Revised Bushfire Protection Assessment

North Turramurra Aged Care Redevelopment

Prepared for
Southern Cross Care

11 December 2014

DOCUMENT TRACKING

Item	Detail
Project Name	Bushfire Protection Assessment, Aged Care Redevelopment – 402 Bobbin Head Road, North Turramurra
Project Number	13SGBBUS-0056
Project Manager	Rod Rose 02 4201 2267 8/128 Island Point Road, St Georges Basin
Prepared by	Rod Rose
Reviewed by	David Peterson
Approved by	Rod Rose
Status	FINAL
Version Number	4
Last saved on	11 December 2014

This report should be cited as 'Eco Logical Australia December 2014. *Bushfire Protection Assessment, Aged Care Redevelopment – 402 Bobbin Head Road, North Turramurra*. Prepared for Southern Cross Care.

Contents

List of Figures

List of Tables

1 Property and proposal

Name:	Southern Cross Care		
Street or property name:	402 Bobbin Head Road		
Suburb, town or locality:	North Turramurra	**Postcode:**	2074
Lot/DP no:	Lot 8 DP 23868		
Local Government Area:	Ku-ring-gai Council		
Type of development:	Infill - Special Fire Protection Purpose		

1.1 Introduction

This report is a revision of the previous BPA dated 15th April 2014. The revision has come about following RFS request for additional information and a meeting with RFS officers on the 7th November 2014. The revised areas of this version of the Bushfire Protection Assessment are:

- Section 1.1 and 1.2;
- Section 1.4, paragraph 1;
- Section 2.2, paragraphs 3;
- Section 2.3 (underlining emphasis in paragraph 2);
- Section 2.4 (paragraph 3 onwards);
- Table 1;
- Section 5 (paragraph 1 and Table 2);
- Figures 5 and 6;
- Table 4;
- Section 9.1;
- Section 11.1;
- Section 12 (conclusion);
- Appendix 1;
- Appendix 2;
- Appendix 3.

Southern Cross Care (NSW & ACT), commissioned Eco Logical Australia Pty Ltd (ELA) to prepare a bushfire protection assessment (BPA) for the proposed Aged Care redevelopment, situated at 402 Bobbin Head Road, North Turramurra (hereafter referred to as the subject land).

This Bushfire Protection Assessment was prepared by ELA Director - Bushfire, Rod Rose (FPAA BPAD-A Certified Practitioner No. BPAD-PA-1940); and reviewed by ELA Principal Bushfire Consultant David Peterson (FPAA BPAD-A Certified Practitioner No. BPD-PA-18882). Both are highly qualified and experienced in alternate solution bushfire protection measures for Special Fire Protection Purpose developments.

1.2 Additional Information request

A summary of the additional information requested by the RFS is provided in italics below, with an indication of how this is dealt with in this Revised Bushfire Protection Assessment provided immediately below each point:

- *Demonstration that the proposal will result in a safer outcome for the site and wider community*.
    - *An issue by issue 'safety' comparison of the existing RACF against the proposed Facility is provided as Appendix 1 and summarised in Section 2.4. Also see Section 12 (conclusion).*
- *A emergency evacuation management plan detailing the method(s} of evacuation of all residents on the site;*
    - *An Emergency Evacuation Management Plan accompanies this Assessment.*
- *An assessment of the impact of the above evacuation methods on evacuation of residents in the wider North Turramurra area, including impacts on traffic and emergency services;*
    - *A Traffic Engineer study has been completed and is provided as Appendix 2.*
- *Further details in relation to the safety of the proposed on-site refuge, including compliance with relevant standards;*
    - *A Fire Engineers report is provided as Appendix 3.*
- *Confirms the slopes under the hazard adjoining the site and provides an updated assessment based on these.*
    - *See Section 2.2.*
- *Confirms the proposed number of residents in the redeveloped facility.*
    - *See Section 1.4, paragraph 1.*

1.3 Location and description of subject land

The subject land is located at North Turramurra on Bobbin Head Road (see Figure 1). It is also located on Bushfire Prone Land (see Figure 2).

The subject land has development on all but its south-western boundary which abuts an expanse of bushfire prone vegetation (forest) within Ku-ring-gai Chase National Park (see Figure 1). The locality also has a history of bushfire, and bushfire attack of the site is considered highly probable in the future.

1.4 Proposed development

An existing Residential Aged Care Facility (RACF) on the subject land provides for a maximum of 113 residents and is to be redeveloped to provide a Facility with a reduction of 9 RACF occupants (to 104) and the inclusion of a maximum of 48 residents in Independent Living Units (ILU). Staff numbers for the existing and proposed facility remain the same at 39. The maximum on-site residents in the proposed facility are 152, a net increase of 39.

The existing facility was constructed many years prior to the introduction of the NSW bush fire planning requirements from *Planning for Bushfire Protection* in 2001 and 2006 and *Australian Standard AS3959 Construction of Buildings in Bushfire-prone Areas*. It therefore is a facility that has minimal contemporary bushfire protection measures incorporated into the building or its surrounds and an external fabric which is highly vulnerable to bushfire attack. As it is a facility located on bushfire prone land on a relatively high risk site with a large existing building located with the Flame Zone, its bushfire risk is a serious concern, and one that owners of the facility wish to correct.

The development is an infill development as it involves the redevelopment of an existing Residential Aged Care Facility. It is also a Special Fire Protection Purpose (SFPP) development. The proposal is to replace all of the existing buildings in the Residential Aged Care Facility (RACF) except for Huon Park House and the Chapel (see Figure 3) and locate these in a position of lower bushfire risk, with buildings constructed to be compliant with its Bushfire Attack Level (see Figure 4 and Figure 6). This will provide a substantial improvement in bushfire safety for residents, visitors and emergency responders. In addition to this higher level of bushfire safety and resilience an on-site refuge (see Figure 4) for use during a bushfire attack will be provided in the event that a bushfire attack occurs under circumstances where an off-site evacuation is not feasible (a highly likely scenario as explained in Sections 2.3 and 9.1).

The redevelopment proposal offers a critically important opportunity to redress the bushfire safety concerns of the existing RACF. Although there is an increase in occupants numbers (by 39) the number of frail persons decreases by 9, and importantly there is a replacement of a grossly under protected existing RACF with a much higher level of bushfire safety. In the authors expert judgement this provides a significant net improvement in bushfire safety.

The rationale behind this judgement is that a major building within the current RACF is located within the Flame Zone (see Figure 6), and is extremely vulnerable to destruction during bushfire attack. If this building is ignited then the duration and intensity of its burning will probably spread a fire to all buildings within the existing RACF. It is also highly probable that a bushfire burning under an FDI of 100 (Catastrophic Fire Danger Rating), which is the weather scenario required to be used under PBP for development design, would impact the site well before evacuation could be completed (see Section 9.1). This means that the total occupancy of the site (113) plus staff and visitors would potentially not survive the bushfire attack. This fire risk is therefore considered much higher than that associated with an additional 39 residents within a development only located within a BAL 29 or less and within building designed to withstand this level of attack.

1.5 RFS consultation

A meeting with the NSW RFS at their offices in Glendenning was held on the 9th January 2014 and 7th November 2014. Issues raised by the RFS at the meeting have been addressed in the design of the proposed development.

