - Ground control
  - Visible camera
  - Thermal camera
  - $35,000

  - Hawkeye
  - Ground control
  - Visible camera
  - Thermal camera
  - $100,000

Beam imagery down to an electronic map

- Tait Communications
- Continuously updated
- Resource location
  - People
  - Appliances
  - Pumps
  - Aircraft
- Fire location

3D electronic map

Telemetry for pilot

SCION
Next generation biomaterials

Conclusions

- Administrative challenges
  - Relatively high cost
  - CAA Regulations
  - Fit in Fire command structure
- Technical challenges
  - Reliability
  - Data processing
  - High winds
  - Other aircraft

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Recommendations

- IR hot spotting, early morning
  - low wind conditions
  - No other aircraft
- Fire perimeter IR line scanning
- Project Team – pilots, NRFA Aircraft Management Group, End user representatives
- Links to other UAV users
- Downlink to existing ground control systems

Maybe … UAV water bombers!

Want to know more?
CONTACT: richard.parker@scionresearch.com

Liam Fogarty
Department of Environment and Primary Industries, Victoria

Role of Science in reducing uncertainty and bushfire risk

Scion, Bushfire CRC and NRFA Science Day
Queenstown

30 07 2013

Liam Fogarty
Director Knowledge and Engagement
DEPI Fire Division

Victoria
The Place To Be

Capability for Global Fire Issue – FRFANZ 2007

- **Some global *symptoms*/issues (DSE) need to deal with:**
  - **Well being of our people**
  - **Caught on the response and recovery cycle;**
  - **Increasing social impacts and costs:**
    - **Homes & property;**
    - **Individual and community, loss and trauma;**
    - **Combined with drought and recently flood impacts;**
  - **Economic impacts:**
    - **Industry – tourism, timber, apiarists, water etc;**
  - **Environmental impacts:**
    - **Areas long unburnt or recently and intensively burnt – not much in between;**
    - **Catchments threatened/compromised.**

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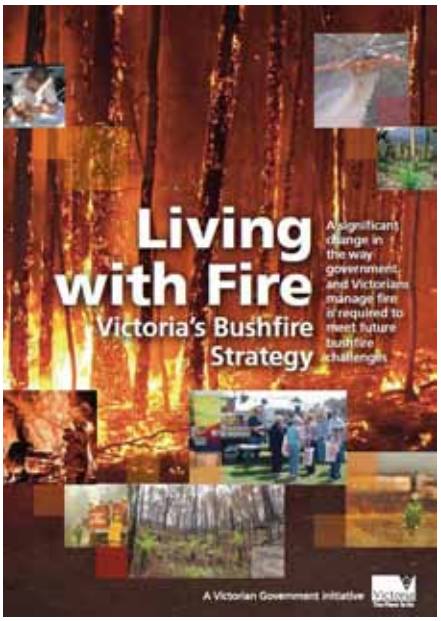

- **Objectives:**
  - **Reduce the occurrence and impact of severe bushfires,**
  - **Promote community and ecosystem resilience,**
  - **Manage and adapt to current and emerging risks.**

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Living With Fire Timeline

	Natural Fire	Pre-Organisational	Organisational	Protection	Mega Fire	Future Fire
Phase	Natural Fire	Pre-Organisational	Organisational	Protection	Mega Fire	Future Fire
Drivers	Australia separates from Gondwana and migrates north; Drying and genesis of the Eucalyptus (30 M yrs ago); Natural lightning fires (at least 200,000 yrs ago); Aboriginal settlement and fire use - 40,000 yrs ago.	Settlement and development.	1939 & 1944 Fires; Stretton and other Inquiries; Rural settlement & development.	1983, 85 Fires; Forestry, fire, rare & threatened species concerns; Linton/Moggs Crk; Fire (edge) Protection; Sea change/tree Change.	2003, 2006/07 Mega Fires; COAG & Victorian Bushfire Inquiries Climate change - decadal drought.	More drought; More fires; More assets at risk; Higher values; Greater community demand and engagement; More workforce/ wellbeing pressure.
Outcomes	Drought and fire prone and adapted landscape.	Early (independent) Brigades; Limited structure and organisation.	Forest Commission and CFA formed; Forests & CFA Acts; Australia leaders in burning; Forest and fire science initiated.	Declining burn size; Increasing QA - input focus; Increased fuel; Diminished habitat; Extended initial attack success; Leaders in community preparedness.	Increased cooperation; IA capability exceeded; Greater community involvement; Integrated planning initiated; Role of fire in the environment re-considered.	More "good" fire; Engaged/aware communities; Enhanced Response; Bushfire Charter - shared responsibility; State Bushfire Strategy; Bushfire Capability
	Pre European	Pre and Early 1900s	Mid 1900s	Late 1900s	Early 2000	Future Fire

4

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The Place To Be

Water supplies, urban fringe at risk

Horror fire warning

PETER ROLFE

MELBOURNE'S urban areas and precious water supplies have been identified as major fire danger zones ahead of a horror bushfire season expected to grip the state.

Fire chiefs have warned of an extreme season expected to come earlier and last longer following a record dry start to spring and forecasts of a hot summer.

Melbourne's urban fringe has been identified as a particular risk zone, with the Mornington Peninsula, the Dandenongs and the Alexandra and Macedon regions told they should be on high alert.

Far East Gippsland and communities north of Horsham and around Bendigo have also been warned they are at risk of severe bushfires, fuelled by the absence of spring rainfall.

Department of Sustainability and Environment chief fire officer Ewen Waller said the threat was genuine.

"We're quite concerned about those areas because they're all populated and to be dry at this time of year means the fire season will come earlier," he said.

"Conditions are deteriorating and that means a big bushfire threat."

Mr Waller said Melbourne's water supplies, including the Thomson, Sugarloaf and Silvan reservoirs, could be contaminated by charcoal and sediment stirred up by fire.

"These areas are rapidly drying out and becoming susceptible to bushfires," he said.

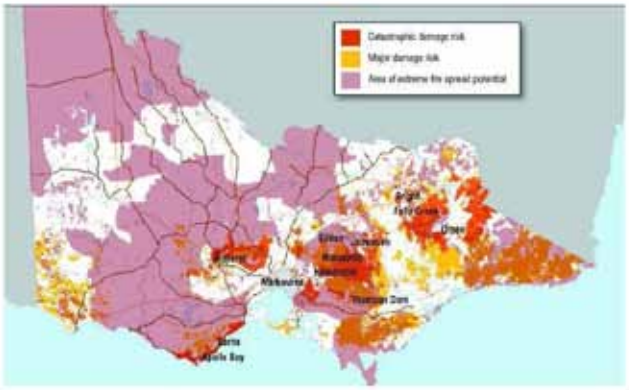
If dams were polluted it could have a disastrous impact on the city's supply, forcing draconian short-term restrictions.

Melbourne experienced its driest September and October on record this year, Victorian Bureau of Meteorology figures reveal.

A little more than 20mm of rain fell in Victoria during the period, surpassing the previous low of 35.2mm set in 1914.

Statewide, Victoria had its third driest start to spring of all time.

Fire restrictions commenced in some parts of Victoria this weekend.



WHERE THE THREATS ARE

Fire season launch
- 2 November 2008 -

Melbourne - Evening of September 7 2009

Impacts

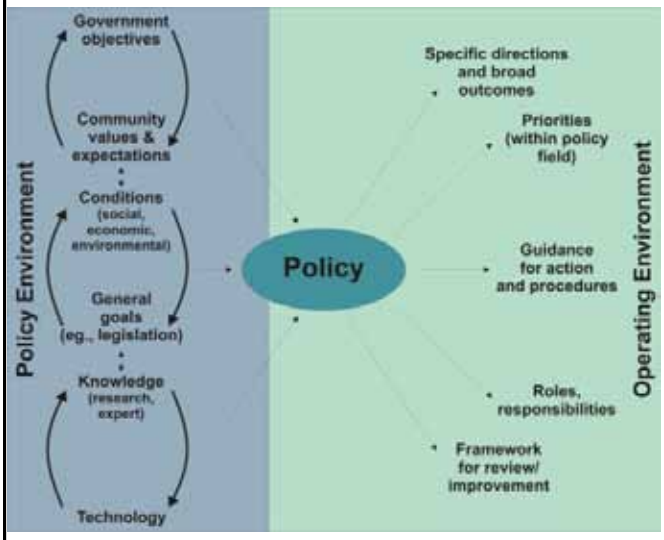
- Fatalities: 173
- Homes lost: about 2,000
- Total fire area: 400,000ha (approx.)

Science to Policy and Practice - Critical Elements -

- Policy and Objectives,
- Application of risk management processes and principles
- Supporting Science Investment Framework
- Capacity:
  - Decision Making Tools – Invest in Integration
  - Invest in People
- A Case Study – Otways – Future Fire

8

Policies



Tell us WHAT to do:

- **Clear direction of (relative) intent;**
- **Reduce uncertainty about what is important;**
- **Reduce conflict at doing (tactical & operational) level;**
- **Support high level vision and objectives = expectations/objectives;**
- **Do not override Legislation – typically general/overlapping.**

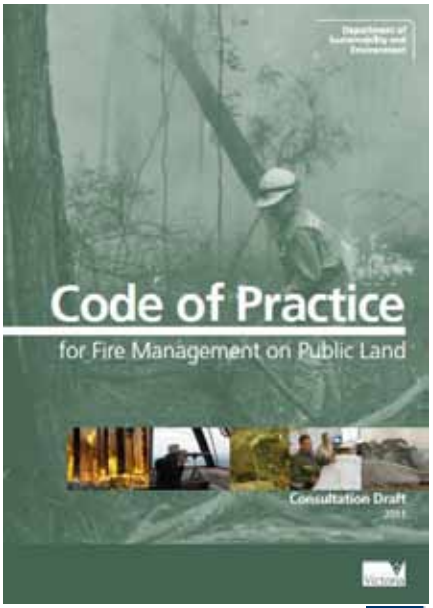
Planning for outcomes

Establishes bushfire management objectives:

- *minimise the impact of major bushfires on communities = risk*
- *maintain or improve the health of natural ecosystems = resilience*

Some supporting goals:

- manage and adapt to current and emerging risks,
- work within a risk management
- framework (was AS4360 2004 - now ISO 31000 2009)
- take a landscape approach,
- be measured against outcomes..



