Report on Assessing Defendable Space
Around Houses in Bushfire-prone Environments

A report prepared by:

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Dated: 18th June 2009

This report has been written in response to the request by the Counsel Assisting the Royal Commission (letter dated 12 June 2009).
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Dr Kevin Tolhurst, 18th June 2009

This report has been written in response to the request by the Counsel Assisting the Royal Commission (letter dated 12 June 2009). Specifically, the request was to provide a written report which outlines:

(a) the House Ignition Likelihood Index (HILI) which was briefly outlined in your appearance before the Commission on 21 May 2009, including:

(i) an explanation of how the model was developed and how it is applied;
(ii) an overview of the benefits and limitation of the model;
(iii) evidence on the accuracy of the model;
(iv) examples of locations where the model has been used; and
(v) comments on other comparable and/or complementary models, including the CSIRO House Survival Meter developed by Andrew Wilson and the Project Vesta model.

(b) the issues involved in creating a “defendable space” around houses / structures in bushfire-prone areas on the basis that the Commission will consider this issue in greater details during another block of hearings.
Preface

My interest in “Defendable Space” was raised following the release of the Australian Standard for “Construction of Buildings in Fire-prone Areas” (AS 3959-1999) published in 1999. It was my view, and the view of some others, that the assessment of bushfire threat in this Standard was inadequate. The assessment of the “Bushfire Attack Level” (BAL) has been improved in the revised Standard released this year (AS 3959-2009), but it still does not describe the vegetation in terms of its fuel properties, nor does it adequately take into account local weather conditions and topography.

Following discussions in 1999 with Dr Noreen Krusel, a CFA (Country Fire Authority) Officer, I undertook to assess the Standard as part of a student’s honours project. Kelly Howlett was the student who undertook the field data collection and analysis as part of her Bachelor of Forest Science Honours degree. This work was done in the Macedon Ranges, the same area where Andrew Wilson had conducted his research, as part of a Masters of Forest Science degree, on the factors important to house survival following the 1983, Ash Wednesday fires. Ms Howlett’s report was completed by November 2000 and I passed the report on to Dr Krusel in May 2001. To make the findings from Ms Howlett’s report more useful, I summarized her results and other available research into a spreadsheet-based model which I called the “House Ignition Likelihood Index” (HILI) and presented the index and its basis to an international fire conference in Sydney in 2003 (Tolhurst & Howlett, 2003).

The House Ignition Likelihood Index deals mainly with the effect of different fuel arrangements on the probability of a house catching fire in a bushfire under variable fire weather for a specific topographic location for a house with a specific height. The model does not consider the likely survival of a house in a bushfire, this was done by the House Survival meter developed by Wilson & Ferguson (1986) which takes into account the nature of the house design, construction material and the presence or absence of someone to defend the house.

As part of the Bushfire CRC, significantly more research has been undertaken into House Survival by Mr Justin Leonard and his colleagues (e.g. Blanchi & Leonard 2005), but much of Wilson’s House Survival meter (model) (Wilson 1988) remains relevant.
Context
There are four major factors that need to be considered when assessing the defendability of a house. These are: 1) weather, 2) fire, 3) building design & maintenance and 4) level of defence. These factors are shown diagrammatically in Figure 1.

Defendability is a measure of the resistance to damage for a given level of pressure or attack.

Figure 1. Factors important in determining the level of defendability of a house in a bushfire-prone environment.

“Defendable Space” is therefore a relative concept that can only be assessed in the context of the severity of the impact pressure and the strength of the property design and defence force able to be mounted to resist the pressure from a bushfire. The concept of “defendable space” therefore implies a level of probability of success and a probability of failure; it does not ensure certain safety.
**House Ignition Likelihood Index (HILI)**

The House Ignition Likelihood Index (HILI) was designed to quantify the level of fire attack on a house for a specified fuel level within 2000 m of the house, in a given topographic location, under specified weather conditions. It was felt by myself and others, that the Australian Standard did not go far enough to give a realistic assessment of the potential bushfire threat – called the Bushfire Attack Level (BAL) in the Australian Standard (AS 3959-2009).