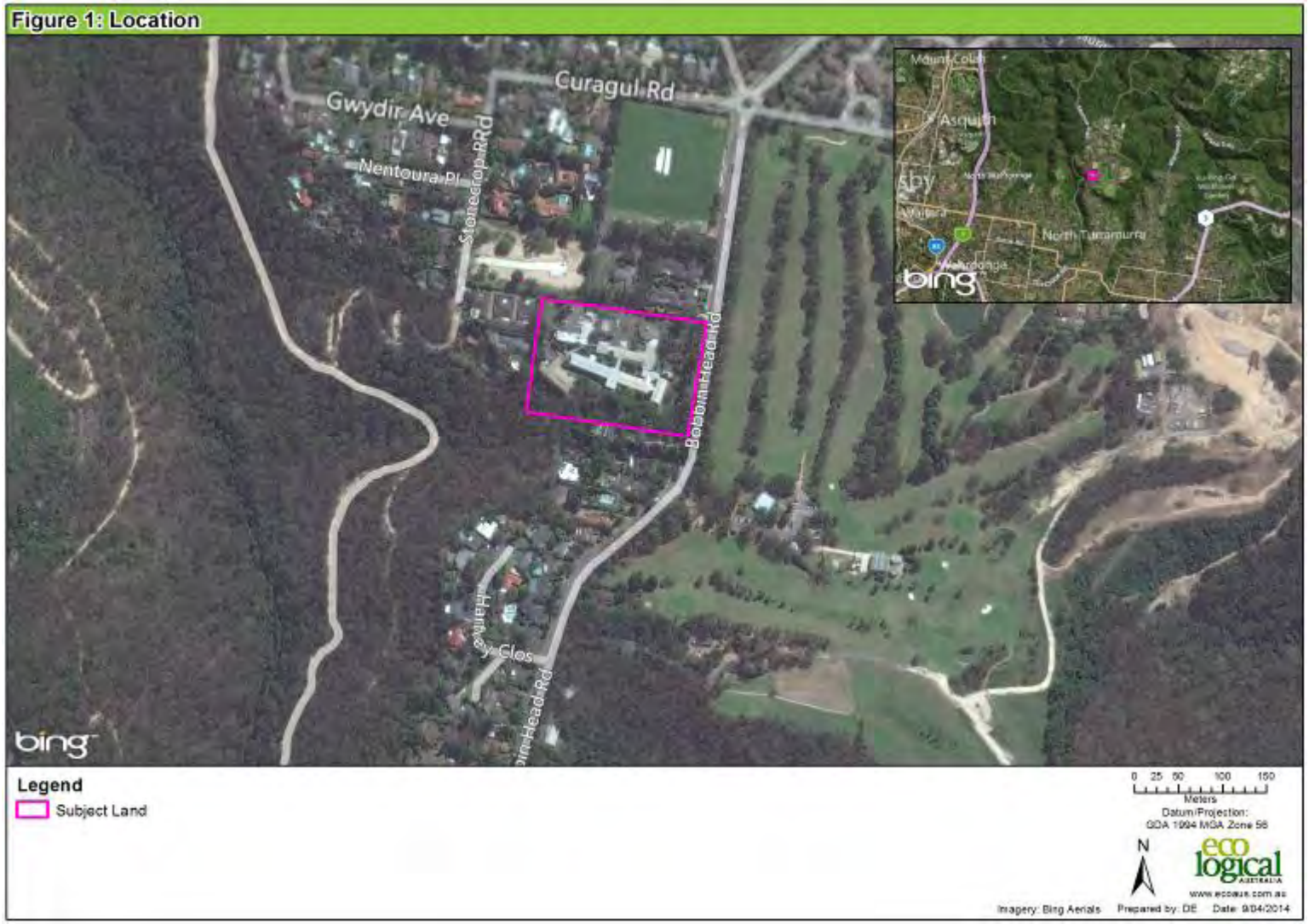


Figure 1: Location of subject land

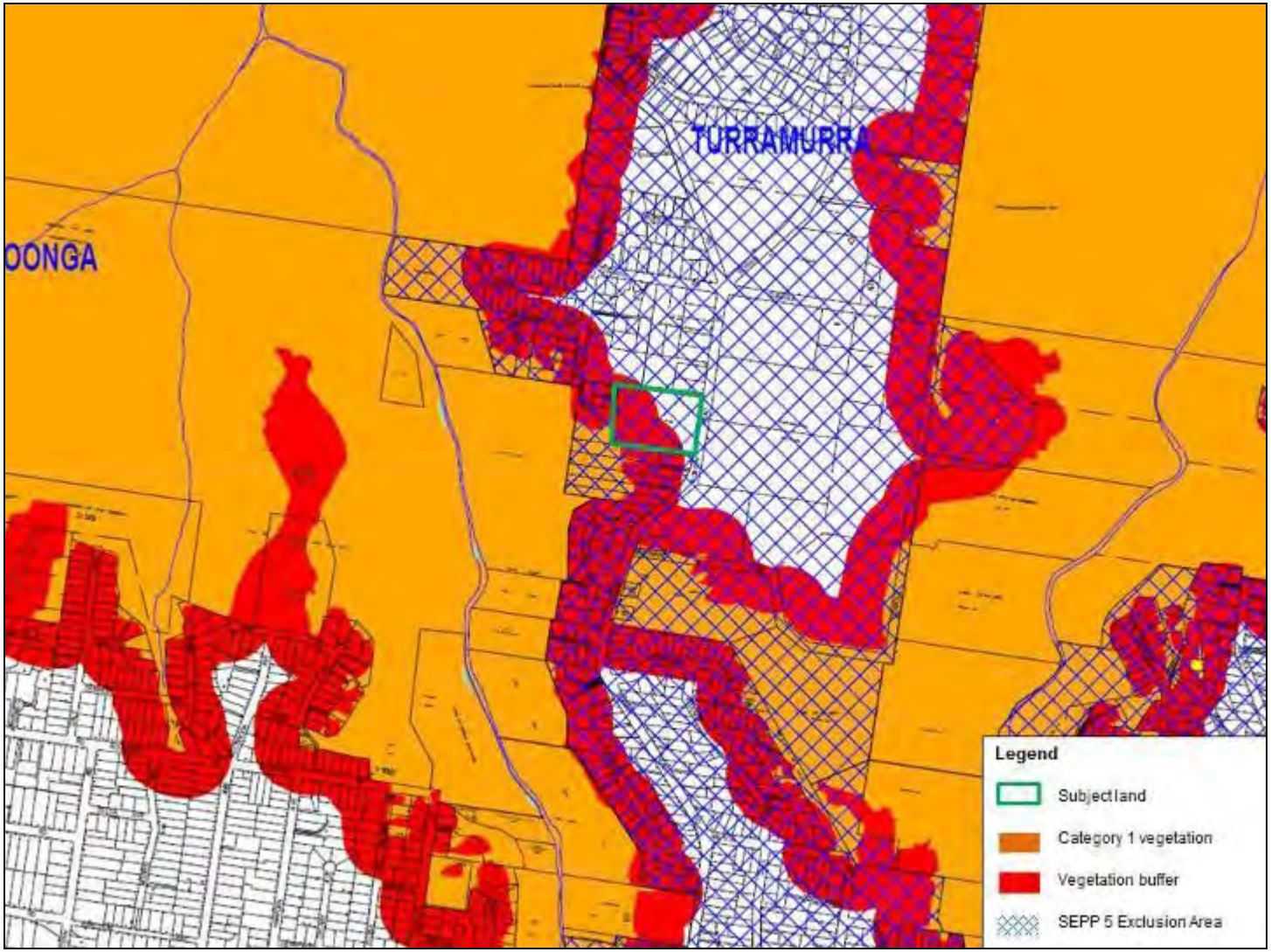


Figure 2: Bushfire Prone Land map

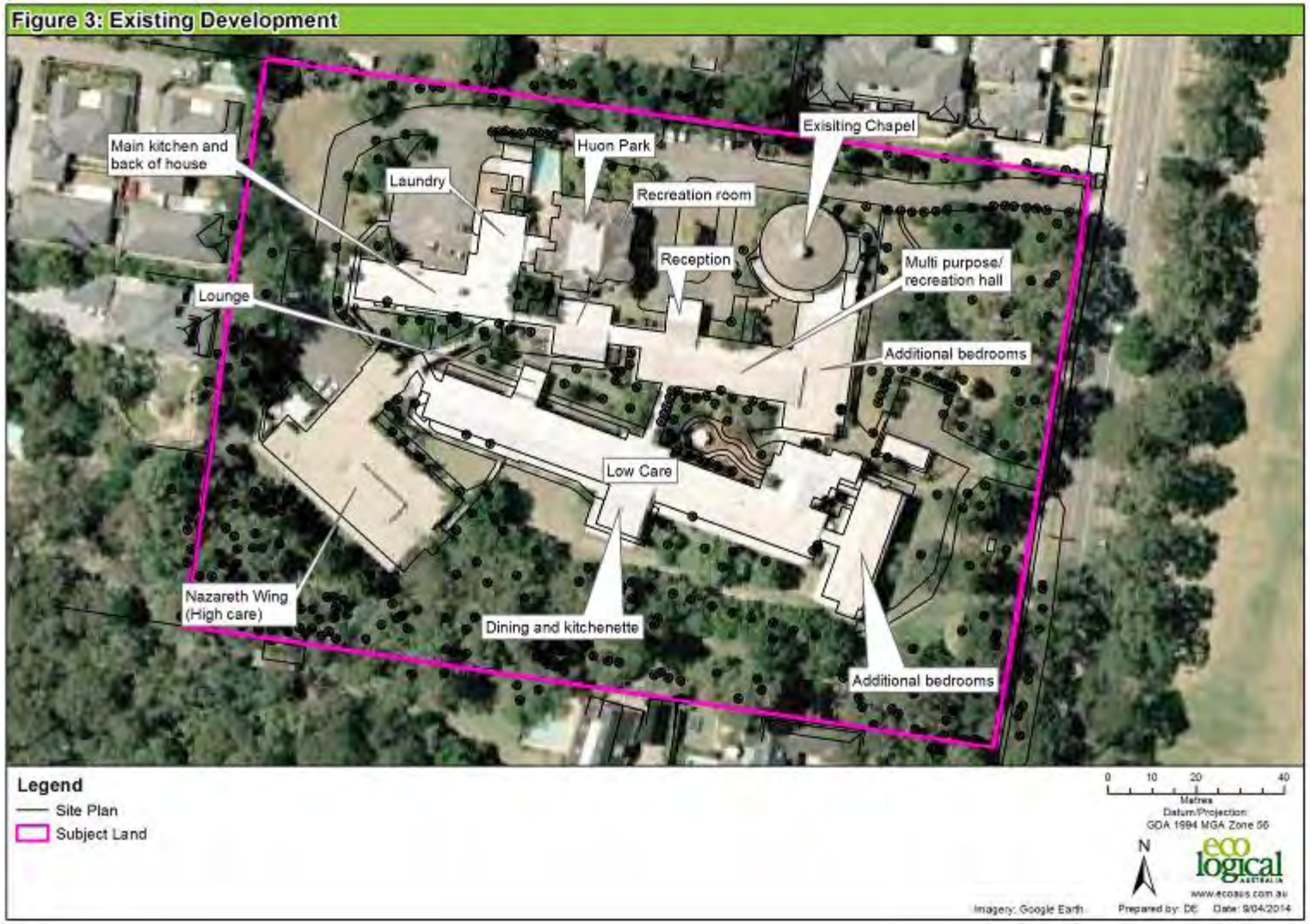


Figure 3: Existing Development

Figure 4: Proposed Development

2 Bushfire threat assessment

2.1 Bushfire protection assessment requirements

In accordance with Section 91 of the Environmental Planning & Assessment Act, 1979, the proposed development is *integrated development* and requires the concurrence of the RFS. The following assessment is therefore prepared in accordance with Section 100B of the *Rural Fires Act 1997*, Clause 44 of the *Rural Fires Regulation 2008*, and '*Planning for Bushfire Protection* 2006' (RFS 2006) herein referred to as PBP.

The proposal is an infill Special Fire Protection Purpose (SFPP) development. SFPP developments are treated and assessed differently to other developments, and they require a higher standard of bushfire protection due to one or more of the following reasons:

- Occupants may not originate from the area and therefore may be less educated in relation to bushfire impacts
- They may have a reduced capacity to evaluate risk and respond adequately to the bushfire threat
- They may be more vulnerable to stress arising from bushfire threat; and
- They may present logistical difficulties for evacuation, due to reduced mobility, larger numbers of people, communication barriers and the requirement for increased supervision.

The PBP specific objectives for SFPP development are to:

- *Provide for the special characteristics and needs of occupants. Unlike residential subdivisions, which can be built to withstand the fire event, enabling occupants and firefighters to provide property protection after the passage of fire, occupants of SFPP developments may not be able to assist in property protection. They are more likely to be adversely affected by smoke or heat while being evacuated*
- *Provide for safe emergency evacuation procedures. SFPP developments are highly dependent on suitable emergency evacuation arrangements, which require greater separation from bushfire threats. During emergencies, the risk to firefighters and other emergency services personnel can be high through prolonged exposure, where door-to-door warnings are being given and exposure to the bushfire is imminent*.
- Section 4.2.5 of PBP identifies the requirements for SFPPs as infill (PBP p. 30); these requirements are provided below:
- *"In circumstances where alterations or additions to existing SFPP's facilities are proposed, the RFS requires an appropriate combination of bush fire protection measures and compliance with the intent and performance criteria of each measure within section 4.3.5.*
- *However, it is also acknowledged that existing circumstances may make the preferred standards difficult to achieve. In such cases, the specific objectives in Section 4.2.3 are to be followed.*
- *Alterations and additions to existing SFPP's (i.e. approved prior to 1st August 2002), including their external appearance or finish, which may involve an increase in size and footprint of the building or redevelopment of an existing building are considered to be infill development.*
- *This type of development should also seek to achieve a better bush fire risk outcome (such as improved construction standards) than if the development did not proceed. The new building work should comply with AS 3959 - 1999 (and Appendix 3 of PBP) or be no closer to the*

hazard than the existing building. Existing facilities such as water supply should also be upgraded."

Specifications and Requirements for Bush Fire Protection Measures for Infill Development Intent of measures: (p. 42)

- *To minimise the risk of bush fire attack and provide protection for emergency services personnel, residents and others assisting firefighting activities."*

Specific Objectives for Infill development *(p. 43)*

Performance Criteria Acceptable solutions	*Performance Criteria Acceptable solutions*
The intent may be achieved where:	
in relation to Asset Protection Zones: *• a defendable space is provided onsite.* *• an asset protection zone is provided and maintained for the life of the development.*	*• APZ determined in accordance with Appendix 2.*
in relation to siting and design: *• buildings are sited and designed to minimise the risk of bush fire attack.*	*• buildings are designed and sited in accordance with the siting and design principles in this section (see also figure 4.7).*
in relation to construction standards: *• it is demonstrated that the proposed building can withstand bush fire attack in the form of wind, smoke, embers, radiant heat and flame contact .*	*• construction determined in accordance with Appendix 3 and the Requirements for attached garages and others structures in this section.* *Note: provisions in relation to Class 10a buildings may also apply.*
in relation to access requirements: *• safe, operational access is provided (and maintained) for emergency services personnel in suppressing a bush fire while residents are seeking to relocate, in advance of a bush fire, (satisfying the intent and performance criteria for access roads in sections 4.1.3 and 4.2.7).*	*• compliance with section 4.1.3 for property access roads.* *• compliance with section 4.2.7 for access standards for internal roads.*
in relation to water and utility services: • adequate water and electricity services are provided for firefighting operations • gas and electricity services are located so as not to contribute to the risk of fire to a building.	• compliance with section 4.1.3 for services - water, electricity and gas.
in relation to landscaping: • it is designed and managed to minimise flame contact and radiant heat to buildings, and the potential for wind driven embers to cause ignitions.	• compliance with Appendix 5.

2.2 Vegetation and slope analysis

The vegetation and slope have been assessed in all directions for the proposed development. In accord with PBP, the predominant vegetation class has been calculated for a distance of at least 140 m out from the boundary of the subject land and the slope class *"most significantly affecting fire behaviour having regard for vegetation found [on it]"* determined for a distance of at least 100 m in all directions. The predominant vegetation and effective slope assessments are shown in Table 1 and in Figure 5.

Forest vegetation occurs to the south-west and poses the greatest threat to the proposed development.