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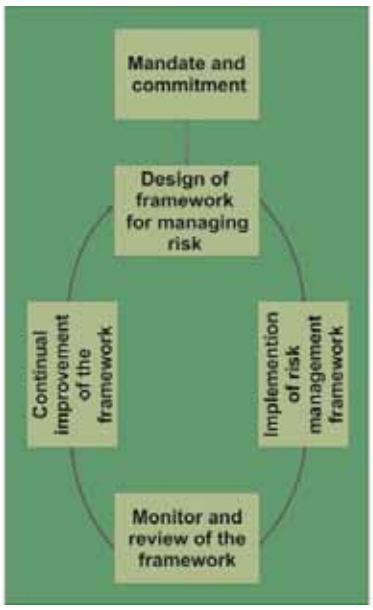
ISO 31000

- Creates value
- Integral part of organisational process
- Part of decision making
- Explicitly addresses uncertainty
- Systematically structured and timely
- Based on the best available information
- Tailored to meet objectives and context
- Takes human and cultural factors into account
- Transparent and inclusive
- Dynamic, iterative and responsive to change
- Facilitates continual improvement and commitment



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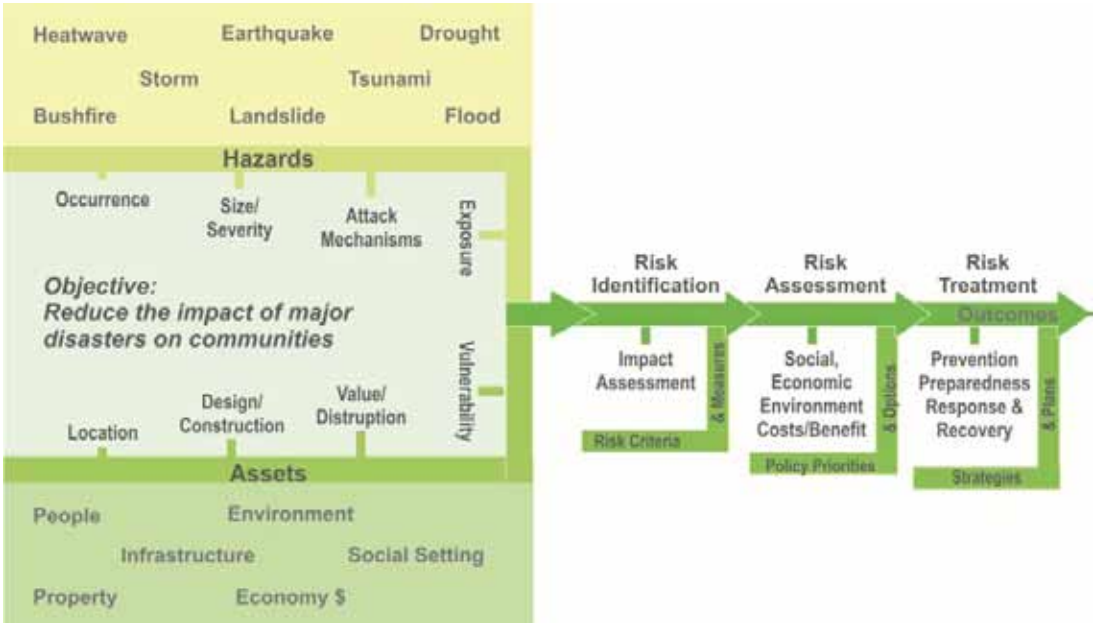
All Hazards and Risk



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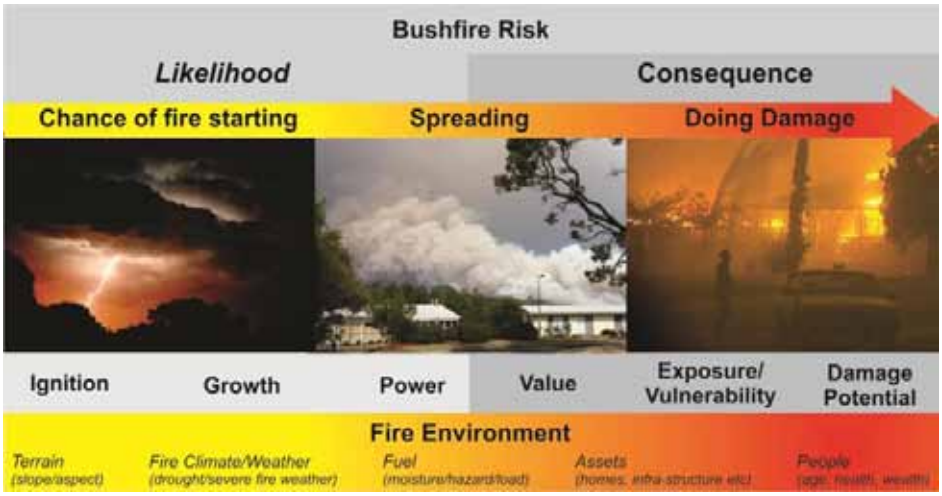
Bushfire Hazard and Risk



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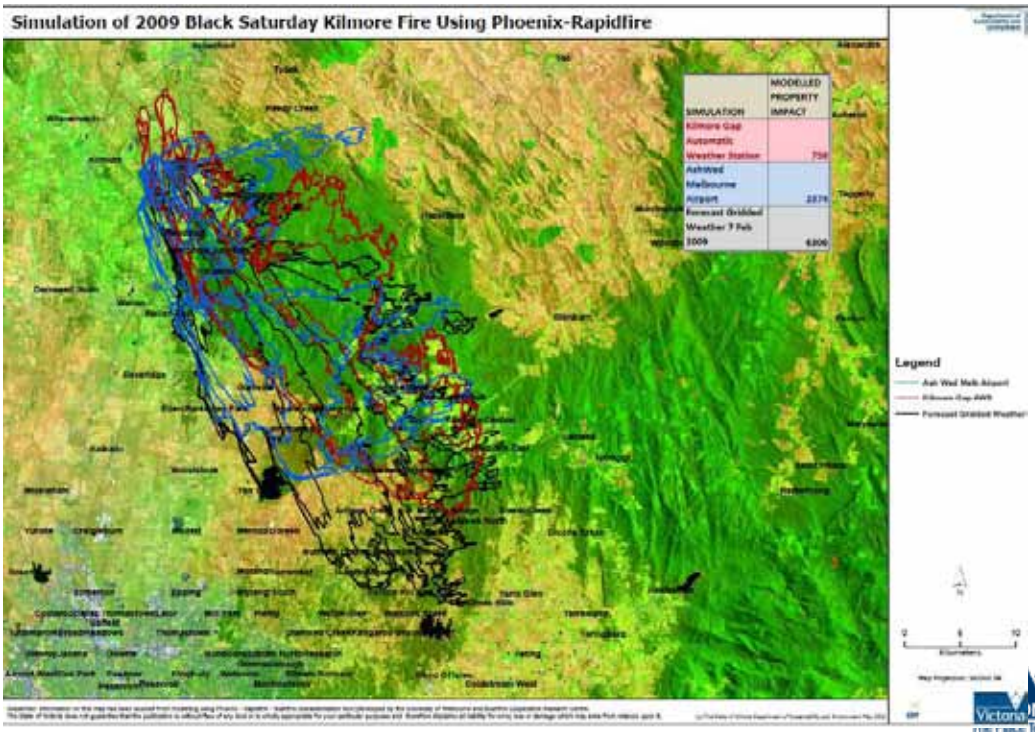
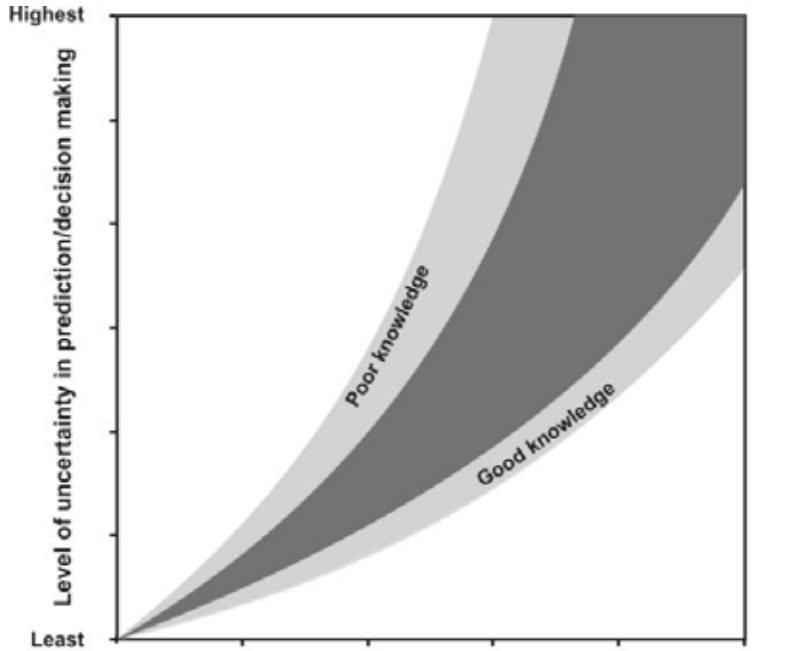
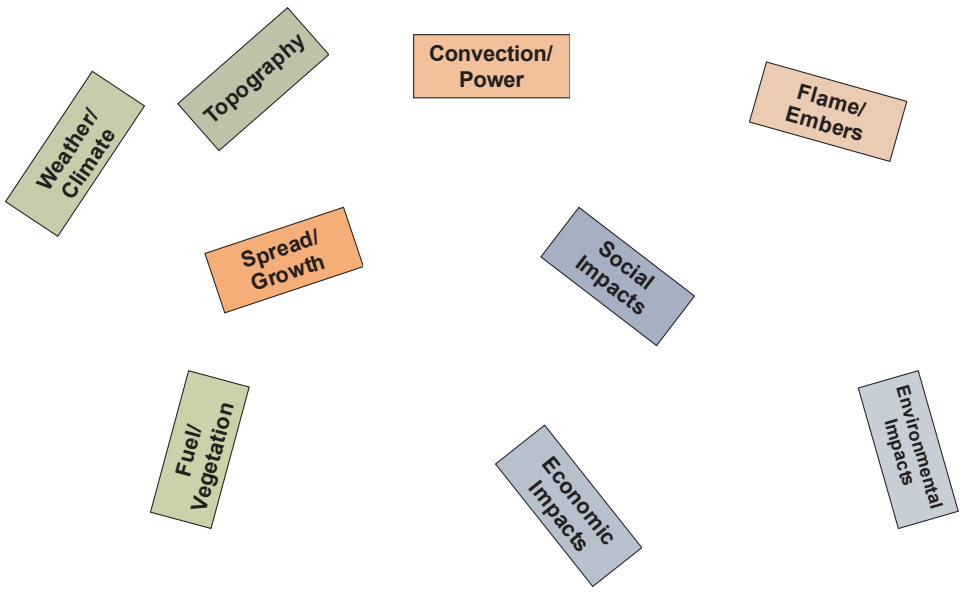
How much uncertainty are we prepared to accept?