The House Ignition Likelihood Index does not deal with the level of resistance to bushfire that might be achieved through building design and maintenance or the effect of defence efforts such as fire suppression in and around a house during the time of a bushfire.

The model was developed following the collection of data in the Mount Macedon area which had been previously studied by Andrew Wilson following the Ash Wednesday fires in 1983 (Wilson & Ferguson 1986).

Detailed site assessments were made of 38 houses in Mt Macedon, 10 of which had survived the Ash Wednesday fire and 28 which had been built / rebuilt since the fire.

The assessments included using the approach suggested in the Australian Standard (AS 3959-1999) and a much more detailed assessment of the fuels and topography surrounding each house.

A review of the available literature on the factors affecting house ignition was used to produce a single model of house ignition likelihood. This incorporated the degree of ember attack, the extent of radiant heating, the presence or absence of flame contact and the presence or absence of significant convective heating. These four potential ignition factors were rated separately and in combination to compute a single index – the HILI.

Unlike the Australian Standard (AS 3959), the House Ignition Likelihood Index requires the vegetation to be assessed in terms of its fuel properties, including consideration of the plant species and fire history of the vegetation, rather than simply its structure. In HILI, fuels are divided into “suites” to recognise the fact that low levels of fuel hazards close to a house may be more important than high levels of fuels far away and vice versa. For example embers carried from burning stringybark trees several hundred meters from a house may represent a high level of threat or shrubs up against the house may represent the greatest threat. It is important to know where the potential ignition sources are coming from and what the most likely ignition mechanism might be. In the House Ignition Likelihood Index, the ignition factor contributing the greatest threat from any of the fuel suites is included in the calculation of the index.

Information Entered and Calculated in the HILI Spreadsheet

An example of the spreadsheet used to calculate the House Ignition Likelihood Index is shown in Figure 2. The column on the left is where the data are entered and the column on the right is where most of the calculated values are displayed. The first section in the left column is where the weather conditions being used for the evaluation are entered. These weather conditions need to be varied depending on the location being assessed and the severity being considered. These weather conditions can also be varied to see...
how different the risk of house ignition will be, for example how different it will be for an “Ash Wednesday” scenario to a “Black Saturday” one.

The second section is where you enter the height of the house and the steepness of the slope leading to the house. The ground slope of concern is the average slope in the direction of interest which may be one to two kilometres from the house.

The third section is where the fuels in up to four suites are described using the Overall Fuel Hazard Guide (McCarthy et al. 1999). For example, the first suite may deal with the garden or paths closest to the house. The second suite may deal with the main garden area, the third suite may be an area of modified native vegetation, and the fourth suite may be an area of native forest. Typically, these fuels would be described for a distance of up to two kilometres from the house, since embers will easily travel this distance and it is known that houses have been ignited from embers emanating from up to 700 m away.

The fourth section on the left-hand side of the table is the wind mitigation factor. This takes into account the benefit of trees in locally reducing the wind speed at a house. The shelter of trees affects the wind in the area of the “Suite 1” by either increasing or decreasing the effective wind speed and therefore affecting the effective fire behaviour in this zone.

The right-hand column shows the various calculated values for the expected fire behaviour and the associated likely impact of “Convective Heat Load”, “Flame Zone Contact”, “Ember Attack Load”, “Radiant Heat Load” and the combined “House Ignition Likelihood Index” based on the combination of the four ignition mechanisms. Fire behaviour characteristics are calculated using the McArthur fire behaviour model (McArthur 1977, Noble et al. 1980). The idea of having all this information displayed is that a house owner is able to identify the source of the threat and may be able to deal specifically with that issue.

The HILI has been arbitrarily divided into four classes based on experience rather than experimental results. A rating of “Low” means that there are likely to be only a few ignition impacts on a house which would be relatively easily defended by a well prepared individual. A rating of “Medium” means that there may be several possible impact points that could be controlled with a concerted defence. A rating of “High” means that it would be very difficult to defend this house because the number of ignition points is likely to overwhelm the owner. An “Extreme” rating indicates that it would be virtually impossible to defend this house under the conditions specified, with any conventional fire suppression effort.