Slope has been calculated from LIDAR data providing a 1 m contour interval for over 100m beyond the site boundary. The slope causing greatest potential impact on the proposed development is 23.7 degree downslope (see Figure 5). Slope from other directions were considered, however, in determining the BAL from the different slopes and directions the BAL outcome from the south west was the effective slope. A BAL map has been prepared (Figure 6) using the AS3959 15-20 degree downslope class.

All other areas surrounding the subject land are managed lands under PBP and AS3959 i.e. residential properties (north and south) or a golf course to the east (see Figure 1 and Figure 5).

.

Figure 5: Vegetation and slope analysis

2.3 Bushfire attack scenarios under an FDI 100

Planning for Bushfire Protection (PBP) identifies a Forest Fire Danger Index (FFDI) of 100 as an appropriate level for bushfire planning in the Greater Sydney Region. Under this weather scenario the rate of spread[1] of a bushfire in the forests and heaths to the west and northwest of the subject land would likely impact the existing RACF well before evacuation off-site could be implemented. As an example of the magnitude of this risk, Figure 7 shows the distance a bushfire could travel in three hours under an FFDI of 100. It also shows the distance that could be travelled under an FFDI of 50. Although a three hour fire travel time has been used to help quantify the risk, it is the author's expert judgement that safe evacuation of the existing RACF in three hours or less from when the fire starts is unlikely to be feasible.

If this fire attack scenario were to occur (i.e. where a fire starts within the 3 hour 'evacuation trigger line' shown in Figure 7) the 113 existing residents, plus staff and visitors, would be forced to seek refuge in buildings highly vulnerable to bushfire attack and not constructed in accordance with current bushfire standards. It is reasonably foreseeable that the existing buildings within which refuge is sought would be destroyed by a bushfire of the intensity expected under an FDI 100 and its occupants unlikely to survive. The main hope under such a fire attack would be firefighter intervention, however, the North Turramurra bushland interface has many similar bushfire risks and the capacity of firefighters to protect so many people and buildings under such dangerous conditions would be limited and resources would typically be directed according to a triage-like process. It is also reasonably foreseeable that under these weather conditions a bushfire could impact the existing RACF well before fire firefighter assistance could reach the site.

It is not feasible to upgrade the existing facility to overcome these vulnerabilities to any extent.

2.4 SFPP Infill

As the development is SFPP infill, an appropriated combination of bush fire protection measures and compliance with the intent and performance criteria of each measure within section 4.3.5 of PBP is required.

In particular, this type of redevelopment should seek to achieve a better bushfire risk outcome than if the development did not proceed (i.e. an improved level of protection for occupants than what the existing development provides for).

In the author's expert judgement the existing RACF and its occupants are exposed to an unacceptable level of bushfire risk and one that is life threatening to most of its occupants (as discussed previously in this assessment). Although an increase in occupant numbers is proposed as part of the development, the building footprint and overall risk to the development on the site is significantly reduced. The redevelopment of the site will ensure that buildings are constructed in accordance with AS3959 and an on-site refuge is proposed within the RACF component of the re-development (see Figure 4).

[1] Assuming FDI = 100, unmanaged forest and a 10 degree upslope. The upslope grade is considered indicative of the slopes most effecting rate of spread in the westerly and north-westerly direction

Additional information was given to the RFS at the meeting on the 7th November 2014, this include the information provided as Appendix 1.

The Appendix 1 information compares the existing RACF with the proposed redevelopment Facility and the impacts of a fast/short run fire and a longer run fire on these. The risk comparison concluded that for fast/short run fires the redeveloped Facility would provide:

- An enormous unquestionable increase in safety for occupants, staff and visitors;
- Building and occupant survival in the absence of firefighter intervention;
- A decrease in risk using AS/NZS 31000:2009 methodology from extreme to moderate

For longer travel time fires when there is time to evacuate off-site the redeveloped Facility would provide:

- An enormous unquestionable increase in building survival within the Facility;
- A significant improvement to the resilience of the urban interface;
- Improved site evacuation times through better Facility design;
- Fewer return road trips required due to having Independent Living Units occupants with their own cars and provision of additional bus facilities;
- No change in traffic flow predicted on Bobbin Head Road (see Traffic Engineer report provided as Appendix 2)
- A decrease in risk using AS/NZS 31000:2009 methodology from major to minor

Figure 6: Asset Protection Zone and Bushfire Attack Level (BAL)

Figure 7: Three Hour Evacuation Trigger

3 Asset Protection Zones (APZ)

PBP has been used to determine the width of Asset Protection Zones (APZ) for the proposed Special Fire Protection Purpose (SFPP) development. Table 1 below shows the APZ calculation, and the APZ is shown within Figure 6.

Table 1: Threat assessment, APZ and Bushfire Attack Level

Direction	Slope[1]	Vegetation[2]	PBP required APZ[3]	Proposed APZ[3]	Comment
South-west	>15-20 degrees down	forest	100 m	>73 m	IPA proposed of grassed or managed gardens
All other directions	Consists of managed lands within existing residential properties and golf course				

[1] Slope most significantly influencing the fire behaviour according to PBP.

[2] Predominant vegetation is identified according to PBP.

[3] Assessment according to PBP.

[4] Assessment according to AS 3959-2009.

4 APZ maintenance plan

To increase the level of resilience it is proposed to have an Inner Protection Standard of APZ over all areas of BAL 12.5 to BAL FZ (see Figure 6). The following fuel management within the IPA has been reviewed and accepted by other disciplines such as Arborist and Landscape Design (see Arborist and Landscape Plans/reports submitted with DA) and is required to achieve the bushfire protection requirements of this assessment:

- No tree or tree canopy within 2 m of all proposed new buildings
- The presence of a few shrubs or trees in the IPA is acceptable provided that they:
    - are well spread out and do not form a continuous canopy
    - are not species that retain dead material or deposit excessive quantities of ground fuel in a short period or in a danger period; and
    - are located far enough away from proposed buildings so that they will not ignite the buildings by direct flame contact or radiant heat emission
- Any landscaping or plantings will include lower combustibility species (wherever possible)
- A minimal ground fuel is to be maintained to include less than 4 tonnes per hectare of fine fuel (*fine fuel* means ANY dead or living vegetation of <6 mm in diameter *e.g.* twigs less than a pencil in thickness. 4 t/ha is equivalent to a 1 cm thick layer of leaf litter); and
- Any structures storing combustible materials such as firewood (*e.g.* sheds) must be sealed to prevent entry of burning debris

5 Construction standard

Method 1 of the AS 3959-2009 '*Construction of buildings in bushfire-prone areas'* has been used to determine the bushfire construction levels required for the SFPP development (Standards Australia 2009). In response to the predicted bushfire attack as identified within Table 1 and Figure 6, the proposed buildings will be constructed under Australian Standard AS 3959-2009 '*Construction of buildings in bushfire-prone areas' (*Standards Australia 2009) in as per below:

- RACF: BAL 12.5;
- Central ILU block: BAL 29 on south-western and south-eastern elevation and BAL 19 elsewhere;
- Northern and Eastern ILU blocks: BAL 19.

In addition to the requirements of AS 3959 2009, NSW has a variation to the Standard (as outlined within the PBP Appendix 3 Addendum 2010) and requires some additional measures to be implemented when BAL 12.5 or BAL 19 are applied.

The Bushfire Attack Level (BAL) distances used in Figure 6 are shown in Table 2, with the green coloured cells showing the BAL applicable to the proposed Facility.

Table 2: BAL separation distances

Direction	Vegetation and Slope	BAL-FZ	BAL-40	BAL-29	BAL-19	BAL-12.5
South west	Forest on >15-20º downslope	<50m	50-<61	61-<78	78-<98 m	98-<100 m
All other directions	Managed lands	BAL Low (separation distance exceeds 100 metres due to existing management or development)				

Information according to AS3959-2009 *'Construction of buildings in bushfire-prone areas'* Table 2.4.2 pg. 29, and PBP revised Appendix 3.

5.1 Existing buildings

In light of the bushfire threat and chance to improve the survivability of the existing Chapel and Huon House it is proposed to upgrade these buildings as follows:

- Openable windows to be screened with tight-fitting fly screens of aluminium, bronze or corrosion resistant steel mesh
- External doors to be screened with tight-fitting fly screens of aluminium, bronze or corrosion resistant steel mesh
- External doors to be fitted with draught excluders of have some other mechanism to prevent embers from entering the building underneath the door
- Vents and weepholes (including subfloor space and roof void) are to be screened with aluminium, bronze or corrosion resistant steel mesh
- Openings where embers may enter the roof space such as the eaves or ridgelines (with the exception of tile spacing) are to be screened with aluminium, bronze or corrosion resistant steel mesh where practicable.

6 Water supply

Reticulated water and hydrants are available along Bobbin Head Road. A reticulated network also exists within the subject land and will be upgraded as part of the redevelopment.

The reticulated water supply is to comply with the following acceptable solutions within Section 4.2.7 of PBP:

- Access points for reticulated water supply to SFPP developments incorporate a ring main system for all internal roads
- Fire hydrant spacing, sizing and pressures comply with AS 2419.1 – 2005. Where this cannot be met, the RFS will require a test report of the water pressures anticipated by the relevant water supply authority. In such cases, the location, number and sizing of hydrants shall be determined using fire engineering principles; and
- The [PBP] provisions for parking on public roads (as contained within section 4.1.3) are met. For road widths of 8m this includes, but is not limited to, having no parking permitted on the side of the road where services (i.e. hydrants) are located.

7 Gas and electrical supplies

The proposed development will be utilising natural gas and no LPG. Metal piping will be used.

Electrical transmission line to the subject land is above ground. No part of a tree will be closer than 0.5 m to the powerline conductors.

8 Access

The subject land is accessed via Bobbin Head Road, which is a sealed two way public road. Within the subject land an internal perimeter road is proposed around the buildings with sufficient widths for the access and egress of the site by occupants and fire fighters (see Figure 4). The internal road will provide for two access points onto Bobbin Head Road. Separate parking areas and turn around areas will be provided so as not to impede fire fighting vehicles.

The proposed internal access road will comply with the standards contained within section 4.2.7 of PBP for the design and construction of roads within SFPP developments, as listed in Table 3. An acceptable solution is achieved for all but the perimeter road on the south-western side of the development. An 8 m trafficable surface is provided in this location, however, rather than curb to curb, it is a 6.9 m road pavement and an adjoining rollover gutter and footpath capable of carrying fully laden tankers (see Figure 4). This is an insignificant difference to the acceptable solution particularly given this is an infill SFPP development and the existing RACF has no perimeter road at all. In the authors expert judgement this 8 m trafficable surface on the hazard side of the development meets the performance criteria for internal perimeter roads described in Table 3.

The internal roads (non-perimeter roads) vary in width from 4m to 6.9 m with the 4 m section providing the southern ingress to the property being one-way. All other parts of the through road (Figure 4) are 6.9 m wide, except where there is the rollover gutter and footpath for the ‘perimeter road’ portion where the trafficable portion is wider.

Table 3: Performance criteria for Internal Access Roads*[1]

The intent may be achieved where	Acceptable Solutions	Complies
• Internal road widths and design enable safe access for emergency services and allow crews to work with equipment about the vehicle.	• internal roads are two-wheel drive, sealed, all-weather roads;	Complies
	• internal perimeter roads are provided with at least two traffic lane widths (carriageway 8 metres minimum kerb to kerb) and shoulders on each side, allowing traffic to pass in opposite directions;	Complies with performance criteria
	• roads are through roads. Dead end roads are not more than 100 metres in length from a through road, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end;	Complies
	• traffic management devices are constructed to facilitate access by emergency services vehicles.	Complies
	• a minimum vertical clearance of four metres to any overhanging obstructions, including tree branches, is provided. Tree crown lifting works to be undertaken in accordance with *Australian Standard: 4373 Pruning of Amenity Trees (2007)*.	Complies
	• curves have a minimum inner radius of six metres and are minimal in number to allow for rapid access and egress.	Complies
	• the minimum distance between inner and outer curves is six metres.	Complies
	• maximum grades do not exceed 15 degrees and average grades are not more than 10 degrees.	Complies
	• crossfall of the pavement is not more than 10 degrees.	Complies
	• roads do not traverse through a wetland or other land potentially subject to periodic inundation (other than flood or storm surge).	Complies
	• the internal road surfaces and bridges have a capacity to	Complies
	• carry fully-loaded firefighting vehicles (15 tonnes).	Complies

*[1] PBP page 35

9 Bushfire maintenance plans and fire emergency procedures

The APZs will be managed by permanently employed ground-keepers for the RACF and ILU. This will ensure a high level of reliability in the upkeep of the APZ.