Impact of uncertainty



Thinking about fire and uncertainty



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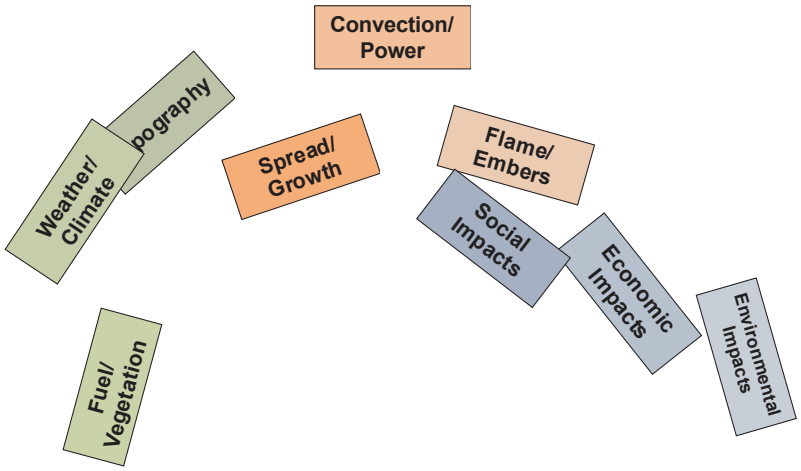
Thinking about fire and uncertainty



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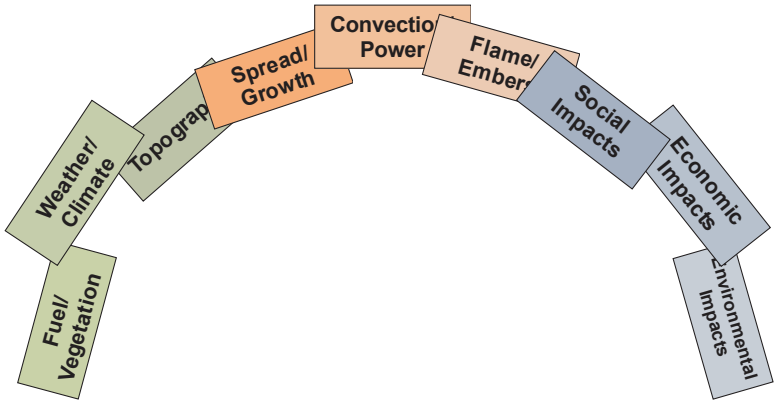
Thinking about fire and uncertainty



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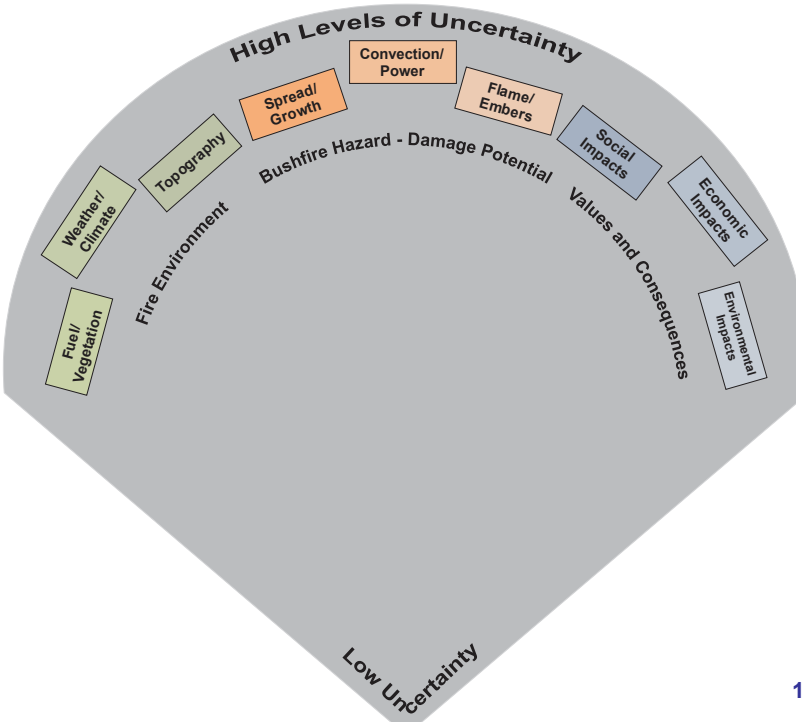
Fire and uncertainty



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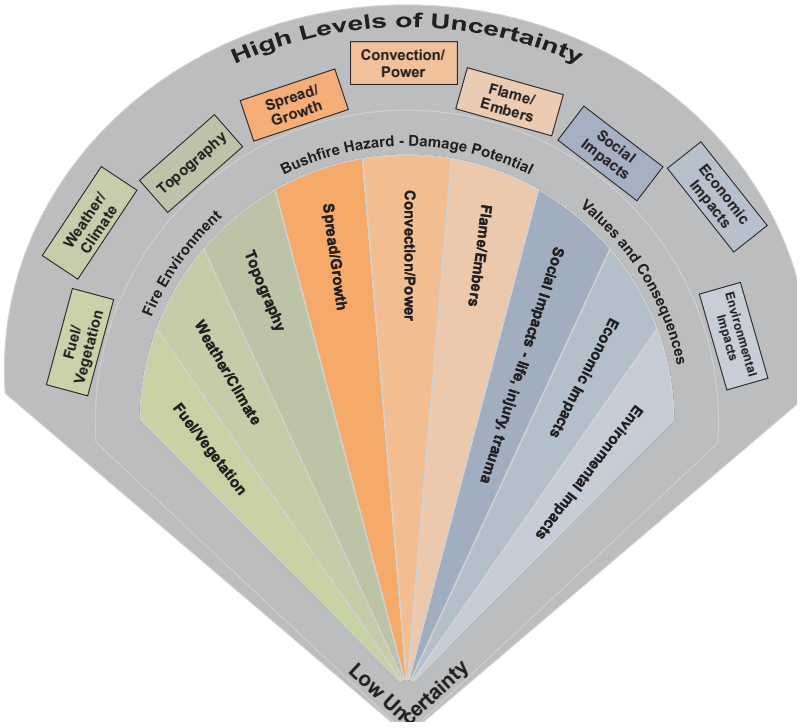
Fire and uncertainty



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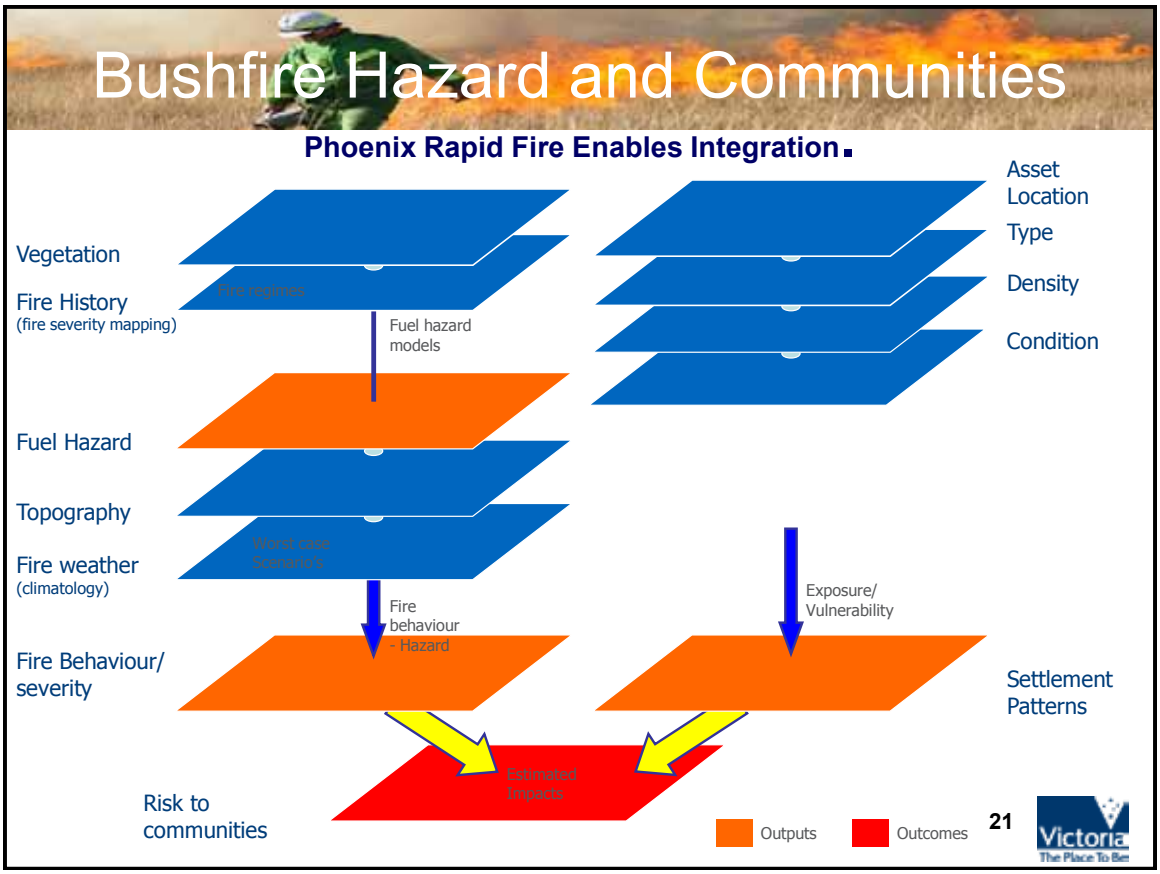
Bushfire Hazard and Communities
Phoenix Rapid Fire Enables Integration.
Vegetation
Fire History
(fire severity mapping)
Fire regimes
Fuel hazard models
Fuel Hazard
Topography
Fire weather
(climatology)
Worst case Scenario's
Fire behaviour - Hazard
Fire Behaviour/ severity
Asset Location
Type
Density
Condition
Exposure/ Vulnerability
Settlement Patterns
Estimated Impacts
Risk to communities
Outputs
Outcomes
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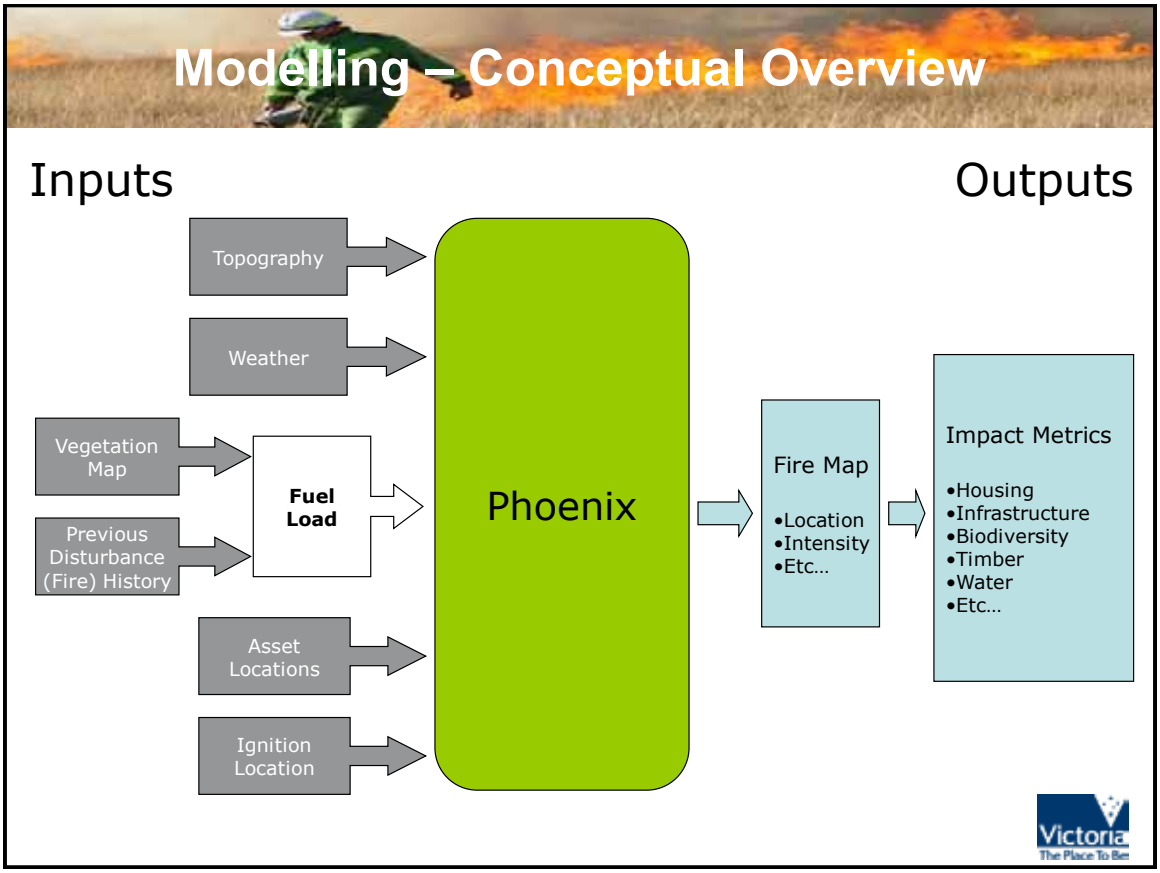
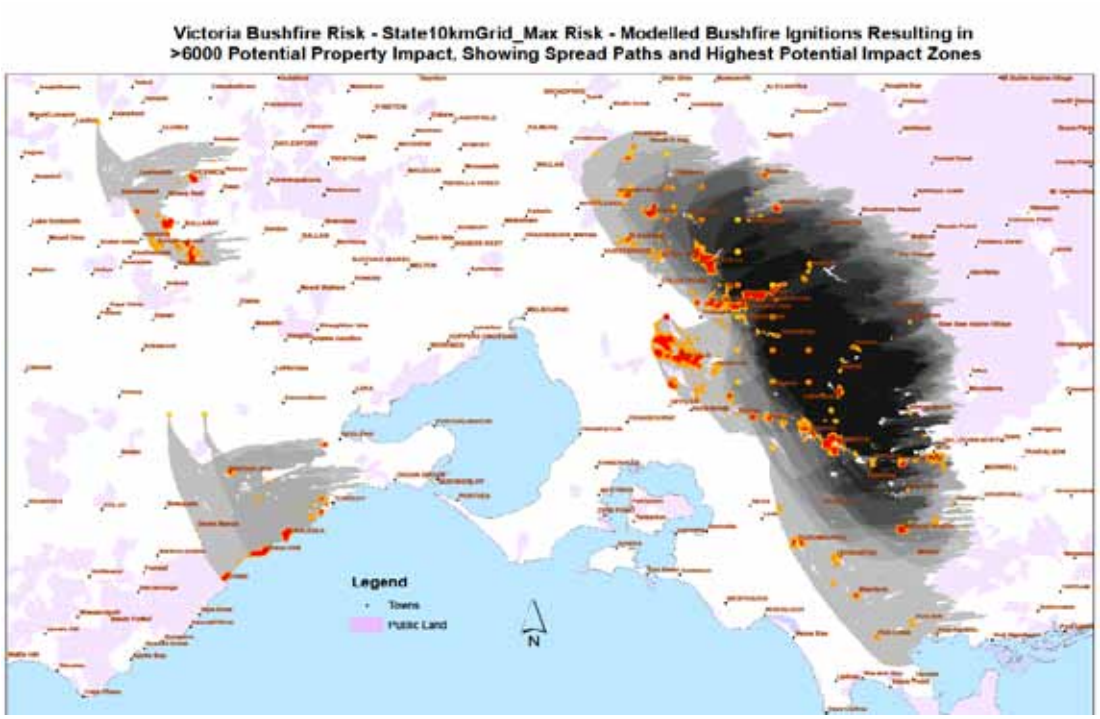
The Place To Be