These house ignition likelihood ratings are not only dependent on the nature of the fuels in the vicinity of the house, but also the weather conditions. A house that may have a High house ignition likelihood under “Ash Wednesday” weather conditions may be rated as Extreme under “Black Saturday” weather conditions. This means that the ability to defend a house is a function of more than just the nature of the defendable space around it.
House Ignition Likelihood Index

Tolhurst and Howlett (2001) DRAFT (* last revised June 2009)

Disclaimer
This is a draft program requiring further verification. It is intended to provide a guide to house ignition likelihood. The likelihood of ignition is dependent on a complex number of factors and their interactions.

There is an onus of verification and interpretation on the user as the quality of the input data and the appropriateness of the application of the model cannot be taken by the authors of this model.

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<table>
<thead>
<tr>
<th>Legend</th>
<th>Default input</th>
<th>House Ignition Likelihood Index</th>
<th>5.39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Ignition Likelihood Rating</td>
<td>Extreme</td>
<td></td>
</tr>
<tr>
<td>Results</td>
<td>Outputs</td>
<td></td>
<td></td>
</tr>
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</table>

**Fire Behaviour**

<table>
<thead>
<tr>
<th>Suite 1</th>
<th>Suite 2</th>
<th>Suite 3</th>
<th>Suite 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Rate of Spread (m/h)</td>
<td>1200</td>
<td>1800</td>
<td>2400</td>
</tr>
<tr>
<td>Fireline Intensity (kW/m)</td>
<td>4680</td>
<td>7181</td>
<td>11200</td>
</tr>
<tr>
<td>Flame Length (m)</td>
<td>10.4</td>
<td>15.1</td>
<td>47.9</td>
</tr>
<tr>
<td>Duration (min)</td>
<td>0</td>
<td>1</td>
<td>13</td>
</tr>
</tbody>
</table>

**Convective Heat Load**

| Assumed rate of plume rise (m/min) | 70 |
| Distance to convective heat (m) | Default |
| Slope to house top (degrees) | 63.8 |
| Flame slope (degrees) | 10.5 |
| Convective Heat Index (0.1,2) | 1 |

**Local Topography**

| Slope below house (degrees) | 3 |
| Height of house above slope (m) | 4 |

**Local Fuels**

<table>
<thead>
<tr>
<th>Rating (L,M,H,VH,E)</th>
<th>Equivalent Fuel Load (t/ha)</th>
<th>Distance (m) Start - Stop</th>
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</thead>
<tbody>
<tr>
<td>Suite 1 (adjacent to house)</td>
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<td></td>
</tr>
<tr>
<td>Surface FF</td>
<td>m</td>
<td>6</td>
</tr>
<tr>
<td>Near-surface FF</td>
<td>m</td>
<td>6</td>
</tr>
<tr>
<td>Elevated FF</td>
<td>m</td>
<td>0</td>
</tr>
<tr>
<td>Bank FF</td>
<td>h</td>
<td>2</td>
</tr>
<tr>
<td>Overall FF</td>
<td>h</td>
<td>2</td>
</tr>
<tr>
<td>Suite 2 (away from house)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface FF</td>
<td>m</td>
<td>6</td>
</tr>
<tr>
<td>Near-surface FF</td>
<td>m</td>
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<tr>
<td>Elevated FF</td>
<td>m</td>
<td>0</td>
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<td>Overall FF</td>
<td>h</td>
<td>18</td>
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<td>Suite 3 (further away)</td>
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<td></td>
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<td>h</td>
<td>10</td>
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<tr>
<td>Near-surface FF</td>
<td>h</td>
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<td>9</td>
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<td>9</td>
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<td>Bank FF</td>
<td>vh</td>
<td>9</td>
</tr>
<tr>
<td>Overall FF</td>
<td>vh</td>
<td>9</td>
</tr>
</tbody>
</table>

**Wind Mitigation Factor**

| Forest within 2 tree heights | 0.9 |
| Clear view to horizon or >100m c | 0.8 |
| Factor here | 0.3 |

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**Figure 2.** An example of the worksheet used to calculate the House Ignition Likelihood Index. In this case, the probability of ignition is “Extreme” due to convective heating, flame contact, embers attack and radiant heating.