A bushfire emergency and evacuation plan and vegetation maintenance plans is not required to accompany this assessment but it is recommended that these be prepared prior to occupation. Any existing emergency or evacuation management plan is to be updated to include the new development.

9.1 Emergency management procedures

PBP recognises that people who cannot cope with bushfire should relocate well before a fire impacts their location, and that there should be an identified 'trigger' to initiate any emergency management plan.

Given the high risk posed by bush fire to occupants of the development, it is highly desirable that relocation occur. However, as circumstances are foreseeable and probable that will not allow enough time for safe evacuation e.g. a fast moving fire that starts in reasonable proximity to the subject land (see Section 1.3 and 2.3), an on-site refuge is proposed in the basement of the new RACF. This on-site refuge will be designed from an appropriate private property adaptation of the Australian Building Codes Board (ABCB) publication on *Design and Construction of Community Bushfire Refuges (2014).*

Appendix 3 provides a fire safety strategy for an on-site bushfire refuge prepared by a Fire Engineer very experienced in refuge design. It provides recommendations for subsequent stages of refuge design.

An Emergency Response and Evacuation Plan has been prepared and accompanies the report. That Plan will need to be updated prior to issue of the Occupation Certificate. It gives priority to off-site evacuation with on-site refuge as a last resort in the event that safe off-site evacuation is not feasible prior to the impact of a bushfire.

10 Assessment of environmental issues

A separate ecology report has been prepared by Travers Fire and Ecology and submitted with the DA. At the time of assessment, there were no known Aboriginal relics identified under the *National Parks Act 1974* that will affect or be affected by the bushfire protection proposals in this report.

Sydney West Region JRPP is the consent authority for this SFPP integrated development and they will assess more thoroughly any potential environmental and heritage issues.

11 Performance criteria of Section 4.3.5 of PBP

Section 4.2.5 of PBP requires that any SFPP infill development consider the performance criteria of Section 4.3.5 of PBP. Table 4 provides an overview of Section 4.3.5 and how compliance is achieved for this redevelopment of the existing RACF:

Table 4: Section 4.3.5 Performance Criteria

Performance criteria	Comment
In relation to APZ	
• A defendable space is provided onsite	A defendable space of 28-70 m is provided within the property boundaries
• An APZ is provided and maintained for the life of the development	An IPA (APZ) is provide for the whole are shown in Figure 5 and is entirely within the property boundaries or provided by existing adjoining residential development
In relation to siting and design	
• Buildings are sited and designed to minimise the risk of bushfire attack	Buildings will not extend any closer than the existing development. Instead they been sited much further away from the bushfire hazard than the existing buildings to minimise the risk of bushfire attack i.e. from BAL FZ to BAL 29, 19 or 12.5
In relation to construction standards	
• It is demonstrated that the proposed building can withstand bushfire attack in the form of wind, smoke, embers, radiant heat and flame contact	All construction works will be in accordance with the relevant BAL of AS3959 with buildings located outside of the flame zone. This is a significant improvement over the construction standard of the existing buildings which do not comply with any BAL standard and some located within the BAL FZ.
In relation to access requirements	
• Safe, operational access is provided (and maintained) for emergency services personnel in suppressing a bushfire while residents are seeking to relocate, in advance of a bushfire, (satisfying the intent and performance criteria for access roads in section 4.3.7)	A perimeter access road is provided around the development and two access points are provided onto Bobbin Head Road. Congestion on Bobbin Head Road during evacuation and the difference between the current occupancy numbers and that proposed has NO effect on the evacuation time (See Appendix 2). A Bushfire Evacuation Plan accompanies this assessment. The internal access road provides parking within dedicated parking areas and provides opportunities for fire fighting vehicles to turn around if needed. All evacuation points from buildings are either shielded or enter areas where the Radiant Heat Flux is <10 kW/m^2 (see Figure 6).

Performance criteria	Comment
In relation to water and utility services	
• Adequate water and electricity services are provided for firefighting operations	The subject land is connected to reticulated water
• Gas and electricity services are located so as not the contribute to the risk of a fire to a building	Any gas and electricity supplies will be located in accordance with PBP.
In relation to landscaping	
• It is designed and managed to minimise flame contact and radiant heat to buildings, and the potential for wind driven embers to cause ignitions.	Vegetation within the subject land will be managed as an APZ in accordance with the IPA standards of PBP.

11.1 Comparison of existing RACF with proposed redevelopment

In addition to the performance criteria discussed in Table 4, the proposed re-development provides a much higher better bushfire outcome than is currently available to the existing RACF; the following summarises these differences.

Existing RACF	Proposed Development
• APZ are significantly inadequate for the construction standard of buildings. Includes buildings in the Flame Zone.	• All proposed buildings are located within the BAL 29, 19 or BAL 12.5 • Highest risk APZ (from the SW) is extended from 40 m to >73 m. • APZ will be managed as IPA over entire bushfire prone portion of property
• Access does not comply with PBP • Only one egress to Bobbin Head Road • No perimeter road exists	• Access is compliant with PBP • Two egress roads exist to Bobbin Head Road • All buildings are within a perimeter road
• Buildings are located within the BAL FZ • Buildings do not comply with even BAL 12.5	• All proposed buildings are constructed to be compliant with their assessed BAL • No building is located in an position of >BAL 29. With most <BAL 19 • Existing buildings that are retained within the BAL 12.5 zone will be upgraded to minimise their vulnerability to bushfire attack
• Electricity, water and gas has not been specifically designed to minimise the bushfire risk	• All site electricity, water and gas supplies that are replaced will comply with PBP requirements

Existing RACF	Proposed Development
• Bushfire risk to life of occupants, staff, visitors and emergency responders is unacceptably high • 113 existing residents all of whom are higher dependency (frail) aged care residents who are difficult and much slower to evacuate	• Bushfire risk to life significantly lowered through larger APZ, higher construction standards, relocation of buildings out of BAL FZ to BAL 29 or further • An evacuation and emergency response plan will be prepared to provide off-site evacuation • In the event of a bushfire impacting the site prior to off-site evacuation being able to be safely completed, an on-site refuge is provided that will meet best practice design. • 152 residents are proposed. However, the higher dependency resident number drops from 113 to 104 with the balance being Independent Living residents who are able to evacuate more quickly with far less assistance being required. An important consideration if evacuation is to occur prior to the arrival of a fast moving fire.

12 Conclusion

The existing development has an extreme bushfire risk (under AS/NZS 31000:2009) with buildings well below contemporary bushfire protection requirements. This risk cannot be adequately reduced without substantial redevelopment and building relocation. Currently, inadequate time exists for off-site evacuation with a fast/short run bushfire under and FDI 100, under these conditions without firefighter intervention buildings will likely be destroyed and many lives lost. Redevelopment with resilient buildings and effective management/evacuation systems offer the only viable solution to the unacceptable level of bushfire risk associated with the existing RACF.

The redevelopment, however, is financially dependent upon the provision of the 39 additional residents. A decision not to allow the re-development based upon a 'blanket exclusion' of any increase in resident numbers in this part of North Turramurra will mean the re-development is not financially viable.

Assessment of the proposal must therefore have a bigger picture view and consider the bushfire risk of the current aged care facility against that of the proposed re-development. This assessment has found even with the 39 additional residents there is an unequivocal and substantial reduction in the bushfire risk compared to the current RACF. Of greatest benefit are reducing the high care numbers in the RACF, the provision of an on-site refuge, relocation of buildings beyond the flame zone, construction of bushfire resilient buildings under AS3959 and more efficient off-site evacuation systems.

There is NO EVIDENCE that evacuation of the additional 39 residents in the new Facility will impact the traffic flow on Bobbin Head Road; and evacuation of the proposed Facility will be quicker as a result of more efficient building design.

This proposal is a critical opportunity to build resilience into a bushfire vulnerable North Turramurra community. The current RACF requires considerable fire fighter intervention to withstand any bushfire attack, and this assistance may not be available. Furthermore, the demands associated with protecting the current sub-standard higher risk RACF reduces the protection effort afforded others at the urban bushland interface in the local area.

Creating long term bushfire resilience within older urban/bushland interface communities without heavy reliance of firefighter assistance is very difficult. It is however critical if these most vulnerable of bushfire prone communities are to have long term reduction in lost lives, employment continuity and avoidance of escalating insurance and rebuilding costs associated with the impact of severe bushfires.

The subject redevelopment proposal provides the opportunity for this resilience!

It will save lives, significantly reduce long term costs for emergency management and substantially improve resilience of a highly bushfire vulnerable local community.

13 Recommendations

The following recommendations have been made within this report to ensure the proposed redevelopment is compliant with Section 100B of the *Rural Fires Act 1997*, Clause 44 of the *Rural Fires Regulation 2008*, and '*Planning for Bush Fire Protection* 2006' (RFS 2006):

Recommendation 1- Asset protection zones are to be provided in accordance with Section 3;

Recommendation 2- Asset protection zone landscaping is to comply with the NSW Rural Fire Service document '*Planning for Bush Fire Protection* 2006' inner protection area requirements as listed in Appendix 2 Section A2.2 of PBP and guided by the fuel management principles listed in Section 4 of this report;

Recommendation 3- Construction works shall comply with the requirements as listed within Section 5 of this report;

Recommendation 5- A reticulated hydrant water supply should be installed throughout the proposed development in accordance with Australian Standard AS 2419.1;

Recommendation 6- Internal access roads are to comply with the NSW Rural Fire Service document '*Planning for Bush Fire Protection* 2006' as listed in Section 8 of this report;

Recommendation 7- New electrical services should be installed underground where possible;

Recommendation 8 Gas services are to be installed and maintained in accordance with AS/NZS 1596:2008 (Standards Australia 2008);

Recommendation 9- Bushfire evacuation / emergency procedures and vegetation management plans should be finalised by the parties responsible for the ongoing management and maintenance of the proposed development prior to occupation.

In the author's professional opinion the bushfire protection requirements listed in this assessment provide an adequate standard of bushfire protection for the proposed development, a standard that is consistent with '*Planning for Bush Fire Protection'* (RFS 2006) and appropriate for the issue of a Bush Fire Safety Authority.

Rod Rose
Director - Principal Bushfire Consultant
FPAA BPAD-A Certified Practitioner No. BPAD-PA-1940

FPA AUSTRALIA
Certified Business
Bushfire Planning & Design

Eco Logical Australia (ELA) is recognised by the NSW Rural Fire Service and the NSW Department of Planning as a suitably qualified consultant as the company is listed as a Certified Business (BPD-BA-18882) under the Fire Protection Association of Australia's BPAD program.

References

NSW Rural Fire Service (RFS). 2006. *Planning for Bush Fire Protection: A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners*. Australian Government Publishing Service, Canberra.

Standards Australia. 2005. *Fire hydrant installations - System design, installation and commissioning,* AS2419.1, Fourth edition 2005, Standards Australia International Ltd, Sydney.

Standards Australia. 2008. *The storage and handling of LP Gas*, AS/NZS 1596-2008, Fourth edition 2005, Standards Australia International Ltd, Sydney.

Standards Australia. 2009. *Construction of buildings in bushfire-prone areas*, AS 3959, Third edition 2009, Standards Australia International Ltd, Sydney.

Appendix 1: Notes from RFS meeting on the 7th November 2014

Re: Safer outcome analysis, Aged Care Redevelopment, 402 Bobbin Head Road, North Turramurra

Table A compares the two primary bushfire attack scenarios between the current and proposed development, based upon a maximum increase of 39 residents for the redevelopment and a bushfire attack under an FFDI 100.