Modelling – Conceptual Overview
Inputs
Outputs
Topography
Weather
Vegetation Map
Previous Disturbance (Fire) History
Fuel Load
Asset Locations
Ignition Location
Phoenix
Fire Map
•Location
•Intensity
•Etc…
Impact Metrics
•Housing
•Infrastructure
•Biodiversity
•Timber
•Water
•Etc…
Victoria
The Place To Be

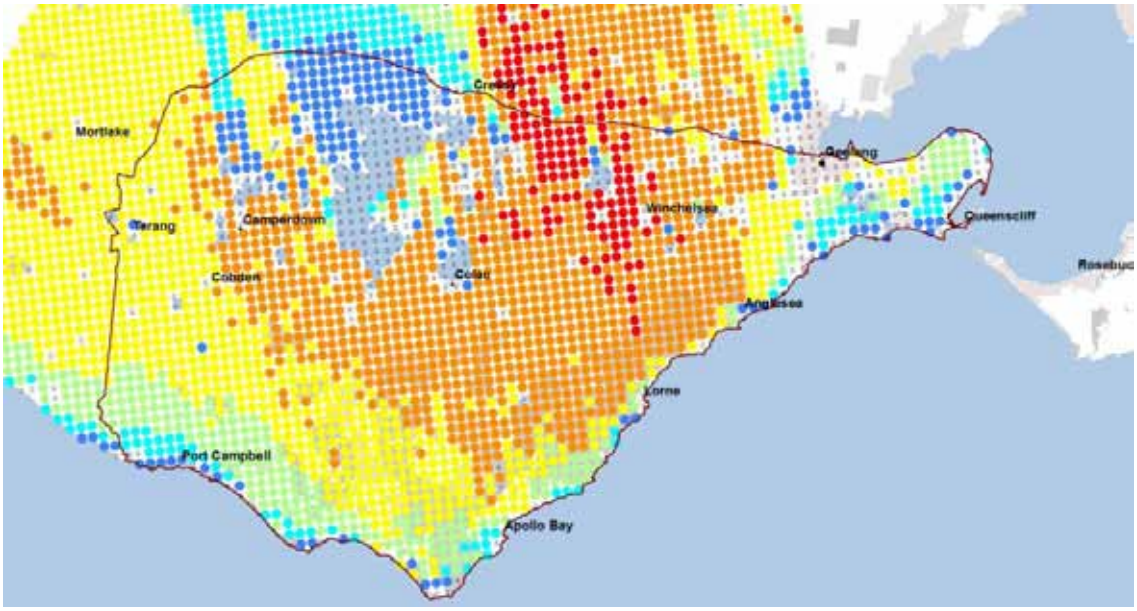

Anglesea
Google


Camperdown
Winchelsea
Cobden
Colac
Anglesea
Lorne
Apollo Bay
Google


Victoria Bushfire Risk - State10kmGrid_Max Risk - Modelled Bushfire Ignitions Resulting in
>6000 Potential Property Impact, Showing Spread Paths and Highest Potential Impact Zones
Legend
Towns
Public Land
N

25


Significant Ignition Zones


Mortlake
Terang
Camperdown
Cobden
Colac
Winchelsea
Queenscliff
Anglesea
Lorne
Port Campbell
Apollo Bay

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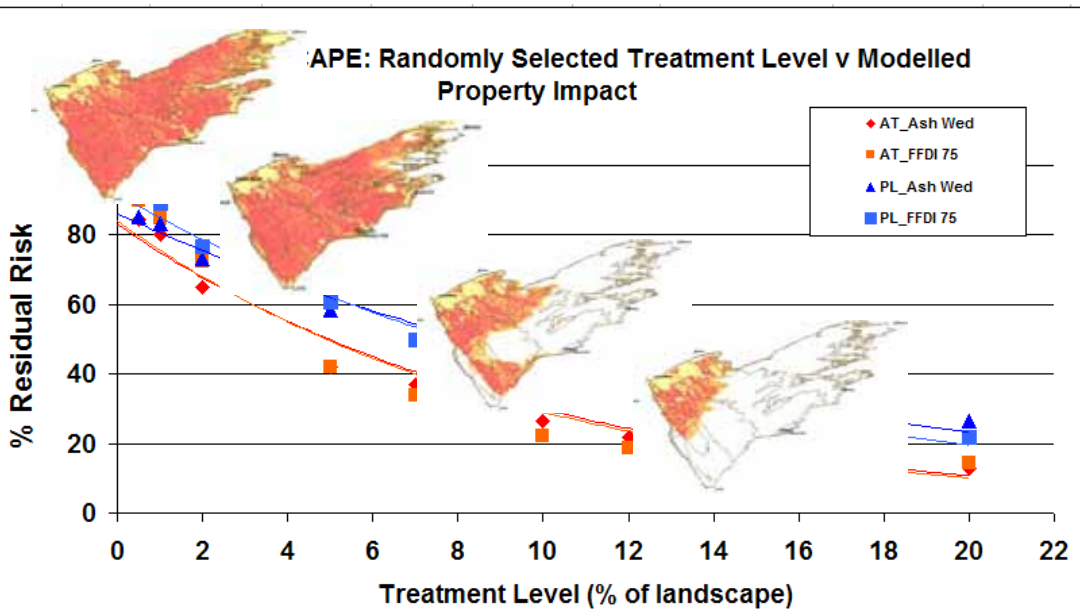
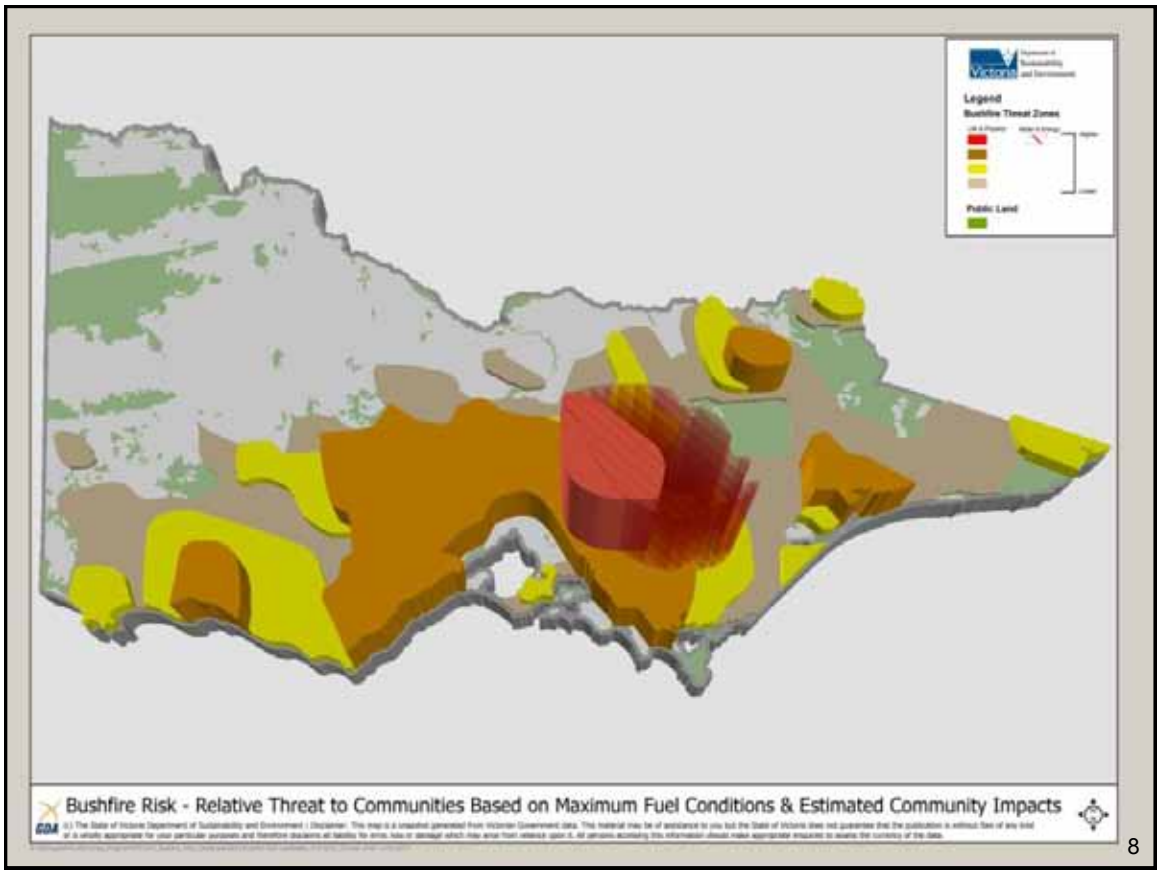
Treat Risk: Benefits of planned burning?