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Evidence of Accuracy of the Model

The House Ignition Likelihood Index has been used intensively in the Otways region by Parks Victoria and the Department of Sustainability and Environment and in the Sydney region by Rod Rose, a bushfire consultant. In both instances, the index has been valuable in decision making, but has not been tested with bushfires. The following are three case studies where the model has been tested after bushfires.

Case Study 1

At the time of its development, the House Ignition Likelihood Index (HILI) was used to rate the 38 houses assessed at Mt Macedon. About 70% of the houses that survived Ash Wednesday were rated as having a Low or Medium house ignition likelihood and those classified as having and Extreme HILI only represented 10% of the Ash Wednesday survivors (Figure 3). This contrasted with over 40% of the rebuilt homes being on Extreme sites, indicating that many of the houses on Extreme sites had been lost on Ash Wednesday. Although it is acknowledged that a few new house sites had been established since Ash Wednesday and that the fuels around some houses may have been different at the time of the survey than they were in 1983. The House Ignition Likelihood Index still provides good predictive power of houses more likely to be defendable.

![Figure 3](image-url)  
*Figure 3. House Ignition Likelihood rating of 10 surviving houses and 28 new houses in the Mt Macedon area burnt in 1983 (data from Howlett 2000).*

Case Study 2

The House Ignition Likelihood Index was also used to assess the Sheahan’s house in Reedy Creek in 2004. Fuel modification around this house had dropped the House Ignition Likelihood from Extreme to Moderate assuming a Forest Fire Danger Index of 100. This house was exposed to fire intensities of about 60,000 kW/m on Black Saturday and was subjected to intense heat and embers for over an hour (Figure 8). The family of four adults were able to defend their home in spite of the house catching alight several times during the fire. All other houses in their neighbourhood would have had a House Ignition Likelihood Index of High or Extreme and were destroyed (Figure 7).
Figure 4a & b. Forest to south of Sheahan's house before and after “Black Saturday”. This forest extended for 1 km to the valley on an average slope of 25 degrees.
Figure 5. View of house from entrance gate before fire (2004). Extent of clearing evident. Plans were in place to plant low-flammability tree species in this area with grazed grass underneath.

Figure 6. Fuel management zones around house as indicated to be needed by HILI. Blue area is low fuel area and yellow area is woodland with grassy understorey. Designed for a Forest FDI of 100.
Figure 7. Google Earth aerial photo of Reedy Creek showing the location of the Sheahan property (yellow circle) and location of buildings destroyed by the Black Saturday fire (red crosses).

Figure 8. Satellite image of Reedy Creek area after the Black Saturday Kilmore East fire showing the burn severity in the vicinity of the Sheahan property (yellow circle). The fire approached from the south after the wind change.
Case Study 3
I made a similar analysis of Wesley College’s Chum Creek Camp in 2003. The recommendations of my report to reduce the fuel hazards to Moderate or less in the vicinity of the dormitories and main buildings were all acted upon. On Black Saturday, the East Kilmore fire approached the camp from the west with average flame heights of about 4 metres (Figure 9). The fuel modified zones were sufficient to prevent the fire impinging on the dormitories (Figure 10).

Figure 9. Forest burnt as fire approached school camp buildings from the west at Chum Creek Camp, Wesley College. Average flame heights were estimated to be 4 metres. No fuel modification in this zone.

On days subsequent to Black Saturday, fire approached the camp from the east. Fuel modified areas such as those shown in Figure 11, made it easy to prevent the fire burning any closer to the facilities. These fuel modified areas were defendable zones. A combination of slashing, manual removal of fuels, prescribed burning and selective planting/thinning of trees are used to modify the fuel hazard levels. The bush character of the site has been maintained.

As a contingency, a significant fire shelter was built on the site in a carefully planned location (Figure 12). A few essential facilities such as water, toilet and first aid kit are stored in the shelter (Figure 13). The preferred plan is to evacuate the site early, but if this is not possible, then it is planned to use the shelter. No school children were at the camp on Black Saturday and the staff evacuated before fire reached the camp and returned Sunday morning and blacked-out areas still burning.