Table A: Comparison of existing and proposed Aged Care Facilities

Bushfire attack	Existing RACF	Proposed redevelopment	Risk outcome
• Fast/Short run fire • No time to evacuate • Very High probability	• No AS3959 compliance • Nearest building to hazard BAL FZ, RACF • • Rapid fire spread building to building • In absence of firefighter intervention whole complex likely to be destroyed • Long duration emergency service help essential • Many of (max) 133 lives predicted to be lost	• AS3959 compliant, some exceeding BAL • Nearest building to hazard BAL 29, RACF <BAL 12.5 • RACF >25 m from ILU • All buildings designed to survive, purpose engineered refuge in RACF • Emergency service help desirable but not essential • Survivability very high	• Enormous, unquestionable increase in safety • Survival in the absence of firefighter intervention • Risk using AS/NZS 31000:2009 o Extreme (existing) o Moderate (proposed)
• Longer travel fire • Time to evacuate • High probability	• Buildings, landscaping vulnerable to long range burning debris attack and delaying evacuation • 9 extra high care residents • Evacuation plan less comprehensive • Site evacuation time longer (smaller elevators, corridors, limited transport etc. • Traffic flow same • • More ingress vehicle movements required for ferrying (no buses	• Buildings, landscaping designed for burning debris attack and negligible delay on evacuation • 39 extra overall residents • Comprehensive plan + risk matrix • ILU self-evacuation, buses proposed • • Traffic flow same; 35 extra egress vehicle movements • Buses and ILU vehicles reduce ferrying time and return trip risk	• Improved site evacuation times • Fewer return road trips required • No change in traffic flow predicted • Risk using AS/NZS 31000:2009 o Major (existing) o Minor (proposed)

Bushfire risk analysis

The analysis provided in Table B - Table D assesses the risks of bushfire to life and property at the existing and proposed Aged Care facility. The methodology adopted is from AS/NZS 31000:2009 '*Risk management – principles and guidelines*' and uses qualitative scales of likelihood and consequence.

This assessment adopts a definition of likelihood based on likelihood of occurrence over a 50 year potential operational life of the Aged Care Facility. The scale of likelihood is shown below and is based on AS/NZS ISO 31000. Values have been allocated to the likelihood descriptors on a scale of 1 to 5 with 1 being extremely rare (extremely unlikely) and 5 being almost certain, as outlined in Table B below.

Table B: Likelihood description

Likelihood Descriptor	Description
Almost certain (5)	The bushfire attack and losses are expected to occur in most circumstances
Likely (4)	The bushfire attack and losses will probably occur in most circumstances
Possibly (3)	The bushfire attack and losses might occur
Unlikely (2)	The bushfire attack and losses could occur at some time
Rare (1)	The bushfire attack and losses are may occur only in exceptional circumstances

The scale of consequence is shown below. Values have been allocated to the consequence descriptors on a scale of 1 to 5 as outlined in Table C.

Table C: Consequence description

Consequence Descriptor	Description
Catastrophic (5)	Death, huge financial loss, irreversible widespread environmental damage
Major (4)	Extensive injury, major financial loss, irreversible local environmental damage
High (3)	Medical treatment, high financial loss, Long-term environmental damage
Medium (2)	First aid, medium financial loss, Short-term environmental damage
Low (1)	No injuries, low financial loss, minor environmental impact

Rating codes and the level of risk have then been calculated by multiplying likelihood levels and consequence levels with the rating determined as per the scale outlined in Table D below.

Table D: Risk rating

Level of risk	Risk rating
0 - 4	Insignificant
5 - 9	Minor
10 - 14	Moderate
15 - 19	Major
20 - 25	Extreme

Risk ranking comparison for **short run fire** under FFDI 100 (assumes on-site refuge)

	Likelihood	Consequence	Risk ranking
Existing facility	Likely (4)	Catastrophic (5)	20 (Extreme)
Proposed facility	Unlikely (2)	Catastrophic (5)	10 (Moderate)

Risk ranking comparison for **long run or slower fire** under FFDI 100 (assumes off-site evacuation)

	Likelihood	Consequence	Risk ranking
Existing facility	Likely (4) –property Unlikely (2) – life	Major (4) - property Catastrophic (5) - life	16 (Major) - property 10 (Moderate) - life
Proposed facility	Unlikely (2) – property Unlikely (2) – life	Major (4) - property Catastrophic (5) - life	8 (Minor) - property 10 (Moderate) - life

Appendix 2: Bobbin Head Road evacuation traffic analysis

Traffic

TaylorThomsonWhitting

Fire Evacuation Traffic Impact Assessment

402 Bobbin Head Road North Turramurra

for Southern Cross Care

10 December 2014

131614.UTA

Taylor Thomson Whitting (NSW) Pty Ltd Consulting Engineers ACN 113 578 377
48 Chandos Street St Leonards NSW 2065 PO Box 738 Crows Nest 1585
T 61 2 9439 7288 F 61 2 9439 3146 ttwsyd@ttw.com.au www.ttw.com.au

Certified System Quality ISO 9001 SAI GLOBAL

SYDNEY
CANBERRA
MELBOURNE
QEC 22375

Table of Contents

Page

Revision Register

Rev	Date	Prepared By	Approved By	Remarks
1	4/11/14	DP	KT	Draft for Discussion Only
2	4/11/14	DP	KT	Draft for Discussion Only Updated with figures
3	10/12/12	DP	KT	Updated staffing and occupant numbers and subsequent model outputs

P:\2013\1316\131614\Reports\TTW\Evacuation Traffic Assessment\141210_North Turramurra_Traffic Assessment Rev 3.doc

Prepared by:
URaP-TAYLOR THOMSON WHITTING

DAVID PAVEY
Principal Consultant

Authorised by:
URaP-TAYLOR THOMSON WHITTING

KAM TARA
Director

1.0 PURPOSE

The purpose of this report is to provide information on and an estimation of evacuation times in terms of the capacity of the existing road network to facilitate the evacuation of a section of North Turramurra due to a bush fire threat on this community and to determine the impact (if any) that the proposed upgrade of the existing Southern Cross Care Facility might have on an effective and timely evacuation of this community.

This report does not attempt to address timing, early warning, evacuation procedures within Southern Cross Care Facility or when such evacuation might be ordered, but solely focuses on the road capacity and traffic issues that may arise after an order to evacuate has been given by the appropriate authority.

2.0 SCOPE

The scope of work undertaken was as follows:

- Site inspection to ascertain current access and traffic conditions,
- Sourcing of public available information on population within the Evacuation Zone,
- Development of an appropriate Traffic Simulation Model for the area, and
- Assessment of proposed development and its ramifications on traffic conditions associated with an evacuation,

Figure 1 shows the area nominated as an evacuation zone by the Ku-ring-gai City Council's (KCC) "Background Study Management Bushfire Risk, Now and into the Future" prepared of the Ku-ring-gai Principal Local Environmental Plan (LEP) 2012

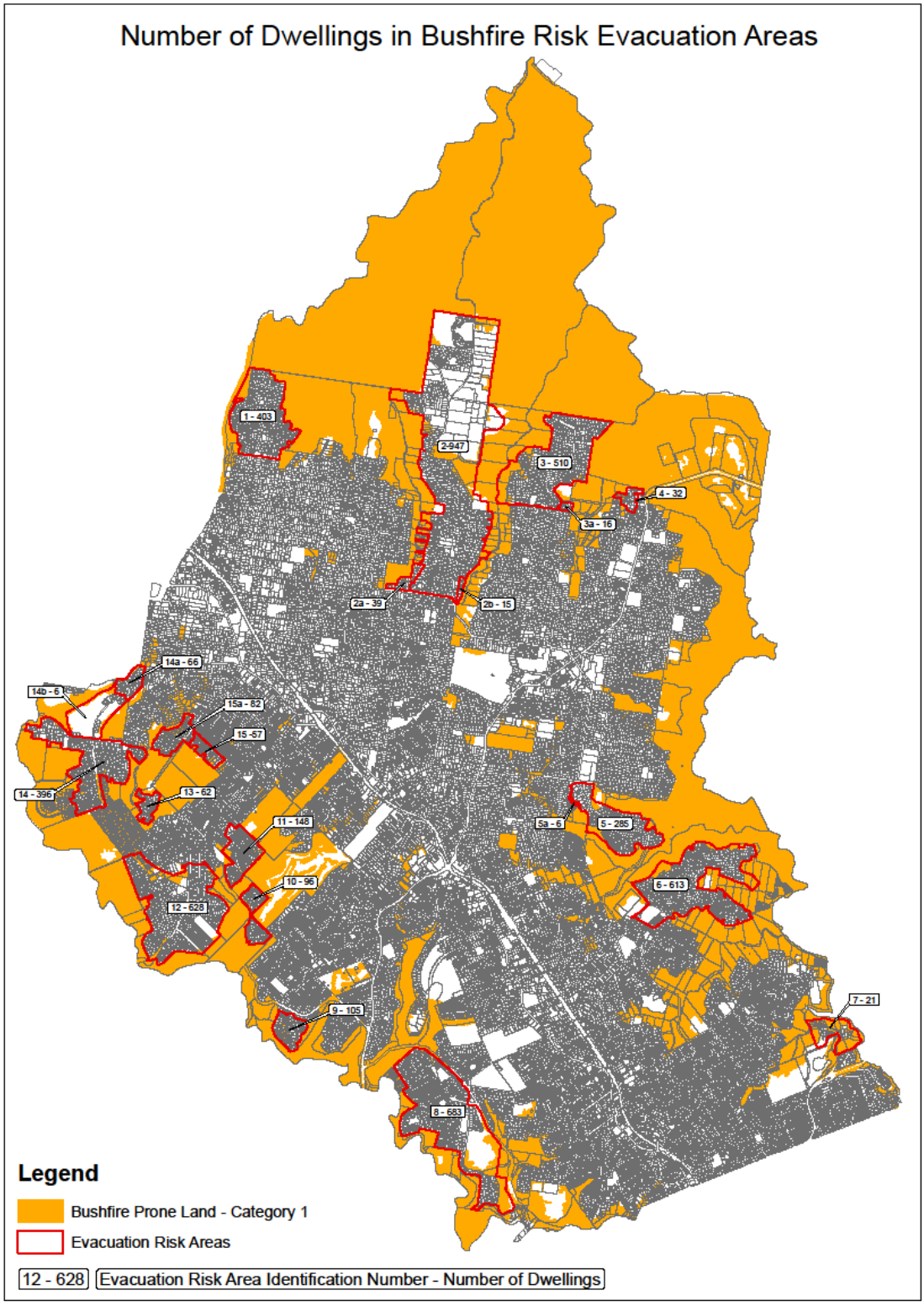


Figure 1 Locality Plan

(Source the Ku-ring-gai City Council's (KCC) "Background Study Management Bushfire Risk, Now and into the Future")

3.0 CURRENT EVACUATION ROUTES AND CONDITIONS.

The current evacuation area can be subdivided into two discrete sections which are shown on **Figure 2** below. The Northern Zone covers the area north of Milton Ave were the proposed development lies and the current evacuation route from this area is via a single access being Bobbin Head Road. There is an alternative route to the north via Bobbin Head and Appletree Bay but in this simulation, it has been assumed that this route is not available. Bobbin Head Road north of this locality has a single lane in each direction approx 3.5 m wide and marked parking lanes on each side with intermittent parking.

The Southern Zone covers the area south of the intersection of Bobbin Head Road and Milton Ave the evacuation traffic can be separated and directed to follow two distinct routes.

- The first route being the continuation of Bobbin Head Road though the shopping centre to Burns Street. Along this section Bobbin Head Road has one lane in each direction (approx 3.5m wide) and marked parking lanes on each side with parking which are well utilised
- The second route being Milton / Mioere / Allara / Ellalong Rds to Burns Road. This route consists of residential back streets with typical 10m wide between kerbs urban road with no road markings.