Assessing treatment options





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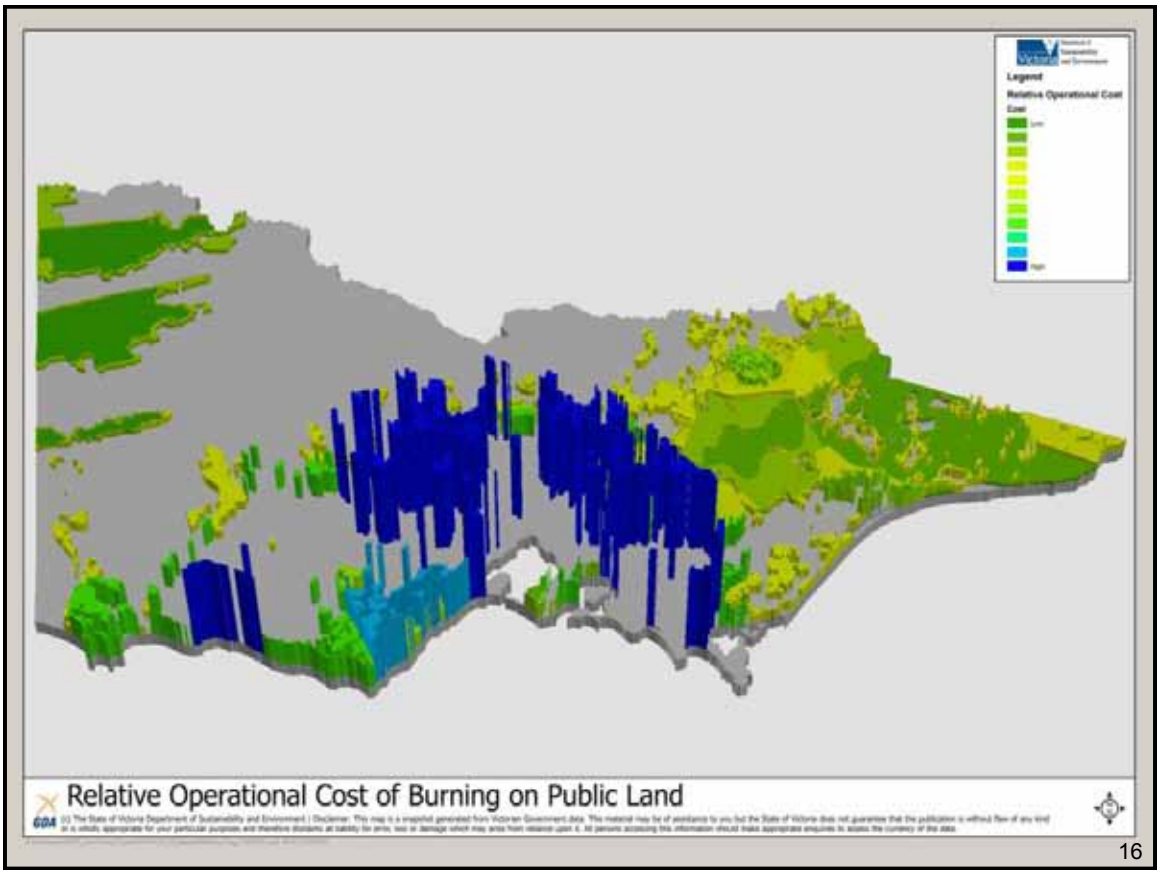
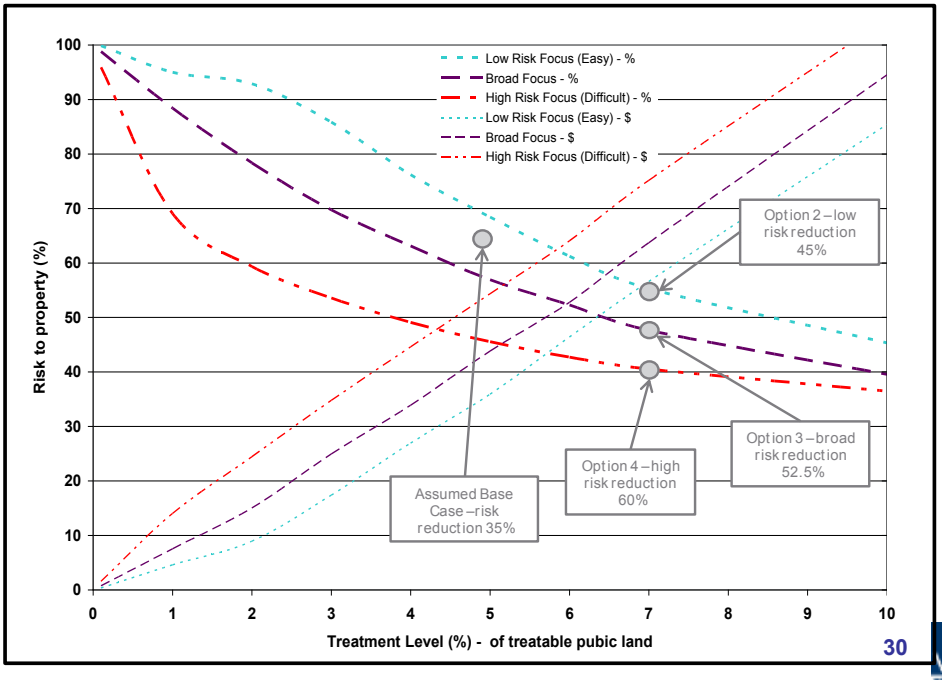
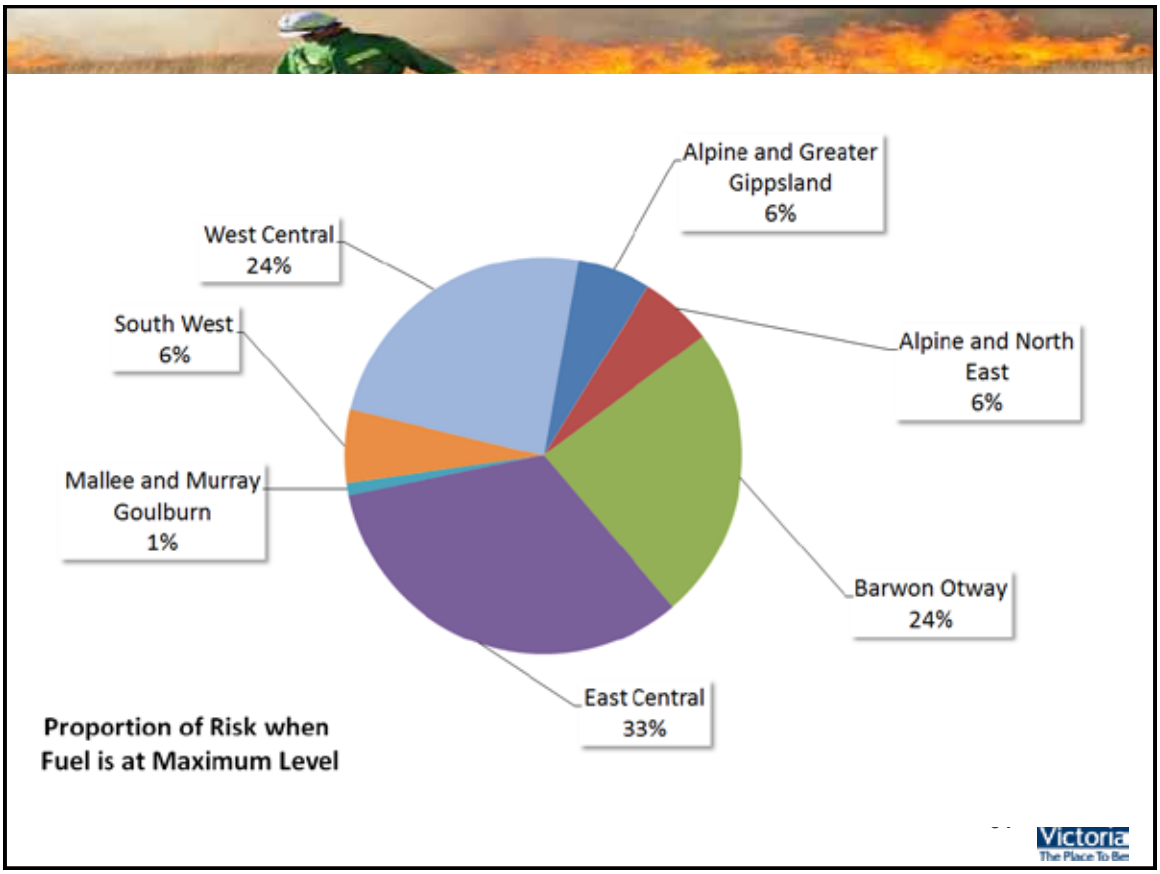