In the absence of the defendable space, the dormitories and other buildings are likely to have been destroyed.
Figure 10. Flame height reduced to 0.5 metres and less in fuel modified zone within 30 metres of dormitories. Only peppermint eucalypts retained in this area; no stringybark species to generate embers. Chum Creek Camp, Wesley College.

Figure 11. Fuel modified zone on north east side of buildings. Fire approached camp from east on subsequent days but was easily held on these fuel breaks – slashed in foreground, prescribed burnt in gully. Chum Creek Camp, Wesley College.
Figure 12. Emergency fire shelter (centre) at Chum Creek Camp, Wesley College.
Planned to be used if early evacuation not possible.

Figure 13. Inside the emergency fire shelter at Chum Creek Camp, Wesley College.
Benefits and Limitations of the House Ignition Likelihood Index

The House Ignition Likelihood Index provides a better fire context in which to assess house defendability than other existing models and guidelines. Specifically:

- Fuels are explicitly assessed as fuels and fed into the fire behaviour calculations.
- It is applied individually to each house site and will consistently apply the same method of evaluation to different houses.
- The HILI also allows for “what if?” scenarios to be explored so that limits of defendable space effectiveness can be tested and weakest links identified.
- The HILI calculation is not limited to a specific range of slope, weather, fuel or other input conditions as are some other models.

Limitations of the HILI include:

- A need for the user to be competent in assessing bushfire fuels and understanding the possible fire weather conditions for the site being assessed. This requires a certain level of expertise that may not be held by all house owners, firefighters, or municipal officers.
- HILI is also based on a range of published and unpublished impact models which have not been fully validated. Field validation is required to improve the confidence in the index and the ratings it produces.
- The HILI only deals with issues concerned with the level of “pressure” on house survival, it does not deal with the level of “resistance” that can be mounted through planning, design and intervention during a fire.

Other Models

Australian Standard AS 3959-2009

The Australian Standard (AS 3959-2009) uses an assessment of the potential “Bushfire Attack Level” (BAL), as a basis for determining the need for different design features in buildings in bushfire-prone areas.

The Bushfire Attack Level is based on an assumed Forest Fire Danger Index of 100 for all of Victoria except alpine areas were an index of 50 is assumed. This sets a design condition, but the likelihood of an FDI of 100 will vary across the State and as a consequence the level of design protection will also vary across the State. Weather conditions where the FDI exceeds 100 are not considered.

The second step in determining the Bushfire Attack Level is to assess the vegetation. The assumption here is that the fuel hazard level is directly related to the vegetation structure. This is not the case. Two vegetation types of similar structure can have very different fuel characteristics depending on the fire history in the area, the species present, the age of the vegetation and a range of other factors. The assessment of the vegetation structure on its own is not a good measure of fuel characteristics.

Vegetation more than 100 m from a house or strips of vegetation less than 20 m wide and more than 20 m from a house (such as roadside and streamside vegetation) are not considered. Research shows that embers and heat from fires as far away as 700 m can...
be sufficient to destroy houses. The 100 m limit may have some administrative benefit, but it does not acknowledge the real bushfire threat.

The way in which slopes are considered in the Standard, assume relatively low intensity and small-scale fires. We know that most house loss occurs in high intensity, large-scale fires. Sites where the ground slope is greater than 20 degrees (such as the Sheahan property at Reedy Creek) are not considered.

The maximum fine fuel loads for any vegetation type is taken to be 35 t/ha. In wetter forest types (e.g. Yarra Ranges, South Gippsland, Otways) during drought, the available fine fuel load could be 50 t/ha. The Standard, therefore, significantly under-estimates the potential fire intensity in these forest types.

Wilson’s House Survival Meter (1987)

Wilson’s House Survival Meter (Appendix 1) calculates the probability of an individual house surviving in a bushfire; based on the slope of the ground and fine fuel levels in close proximity to the house, the building materials used in the walls and roof of the house, the presence or absence of someone actively defending the house and the presence or absence of trees or other flammable material such as wood heaps or sheds within close proximity of the house. The survival probability is based on the experience of the 1983 Ash Wednesday fires at Mt Macedon.