The evacuation routes are indicated in **Figure 3** below

Figure 2 Evacuation Zones

Figure 3 Evacuation Route

4.0 EXISTING POPULATION AND DWELLINGS DENSITIES

The Northern Zone consists of a range of developments consisting of single residents, low and medium aged care and medical facilities, public recreational areas and a high school. Whilst the southern zone is predominately residential with a small neighbourhood shopping centre. Current populations are estimates as follows.

4.1 Northern Zone:

- **Residential Properties**

  KCC LEP indicates that there are 947 properties are within the evacuation zone outline in **Figure 1** (both Northern and Southern areas) above. It is unclear from this background report whether this number includes the higher density facilities as one property, so for a conservative estimate it is assumed that it has been assumed for this analysis that there are 947 residential properties with the zone and the higher density premises are in addition to these properties. From a review of aerial photography it is estimated that there are approx 220 residential properties within the northern zone that require evacuation.

  In addition to these residential facilities the following health facilities exits

- **Huon Park**

  This facility has 170 residents living in independent living units (ILU), 40 in residential aged care facilities (RACF). These 210 residents are managed by total of 25 staff maximum per day.

- **The Cotswolds Village**

  This facility has 90 ILU, 40 RACF. The maximum residents on site are 140 who are managed by 12 staff maximum per day.

- **Turramurra House**

  This facility has 58 RACF. The maximum residents on site are 58 who are managed by 25 staff maximum per day.

- **The Landings**

  This facility has 220 ILU. The maximum residents on site 380 who are managed by managed by 7 staff maximum per day.

- **Hammond Care Turramurra**

  This facility has 146 RACF. The maximum residents on site 146 of which 64 are dementia beds who are managed by 60 staff maximum per day.

- **Lady Davidson Private Hospital**

  This facility has 115 bed inpatient care.

- **Southern Cross Care (current facility)**

  This facility has 113 RACF. The maximum residents on site 113 managed by 39 staff maximum per day.

- **Southern Cross Care (Proposed Development)**

  The propose facility is designed to have 174 people in a mix of Independent Living Units (48) and Residential Aged Care (104) managed by 39 staff maximum per day (Ref Parking and Traffic Report - 402 Bobbin Head Road North Turramurra – Taylor Thomson Whitting April 2014)

In addition to these residential properties and health facilities a public high school is also located within the Northern Zone.

- **Ku-ring-gai Creative Arts High School**

  This facility has 500 students and 60 staff members with the majority (90%) of students travelling to school by public transport.

4.2 Southern Area:

Based on the above assumption for residential properties in the Northern Zone it is estimated that within the Southern Evacuation Zone there is 580 residential properties that require evacuation and it has been assumes that this would involve 2 vehicles per property. i.e. a total of approx 1200 vehicles when taking into account the small neighbourhood shopping area.

5.0 TRAFFIC GENERATION, ASSUMPTIONS AND OPTIONS CONSIDERED

5.1 Traffic Generation

Based on the above information the following assumptions have been made to generate peak number of vehicle trips that will be need to successfully evacuate the area.

- **Residential Properties**

  2 vehicles per property

- Independent living units (**ILU)**

It is assumed that each unit would have 2 residents and be evacuated by a single car those residents without cars would be picked up by relatives and hence included in this numbers.

- Residential Aged Care Facilities (**RACF)**

  Staff would all have their own car and assist with the evacuation of some of the residents in residential care.

  Remainder of non mobility impaired residents of RAC units would be evacuated by mini bus organised by each facility.

- **School**

  Staff and self drive students of school would use their own vehicles and the remainder of students be transported by normal school buses (i.e. 50 people per bus

  Based on the above assumptions the following is vehicle numbers that have been incorporated into the evacuation model

5.2 Existing Situation

- **Northern area**

  - Residential houses – 440 vehicle trips
  - Aged Care Units – 297 vehicle trips and 40 x12 seat mini bus
  - High School- 100 vehicles and 8 buses
  - Assume that to manage evacuation an additional 50 emergency vehicles will be need to facilitate high care patients, security and traffic control (police and SES) and fire fighting assets of RFS and NSW F&R

  The total number of vehicle trips would for current population of the northern area:

  - 837 cars
  - 40 mini Buses
  - 8 school, busses and
  - 50 Emergency service vehicles

  Total number of vehicles 935

- **Southern area**

  Total number of vehicle trips would for current population of the southern area: the total number of vehicle trips would then be

  - 2037 cars
  - 40 mini Buses
  - 20 school; busses and
  - 60 Emergency service vehicles

Total number of vehicles 2157

5.3 Proposed Additional Development at Southern Cross Care.

The Second model incorporates the additional trips generated by the upgrade to the current Southern Cross Care facility (i.e. **24 additional car trips**). The additional trips are calculated based on the following assumptions:

- Existing ILU 0 , Proposed ILU 48 assuming 2 people per unit increase in car trips in an evacuation mode 24
- Existing RAC 113 Proposed RAC 104 assume no increase in vehicle trips
- Existing staff 39 Proposed staff 39 assume no increase in vehicle trips
- Therefore total increase in vehicle trips 24

The total number of vehicle trips for revised population in northern area would then be

- 861 cars
- 40 mini Buses
- 8 school, busses and
- 50 Emergency service vehicles
- Total number of vehicles 959

Southern area the total number of vehicle trips would then be

- 2061 cars
- 40 mini Buses
- 20 school busses and
- 60 Emergency service vehicles

Total number of vehicles 2181

5.4 Assumptions

“Transport Modelling Pty Ltd” has been commission to develop a traffic simulation model using the “Dynameq” software package. This application uses a mesoscopic modelling technique and hence allows a level of detail greater than a strategic model. All software houses recognised the need for a software package that sits between strategic and micro-simulation modelling capability. It is widely accepted that “Dynameq” is now the most mature software available to model the affects of the proposed development on the evacuation routes. In preparing this model the following assumptions have been made:

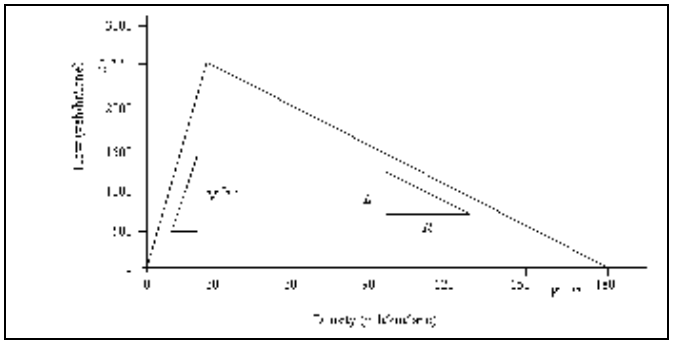
- The following analysis has been based (worst case scenario) that an evacuation

order has been given for the whole of the zone (i.e. both Northern and Southern Zones) to be evacuated and all assumed traffic accesses the evacuation route in the first 15 mins. However this will not be the norm as a more staged approach of evacuating the northern zone first would be generally but into practices

- Likewise all traffic within these zones is also assumed to access the evacuation routes within the first 15 minutes of an evacuation order being made. However in reality some residents will take heed of emergency warnings and leave when the alert level is at a Lower Order
- Back ground traffic on surrounding roads (i.e. outside the evacuation zone and those entering and entering the zone are based on current daily mid morning daily movements
- Any remaining occupants within the National Park or mariners at Bobbin Head and or Appletree Road have been evacuate out prior to the need to evacuate North Turramurra or will use the alternative route off Appletree Bay.
- The existing intersections Bobbin Head Road/Milton Ave, Bobbin Head Rd and Burns Rd and Ellalong Rd / Burns Rd , are operating in their normal level of operations (i.e. whether uncontrolled or with existing Traffic Light Phasing.
- Mid block capacity for the evacuation routes have been determined using the simulation software which uses the US Highway Capacity Manual 2010 which is consistent with the approached recommended in AUSTROADS Guide to Traffic Engineering Practice, Traffic Flow, Part 1

  The maximum “Flow” is the maximum flow rate, expressed as veh/hr/lane that a link can carry of a specific vehicle length.

$$Q_{max} = 1/ (Response\_time + Veh\_length/Free\_flow\_speed)$$



The theoretical maximum flow rate for the evacuation routes (PCU/Hr/Lane) is 2215 however as the model steps through the scenario the evacuation links has maximum flow rate of about 1330 veh/hr/lane with and actual flow rate of 1070

veh/hr/lane. Similarly on Burns Rd, the maximum flow rate in the order of 800 veh/hr/lane. Both well below the maximum capacity of the roads in question. The reason why the mid block capacities are not reached is due to the controls at intersection which are the limiting factors.

- Within the model cars and emergency services vehicles have been assigned as a single Passenger Car Units (PCU) whilst min mini buses and buses have assigned the values of 2 PCU

6.0 IMPACTS OF THE DEVELOPMENT ON EVACUATION TIME

In determining any impact the proposed development might have on the evacuation models two modelling scenario have been utilised. The first based on the existing population and the second with the addition residents (a vehicles trips) generated by the new development.

The first scenario the existing conditions of 2157 vehicle to be evacuated have been modelled , whilst the second model adds the additional proposed generated trips from the upgraded centre being 24 additional car trips.

6.1 Predicated Outcomes

Figure 6 below summaries the output of the modelling scenarios discussed above, The top set of figures represents the base case (i.e. the existing population including the existing operation of Southern Cross Care and shows that the evacuation time is 1 hr 20 mins from the first vehicle leaving the northern area to the mast vehicle from both areas existing onto Burns Road. The bottom set of figures includes the additional population at the proposed Southern Cross Care Development. As demonstrated under this scenarios the additional traffic generated by the development clears the Burns Street Intersection within 1 hr and 20mins of the evacuation order being given. The table below shows that the operations of the evacuation routes are very similar under both scenarios.

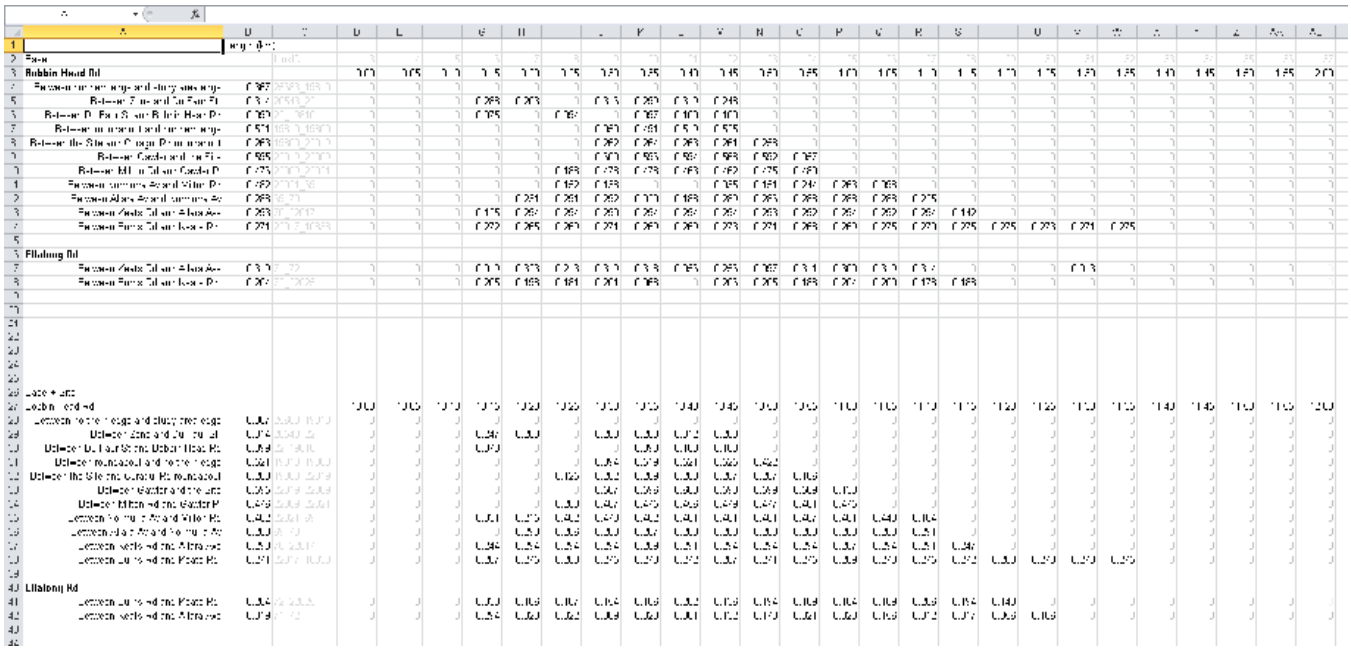


Figure 6 Output of Modelling Scenarios

Figure 7 below shows the existing level of service on the road network (as a function of road occupancy to capacity) and indicates that the majority of the routes are operating at below 75 % of the mid block capacity. This clearly indicates that the constraints to the evacuation are the control of vehicles out of the evacuation zone onto Burns Rd. In an evacuation time these intersections will be controlled by NSW Emergency Services who will give priority to evacuation traffic