Legend
Relative Operational Cost
Cost
Relative Operational Cost of Burning on Public Land
16


Low Risk Focus (Easy) - %
Broad Focus - %
High Risk Focus (Difficult) - %
Low Risk Focus (Easy) - $
Broad Focus - $
High Risk Focus (Difficult) - $
Risk to property (%)
Treatment Level (%) - of treatable pubic land
Option 2 – low risk reduction 45%
Option 3 – broad risk reduction 52.5%
Option 4 – high risk reduction 60%
Assumed Base Case – risk reduction 35%
30


Alpine and Greater Gippsland 6%
West Central 24%
South West 6%
Alpine and North East 6%
Mallee and Murray Goulburn 1%
Barwon Otway 24%
East Central 33%
Proportion of Risk when Fuel is at Maximum Level
Victoria
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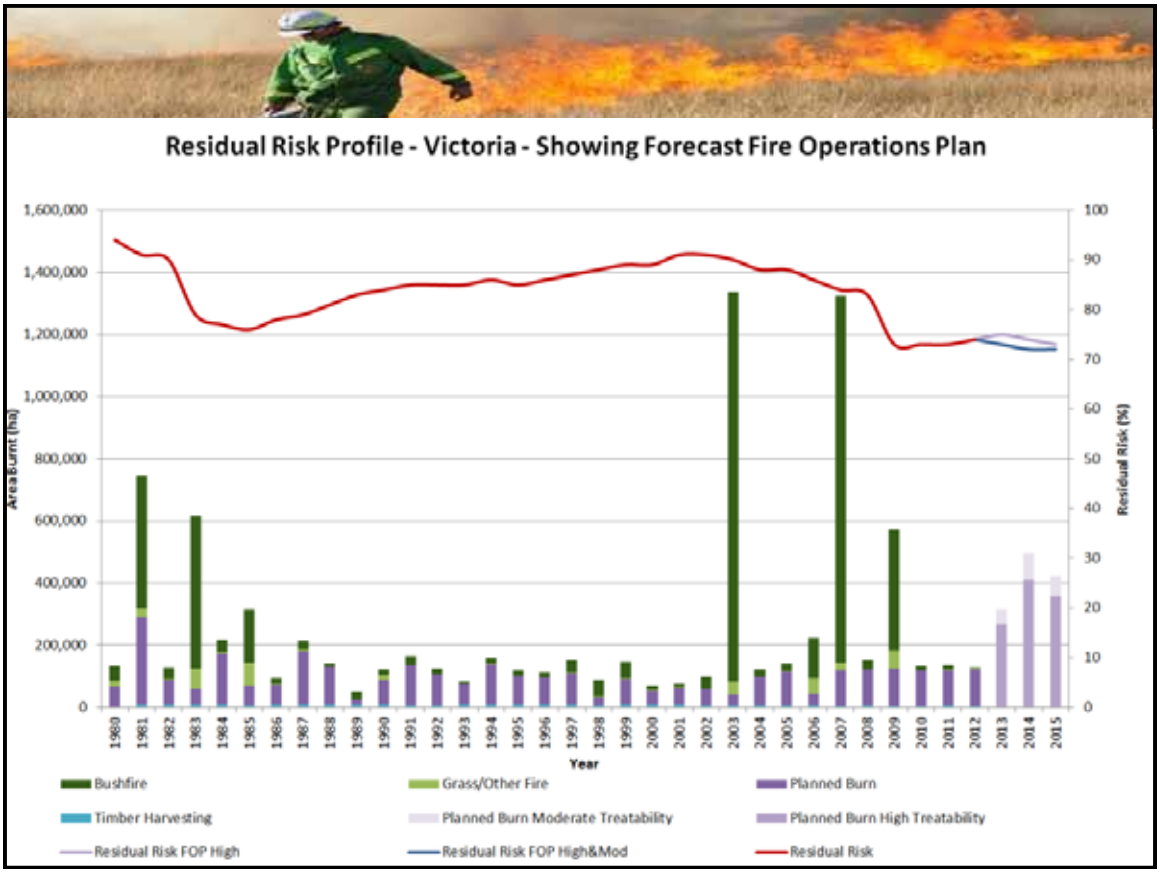
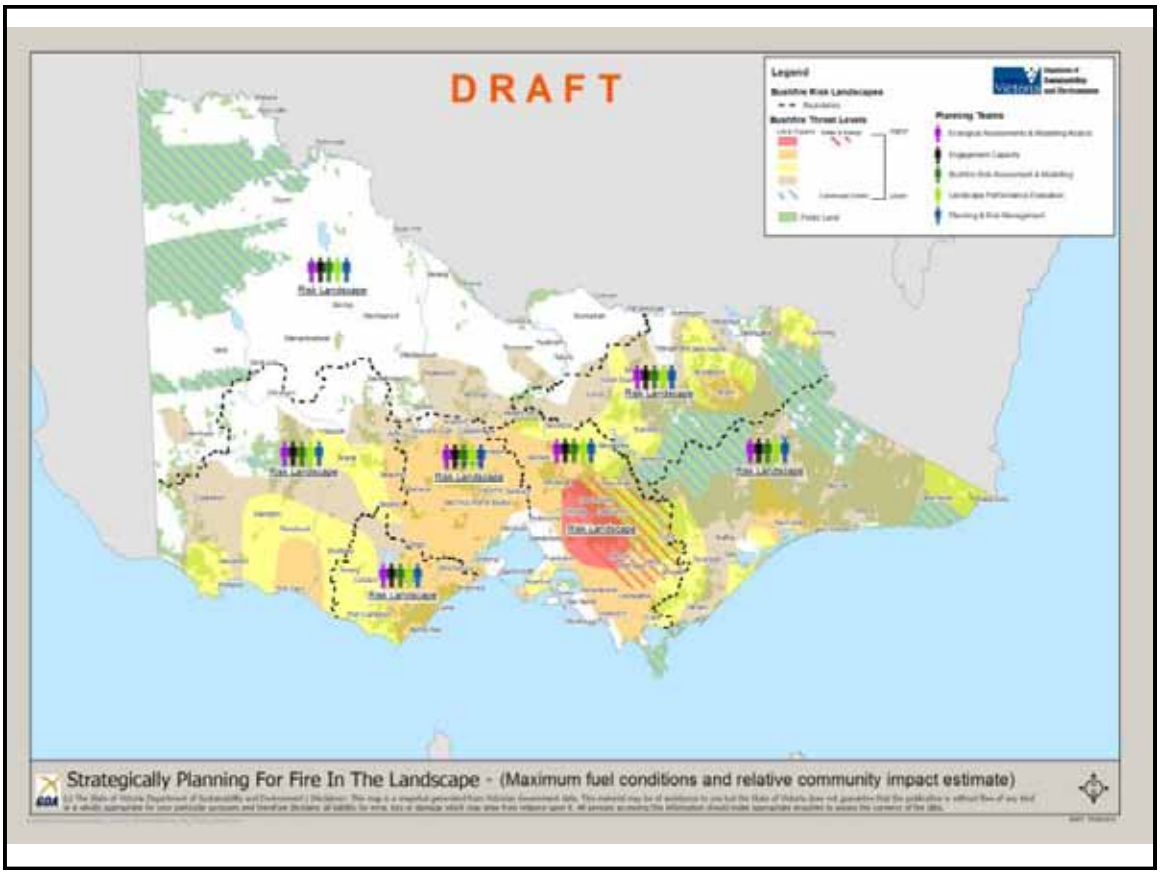
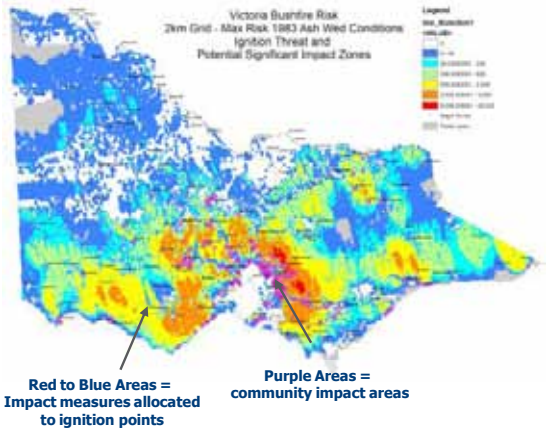

Residual Risk Profile - Victoria - Showing Forecast Fire Operations Plan
Area Burnt (ha)
Residual Risk (%)
Year
Bushfire
Grass/Other Fire
Planned Burn
Timber Harvesting
Planned Burn Moderate Treatability
Planned Burn High Treatability
Residual Risk FOP High
Residual Risk FOP High&Mod
Residual Risk



Planned Burning - Analyse Risk



- Understanding the likelihood of consequences occurring,
- Need to estimate the range of potential consequences:
  - consider range of bushfire events – predict the future
  - provide practical values
  - use reasonable and plausible worst case events to estimate outcomes to inform long term investments,
  - use and fire season, weekly and daily forecasts, and treatment history to inform fire season bushfire and power-line related risk management.