This model provides a guide to the chances of a house surviving in a bushfire and enables the importance of various contributing factors to be explored. The inputs to this model are largely factors that can be controlled by the house owner and do not include the contribution of fuels and fire behaviour on neighbouring property such as State Parks or Forests.

Considerably more research and surveys have been conducted since Wilson’s work on house survival. However, the general relationships and the main contributing factors have held true. The importance of house-to-house ignition has been highlighted as an important factor in more recent fires (e.g. Blanchi & Leonard 2005), and this has not been specifically included in Wilson’s model.

Project Vesta Model

The VESTA fire behaviour model is based on field experiments in Western Australia (Gould et al. 2007a, b). This model gives estimates of fire behaviour such as spread rate and spotting distances which can be used to evaluate the bushfire intensity and severity at houses in forested environments.

A range of other fire behaviour models can also be used for estimating the likely characteristics of bushfires. Some models have been developed for specific fuel types such as pine plantations, heathlands, and grasslands.

Guidelines for Building in a Wildfire Management Overlay Area

The Country Fire Authority (CFA) produced guidelines for building design and vegetation management in areas identified as having a high level of bushfire risk (CFA
2007). Residential development in areas covered by a Wildfire Management Overlay have specific planning permit controls managed by local governments. Developments in a Wildfire Management Overlay area are subject to restrictions on building design, location and ongoing site management.

The assumed design fire-weather conditions for the guidelines is not specified (I would assume it is for a Forest Fire Danger Index of 100), but it is uniformly applied across Victoria.

Fuels are divided into just two categories: “lower risk” and “higher risk”. Fuels are not specifically assessed and it is assumed that vegetation structure is strongly related to fuel characteristics which it is often not the case. Fuels are only assessed within 100 m of a house so it is mainly concerned with the impact of flame contact and radiant heat not ember attack.

Slope steepness is not specifically considered. Slopes are categorised as being “up slope”, “down slope” or “flat”. Fire intensity varies greatly with slope steepness, so by not including this, the assumed intensity could vary by a factor of 10 from the “design” conditions.

The extent of defendable space is divided into two zones. The inner zone extends for 10 m from the house in all directions and the outer zone will extend up to an additional 85 m depending on the slope and vegetation present. (I believe that the extent of the inner zone is less than 10 m in some areas such as the Yarra Ranges and in alpine resorts). No specific fuel levels are given for either zone, but it is assumed that the fuels in the inner zone will be modified: “to eliminate direct flame contact from the vegetation in the outer zone, and reduce radiant heat, fire intensity and ember attack to a level where the house is unlikely to be ignited from passage of wild fire.” The purpose of the outer zone is: “to moderate the fire behaviour so that the inner zone vegetation management is effective.” The problem with limiting the planning considerations to the area within 100 m of the house is that under severe conditions such as Black Saturday, the fire can be impacting on a house while it is a kilometre or more away from the house. The nature of a fire within 1 to 2 kilometres of a house will determine how effectively a house owner can defend their home if the fire conditions are extreme.
Conclusions

The concept of “Defendable Space” makes the assumption that it is possible to establish an area around a house where it will be safe to actively defend your home during a bushfire. It does not assume that your home will be saved, but the chances of the house surviving are increased. It does assume that your personal safety is assured.

Defendable space can only be considered in the context of the nature and extent of the fire and the severity of the weather conditions on one side, and the adequacy of the design and maintenance of a house and the level of active defence that can be mounted during a bushfire, on the other. Whether or not a house is defendable is a function of the interplay of all these factors.

Most existing standards, prescriptions, guidelines and models do not adequately consider the full array of interacting factors. Most definitions of “defendable” are for a fixed set of conditions without the flexibility of being able to reassess the degree of defendability under different sets of circumstances such as more severe weather conditions.

The House Ignition Likelihood Index incorporates a greater degree of flexibility in assessing the degree of defendability in an unlimited range of conditions. To date, the HILI has provided good guidance to the level of defendability, but it needs more extensive testing.