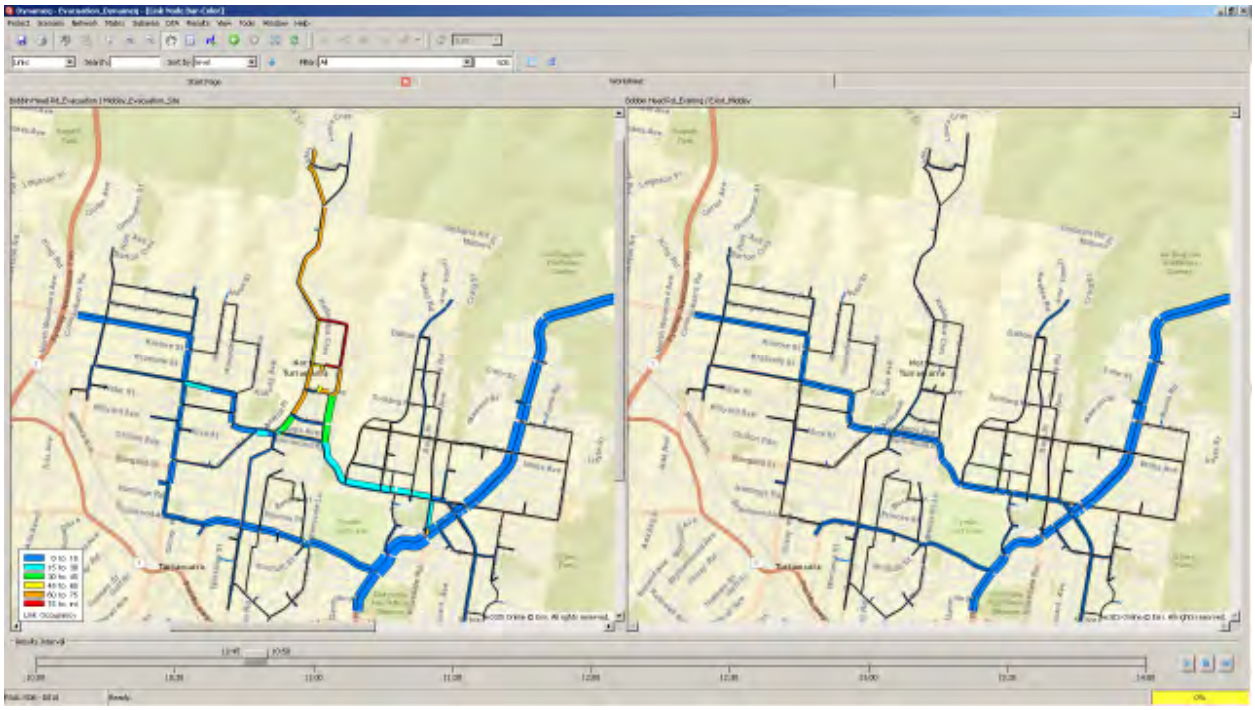


Figure 7 Capacity of existing roads under existing population conditions

6.2 Discussion

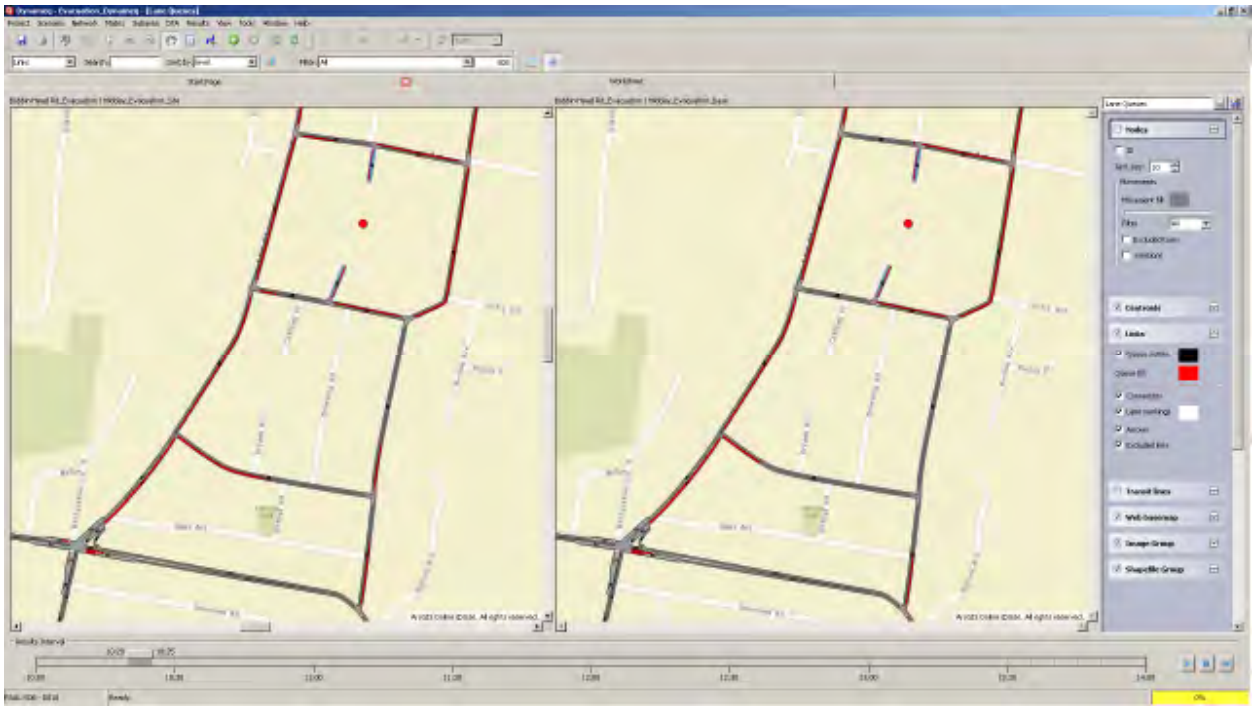
As indicated earlier in this report the above evacuation time of 1hr and 20 minutes is considered a worst case scenario based on the assumptions made above. The above times would also trend towards and upper limit due to the following normal behaviours that have not been taken into account.

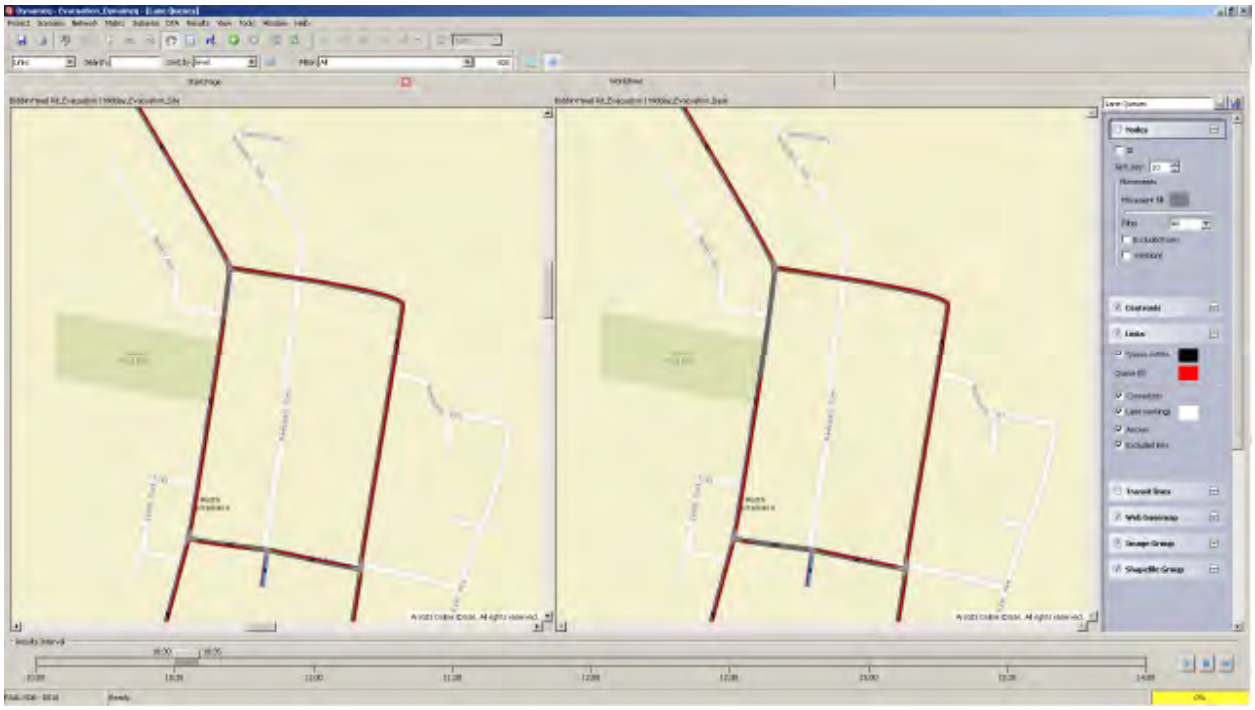
- If an evacuation order was given the intersections at Bobbin Head Road/Milton Ave, Bobbin Head Rd/ Burns Rd and Ellalong Rd / Burns Rd, would be under the control of NSW Police ensuring that traffic along Burns Road did not adversely affect the evacuation effort
- NSW Police would also control the movements at the Mona Vale Rd and Burns Rd restricting turning into Burns Road hence allowing addition al capacity for this vehicles existing out of the evacuation area
- Some residents would begin leaving early when the warning levels were of a lower order and all traffic would not be accessing the evacuation route within the first 15 minutes as modelled.
- The school would normally be closed prior to such an event being implemented.
- Normal traffic entering the zone would be reduced as emergency sieves would only allow residents only to enter the area prior to the order and only allow essential services in after the order
- High care patients would probably have been evacuated prior to the order being given