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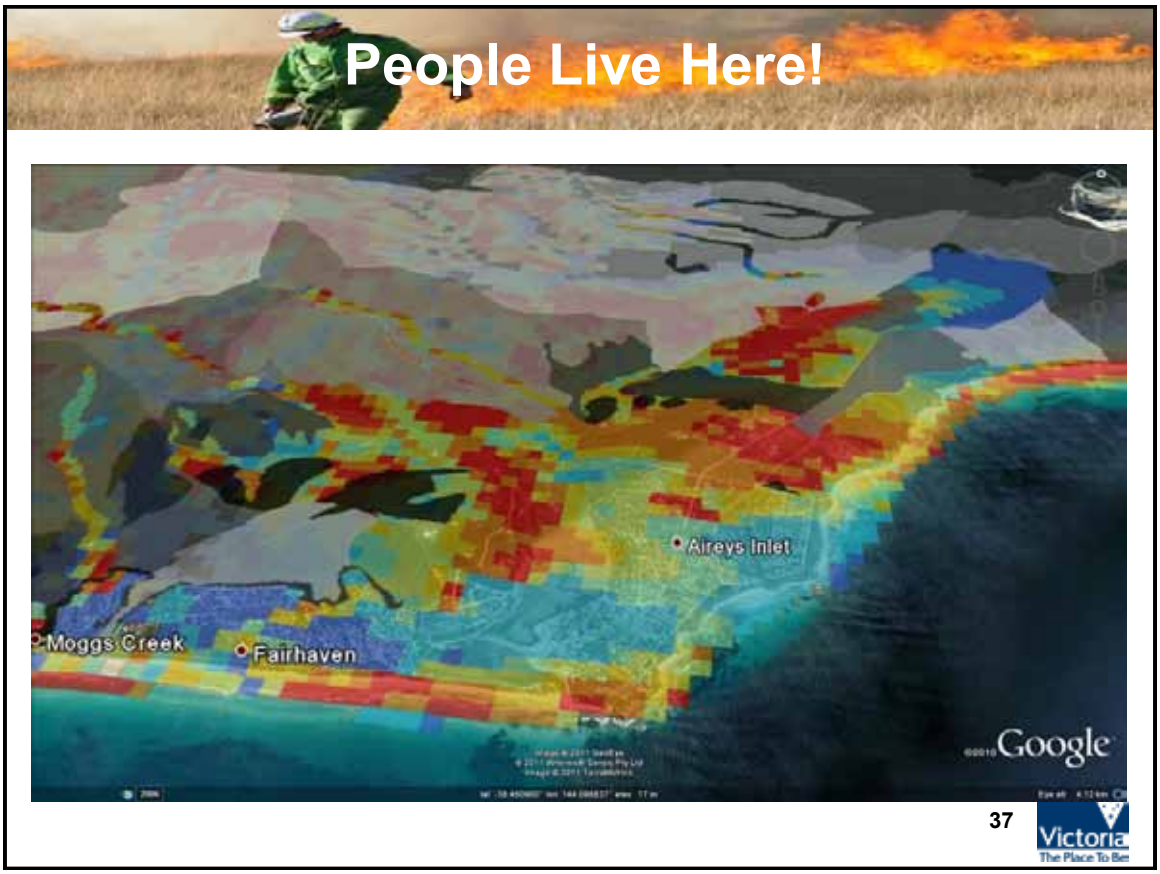
People Live Here!
Aireys Inlet
Moggs Creek
Fairhaven
©2010 Google
37
Victoria
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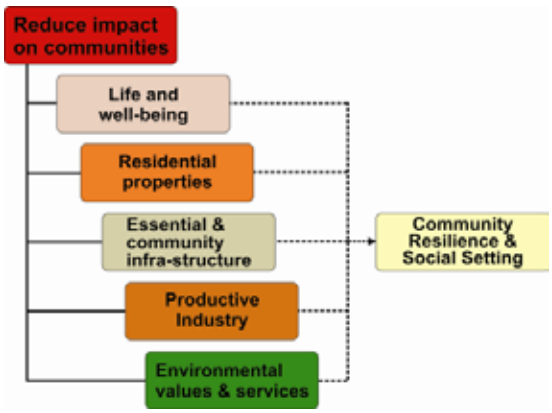
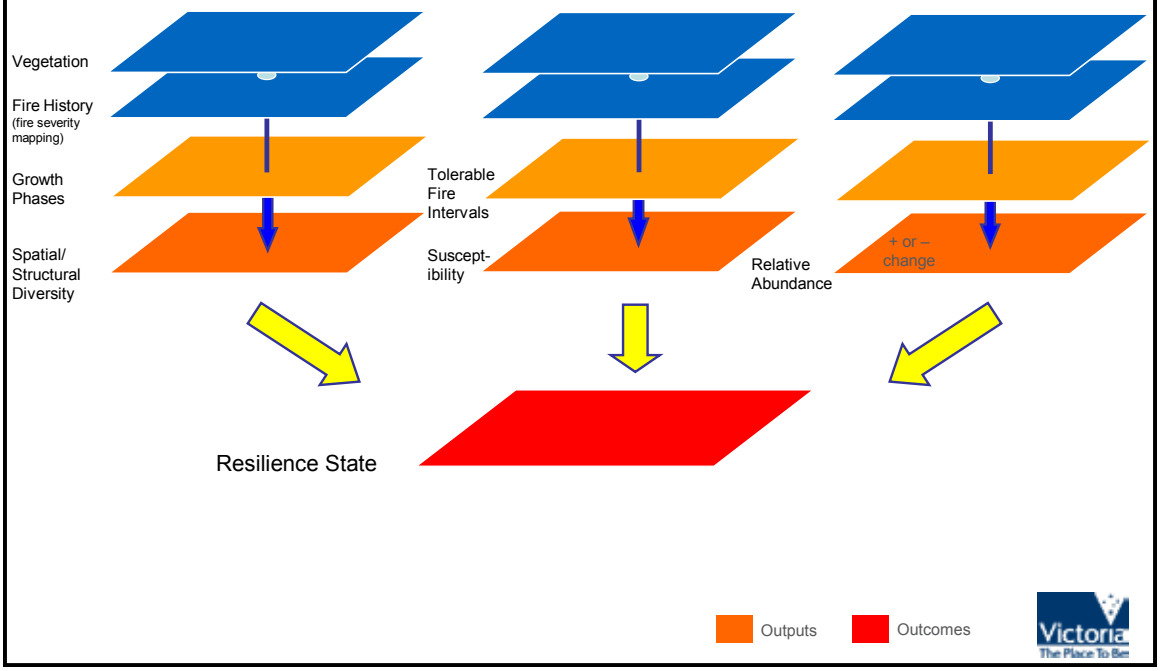
Context: Outcomes and impact measures reflect values

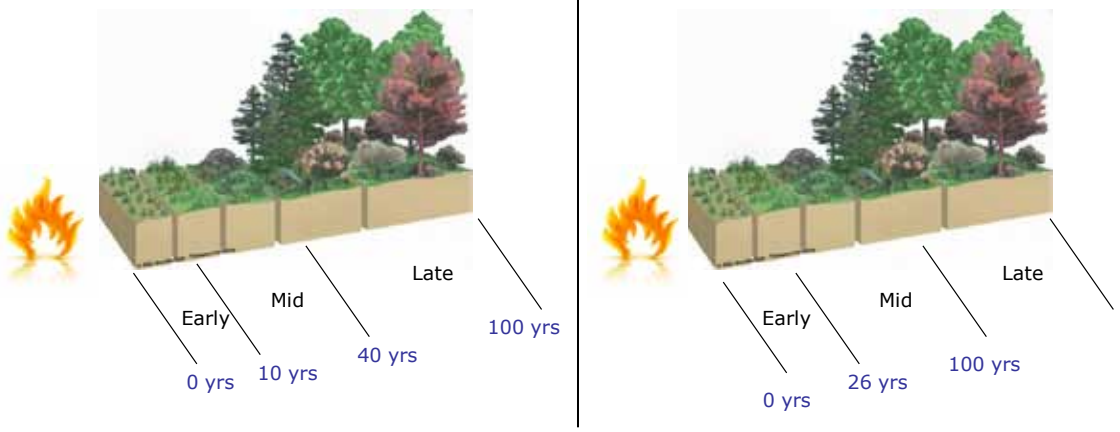


- Options for assessing outcomes (consequences) and measuring success,
- Life is priority – difficult to estimate,
- Property currently used as a proxy for community impacts,
- Can be improved by incorporating:
  - infra-structure and industry disruption,
  - integrated and social and economic measures,
  - integrated social, economic and environmental measures.

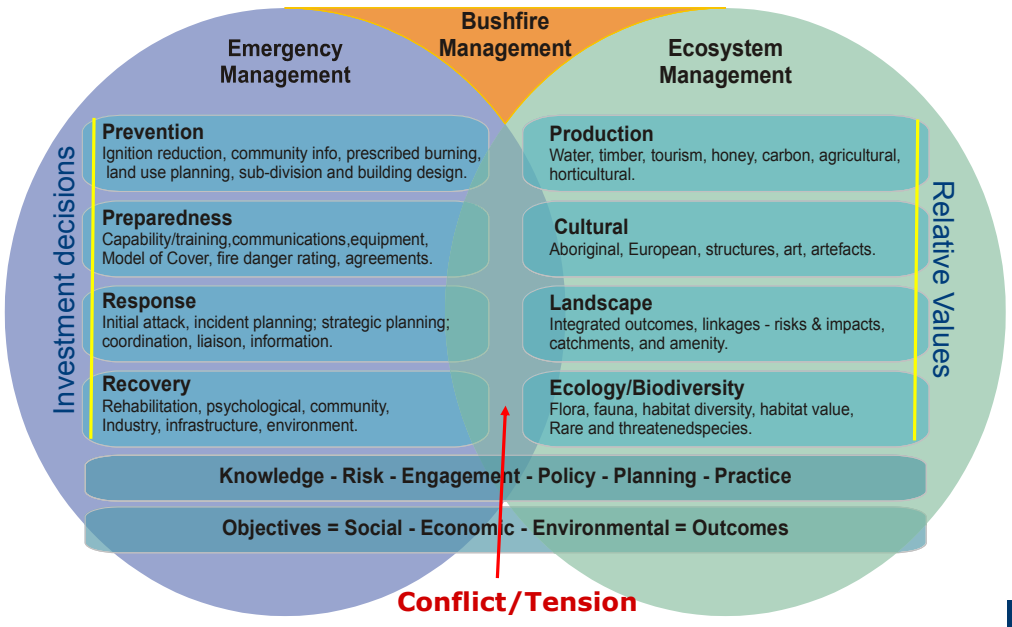
Values and risk profile – Ecological



Growth Stages and ecosystem responses



Bushfire Management policy and stakeholder scope



Risks are incidents/actions/outcomes that negatively impact on objectives

Capability for Global Fire Issues – FRFANZ 2007

- We need people who can bridge issues:
  - Land, fire and emergency management,
  - Land use and development,
  - Broader community values and expectations,
  - Better understand and articulate causes and symptoms,
- Identify social, economic and environmental drivers;
- Understand community/sector values;
- Establish (more) agreed strategies – with communities and stakeholders;
- Use available knowledge:
  - understand risks and trade-offs;
  - negotiate decisions in the face of uncertainty;
- Gather and apply new knowledge – adaptive management;
- Change/alter policy and practice (not just ours) to deal with drivers/meet challenges.