Fuels need to be assessed as such and not indirectly as vegetation types. There are specific properties of fuels not adequately accounted for in broad vegetation descriptions, but which are critical to fire behaviour.

Fuels and site conditions need to be assessed beyond 100 m of a house to give a realistic evaluation of the potential fire impact. In Extreme fire events, when most house losses have historically occurred, the nature of the fire up to two kilometres away is important to the defendability of a house.

There is a need to have a certain level of expertise to competently assess the degree of house defendability. This level of expertise is often not locally available.

Life saving options when the level of defendability is exceeded need to be considered. These considerations should include the use of fire shelters and provision of safe access and egress from houses to safe areas.

A link should be made between warning messages, given out by fire agencies and the Bureau of Meteorology, and the level of defendability people know they have at their home.

Defendability needs to be communicated as a conditional concept, not a guarantee.
References


Appendix 1 – Wilson’s House Survival Meter, 1987

HOUSE SURVIVAL METER

1. Set arrow against the slope of the ground downhill of the house site. The fuel scale will now be in its correct and final position.

2. Set arrow against (not in between) one of the four ▲ s for fire intensity. Your choice will depend on the fuel load near the house. Estimate the fuel load (see back of meter) and find the mark for that value on the fuel load scale. Against this mark is a fire intensity class (e.g. high) — choose the ▲ for this class.

3. Set arrow against one of the four ▲ s for wall material and house attendance during the fire.

4. Set arrow against one of the three ▲ s for roof material and pitch.

Without moving any dials, read off the approximate probability of house survival against one of the four ▲ s for presence (near the house) of trees and sheds or woodheaps.

APPROXIMATE PROBABILITY OF HOUSE SURVIVAL (%)
This guide to house survival during bushfires is based solely on research into the house losses that occurred during the 1983 Ash Wednesday fire at Mount Macedon, Victoria. It is designed for houses exposed to a forest fire which is blown by strong winds on a very hot day. In a forest, assume that the meter may be in error by plus or minus 15%. In grassland or other fuel types it should be useful but less accurate.

**FIRE INTENSITY** is the most important factor which determines house survival; it can be reduced by decreasing the amount of **FUEL** (dry grass and dead leaves, bark and small sticks) on the ground within at least 40m of the house. This fuel can be removed by burning in mild weather, or by raking, grazing or mowing. For most houses, reducing the fuel load is the least expensive and most effective means of increasing the survival chances of the house, and of making the house a safer refuge during a fire.

To measure **FUEL LOAD**, measure a 1m by 1m square on the ground. Collect all dead fuel that is thinner than a pencil, thoroughly dry this fuel until the sticks are quite brittle, then weigh it in grams (on some kitchen scales). Divide this weight by 100 to give you the fuel load in units of tonnes per hectare (t/ha). For best results, obtain several more estimates of fuel load (eg in areas near the house where the fuel load is relatively high, medium and low) and average these values.

**TREES** near a house increase the hazard by a small amount. Trees can, however, be retained if the fuel load on the ground is reduced.

**ATTENDANCE** during a fire is important for house survival. People who stay at a house throughout a fire can extinguish small fires and thereby stop a house from burning down. Evacuations just before the fire arrives are risky. A house or similar building is usually the safest refuge during a fire; even a house that subsequently burns down will protect occupants from the lethal peak of the bushfire’s heat. Calculate a probability of house survival for both the attended and unattended situations.

Users of the meter should obtain further information by reading the publications listed below; and by contacting the fire control or forest agency in their State. Copies of this meter can be obtained from CSIRO’s National Bushfire Research Unit, PO Box 4008, Canberra ACT 2600.

Assessing the bushfire hazard of houses: a quantitative approach.
National Centre for Rural Fire Research,
Chisholm Institute of Technology,
Melbourne, Vic. 18pp.

Fight or flee? — a case study of the Mount Macedon bushfire.
Australian Forestry Vol. 47 pages 230-236.

Predicting the probability of house survival during bushfires.
Journal of Environmental Management Vol. 23 pages 259-270.