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A simple capability model

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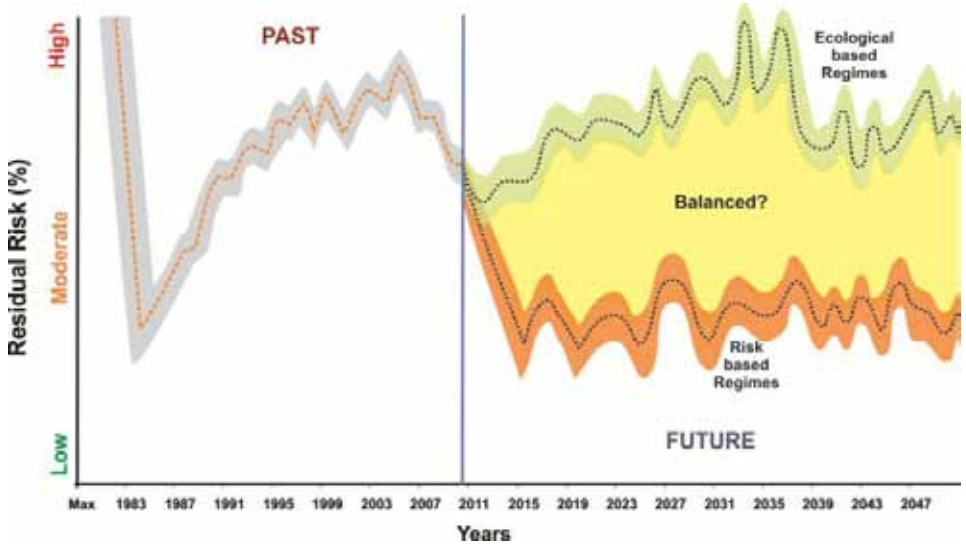
Science Informs Values Based Decision



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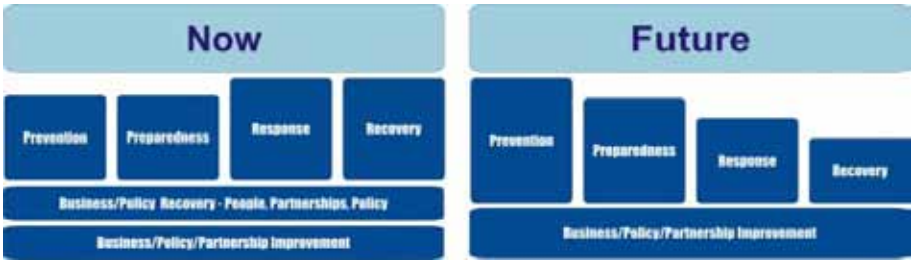
The challenge – changing the balance



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Want to know more?
CONTACT: Liam.Fogarty@dse.vic.gov.au

Richard Thornton
Bushfire and Natural Hazards CRC

Bushfire and Natural Hazards CRC

Shaping a Research Centre

Dr Richard Thornton
Interim CEO

bushfire&natural HAZARDSCRC

- 10 years of co-ordinated research.
- Many successes
- Commonwealth funding finished in July 2013 – commitment to continue until July 2014
- Focus on delivery to end-users in remaining 10 months

bushfire CRC

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SO WHAT DID 'WE' ACHIEVE?

bushfire CRC

© BUSHFIRE CRC LTD 2012

MORE COST EFFECTIVE AIRCRAFT

bushfire CRC

Fire and land management agencies now able to make more informed decisions.

© BUSHFIRE CRC LTD 2012

BETTER VOLUNTEER MANAGEMENT

bushfire CRC

Fire and emergency services have changed the way they manage volunteers.

© BUSHFIRE CRC LTD 2012

GREATER COMMUNITY SAFETY

bushfire CRC

A new national approach to public bushfire awareness based on Bushfire CRC research findings

© BUSHFIRE CRC LTD 2012

INCREASED HOUSE AND VEHICLE SAFETY

bushfire CRC

Increased public safety through better understanding of building construction, preparation and defence, and sheltering in vehicles

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BETTER PRESCRIBED FIRE MANAGEMENT

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A greater understanding of the benefits and limitations of prescribed burning is now more evident

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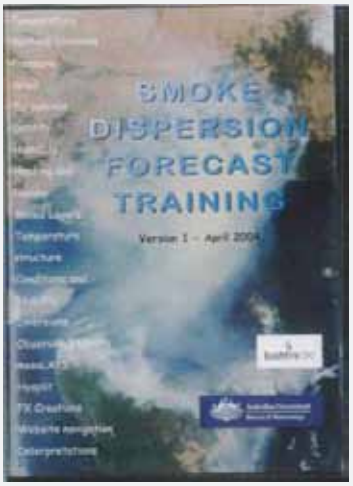
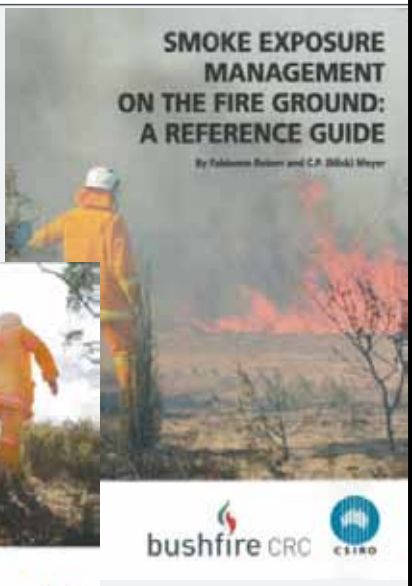
MORE EFFECTIVE SMOKE MANAGEMENT

bushfire CRC

The management of bushfire smoke in the air, on the fire-ground and in the community can be better managed.





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INCREASED UNDERSTANDING OF FIRE BEHAVIOUR

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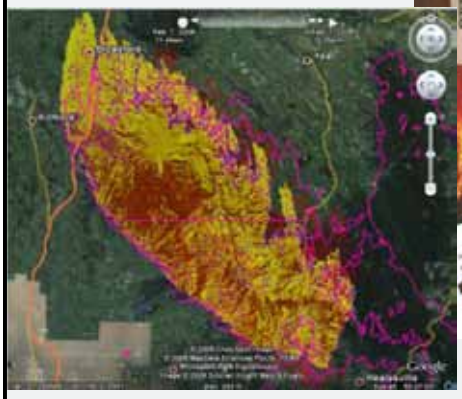
Fire and land managers have better tools and understanding of fire behaviour in a variety of fuels and topography.



Field Guide for fire behaviour in mallee heath

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NATIONAL BUSHFIRE ARSON PRODUCTS

bushfire CRC

Research findings into motivations and patterns are being used to target prevention campaigns and investigations.

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Bushfire and Natural Hazards CRC

- Research to build a disaster resilient Australia
- Building upon a decade of Bushfire CRC achievements
- From 1 July 2013 under Australian Government CRC Program

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A national partnership

- Cooperative Research Centre Program funds - $47m over 8 years
- Fire, Emergency service, policy and land management agencies from all states and territories
- Research partners including Universities, BOM and GA.

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Research

- Coordinated
- Cooperative
- Interdisciplinary

- To support emergency services, government.
- To prevent, prepare for, respond to, and recover from natural disasters.

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Working with communities

- To improve disaster resilience
- To reduce the human, social, economic and environmental costs of bushfires and other natural hazards

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Guiding principles

- National focus
- Large scale of problem
- Multi hazard
- Filling a gap in knowledge
- Sizable impact
- Likelihood of adoption

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195 proposals
35 shortlist
$47m over eight years

1. PM Announcement (13 Feb)
2. Problem statements
3. Call for proposals
4. Proposal evaluation
5. Workshop (23 May)
6. CRC began (1 July)
7. Planning in detail - August
8. Contracts signed - September

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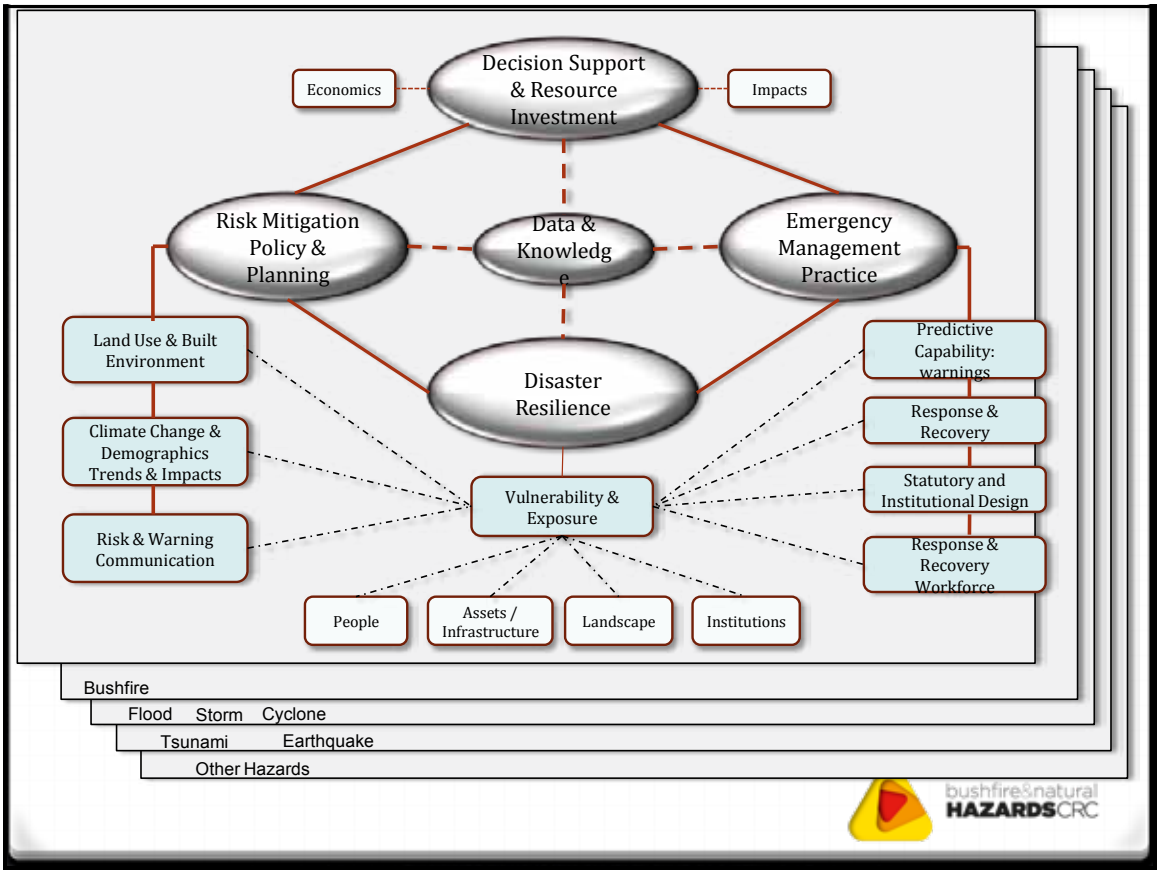

Research Program - themes

- Next generation Fire Danger Rating and fire spread prediction
- Economics and decision-making
- Emergency management operational practices and decision-making
- Landscape vulnerability and resilience
- Natural hazards: monitoring and prediction
- Resilience and mitigation through hardening the built environment
- Resilience: people and community
- Sustainable volunteering

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Expanded focus

Bushfire research focus expanded into:

- Flood
- Storm
- Cyclone
- Tsunami
- Earthquake
- Other natural hazards

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www.bnhcrc.com.au

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Want to know more?
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