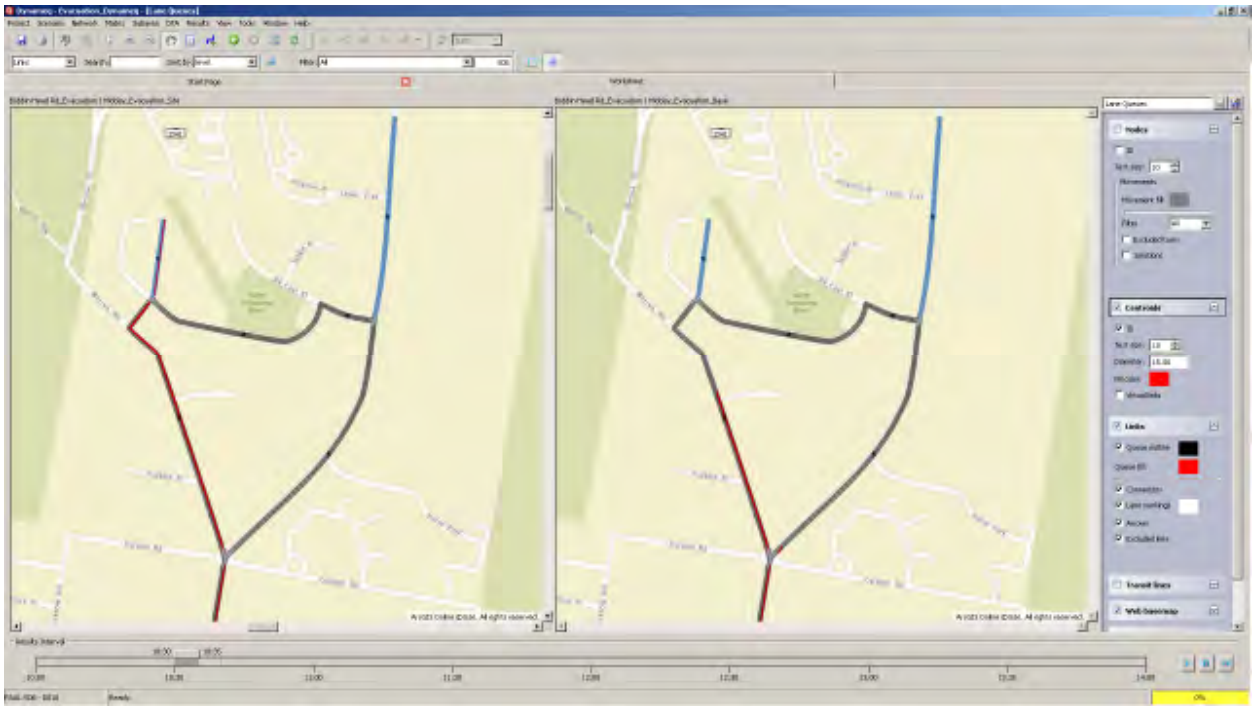
7.0 CONCLUSION

In conclusion, it is clearly demonstrated that the revised development should have no traffic implications from a road capacity perspective on evacuation conditions.

APPENDIX A: OUTPUT MODELS







Appendix 3: Evacuation Traffic Impact Assessment

SKIP

CONSULTING PTY LTD

File No: SKC-354-CA1

7th November, 2014

Alison Holland
Project Manager
EPM Projects Pty Ltd
Suite 2, Level 5
655 Pacific Highway
St Leonards NSW 2065

Preliminary Fire Safety Strategy for a bushfire refuge at SCC, 402 Bobbin Head Road, Turramurra

Dear Alison,

Here is our Trial Fire Safety Design, taking into account the matters determined from a desktop review of the relevant details, and the developing documentation. The analysis in the EcoLogical Australia report of 9 April 2014 provides an excellent assessment of the site issues and I have added some additional matters that relate to the bushfire refuge part of the building.

1.0 External site matters

The site is surrounded by forest from the west-south-west to the south-south-west, with the remainder of the exposure directions containing excluded vegetation. Near to the proposed Residential Aged Care Facility (RACF) building are substantial trees, some native (predominantly eucalypts), some imported (predominantly pines). These are not by themselves considered as a bushfire hazard as the area underneath the trees (fuel) is proposed to be managed. The trees are also not located closely enough so as to create a 'canopy fire' threat. They may present a falling threat to the proposed bushfire refuge, which is outside the scope of AS3959, and will be further considered in the analysis.

For use as a bushfire refuge, substantial vegetation (non-tree) management around the building will be required, typically for at least a 10m zone. This will be to ensure protected circulation routes around the building and to limit localised spot fires around the building which might ignite rubbish bins etc. and create a localised threat of perimeter breech.

Any existing or proposed LPG storage tanks should not be located near the proposed new building. Whilst the risk of a boiling liquid expanding vapour explosion [1] (BLEVE) can be managed by appropriate physical and maintenance procedures, consideration should be given to relocating the tank in the first instance, to a location substantially away from the proposed bushfire refuge.

2.0 Building matters

It is noted that flame impingement (direct flame contact) is not anticipated in the event of a significant bushfire due to the separation distance and that radiant heat form a bushfire is expected to be less than 19 kW/m^2 (BAL-19) on the building. This means the risk to people can be managed by appropriate construction measures, vegetation management and evacuation procedures for the bushfire refuge.

Ember attack is the most prevalent attack mechanism of bushfire and research data indicates that 90% of house losses in bushfire events occur from ember attack, not from direct flame impingement and that ember attack may be present before, during and after the fire front has occurred [2] [3]. Ignition of a building by ember attack also has the potential to spread fire from one building to another, particularly where buildings are closer together relative to their height. The current proposed siting is sufficient to mitigate this measure, but further analysis of the existing surrounding buildings will be required. From the site photographs this appears acceptable, and will be confirmed as part of the site visit.

As the site has a significant bushfire exposure, and vulnerable occupants are likely to be present, the bushfire refuge will be appropriate particularly for 'catastrophic code-red' days where moving people carries with it some inherent risk (heat stroke, stress, vehicle traffic).

3.0 Occupant matters

The document *'Design and construction of community bushfire refuges, information handbook 2014'* [4] published by the Australian Building Codes Board (ABCB) has been reviewed against the proposed building design, noting that the proposed site refuge is not a community fire refuge as intended by this document, and therefore some parts of this document will not be relevant [5].

Statistically the risk to people is low as the average rate of civilian deaths in structures from bushfire is between 3-6 per year [6] and the location of a building is critical as 78% of fatalities occur within 30 m of the forest [3]. Whilst a BAL-19 response is proposed for the building, it is noted that harmful levels of radiant heat could be those as low as 1.0 kW/m2 (where sunburn or heatstroke will occur). Certainly radiant heat levels above 6 kW/m^2 are life threatening [7]. This is why refuge within a building is required for the passage of a bushfire front.

The likely period of occupation of the bushfire refuge is described in the diagram below, and is likely to be 60 minutes. This is the period where the refuge is 'closed' and external conditions can be challenging, or untenable. Beyond 60 minutes the refuge can be re-opened, even though residents might remain within the building. One of the matters for the operational procedures for the refuge will be the estimation of the post-bushfire event, which is a site specific analysis, and will be considered once detailed design is commenced.

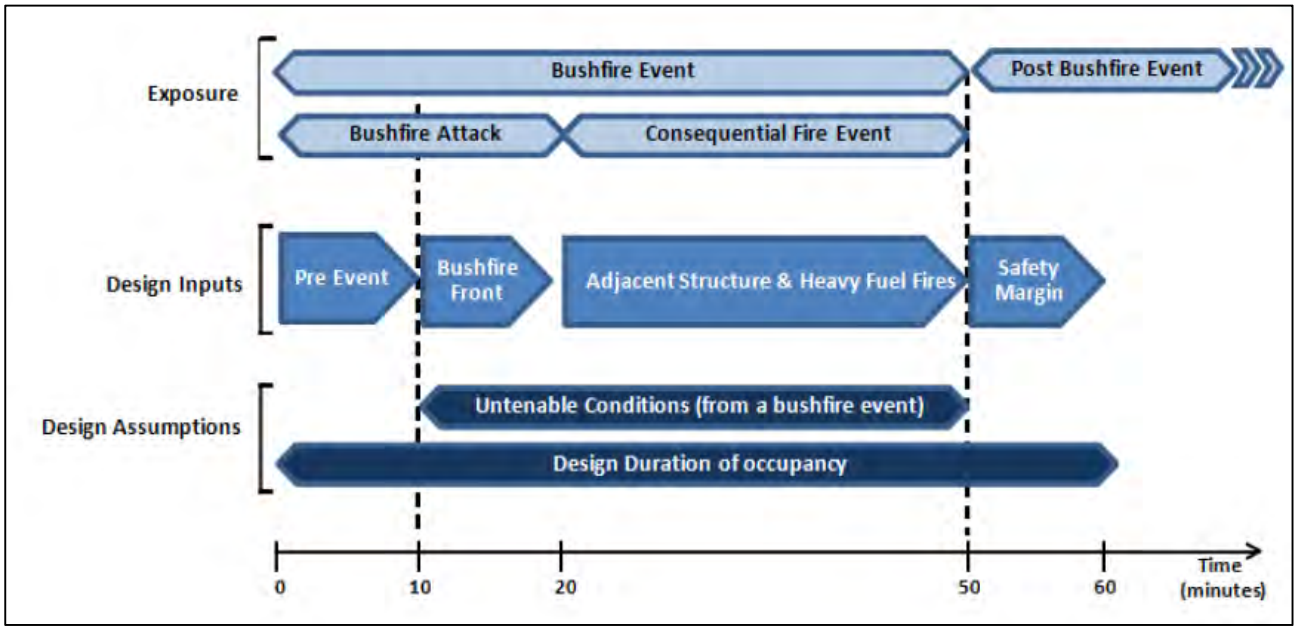


Figure 1 - Design durations of occupancy for a typical bushfire event

Matters relating to operation of the refuge, including (but not limited to); air supply systems, operational procedures, cooling systems, emergency power supply, maintenance requirements, access and egress, psychological conditions, interior fire separation from remaining parts of the building, construction materials, fire-fighting equipment, signage, communication equipment, first-aid equipment and sanitary facilities will be analysed and derived in the detailed design phase of the project.

4.0 Recommendations

The following matters therefore form the Trial Fire Safety Design for the bushfire refuge;

a) The maximum design population is 174 residents + 26 staff = 200 persons.

b) Construction of the RACF building to be BCA Type A construction, including reinforced concrete floors and structural elements to achieve not less than a 90/90/90 fire–resistance level (FRL).

c) The whole of the RACF building should be designed to at least Importance Level 3, in accordance with Part B of the BCA.

d) Ember protection and other construction measures for the entire building to be in accordance with AS 3959-2009, for BAL-19.

e) Water supply for the Rural Fire Service (RFS) fire-fighting purposes to be installed (to be confirmed with RFS).

f) Vehicle access for the RFS fire-fighting purposes to be installed (to be confirmed with RFS).

g) Vegetation management should be implemented prior to each declared Bushfire Danger Period in accordance with the RFS requirements and the outcomes of the analysis of EcoLogical and SKIP Consulting Pty Ltd (this will be further expanded in the final design).

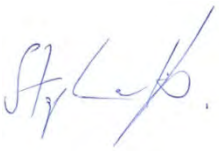
h) A 'bushfire survival plan' should be developed, implemented and reviewed annually prior to each declared Bushfire Danger Period, in accordance with the RFS requirements and the outcomes of the analysis of Ecological and SKIP Consulting Pty Ltd (this will be further expanded in the final design).

5.0 Limitations

This advice uses the processes and methodology in *Australian Standard 3959-2009: construction of buildings in bushfire prone areas*, *Design and construction of community bushfire refuges, information handbook 2014'* published by the Australian Building Codes Board (ABCB) and the International Fire Engineering Guidelines 2005 (IFEG), published by the ABCB and endorsed by the Australian members of the Australasian Fire Authorities Council (AFAC), the Australian Institute of Building Surveyors (AIBS) and the Institution of Engineers Australia (IEAust) Society of Fire Safety. Section 0.13 of the IFEG states;

'The goal of 'absolute' or '100%' safety is not attainable and there will always be a finite risk of injury, death or property damage'.

The owner is therefore advised that all or any of the measures indicated in this advice can mitigate the consequences of a bushfire, but cannot remove all risk.



Stephen Kip Fire Safety Engineer, FIE(Aust)

---

1. Typically, a BLEVE starts with a container of liquid which is held above its normal, atmospheric-pressure boiling temperature. If the pressurized vessel ruptures, the pressure which prevents the liquid from boiling is lost. This causes the entire volume of liquid to instantaneously boil, which in turn causes an extremely rapid expansion. That expansion is so rapid that it is fully capable of inflicting severe damage on its surroundings.
2. Leonard, J.E., Blanchi, R., & Bowditch, P.A., 'Bushfire impact from a house's perspective', Bushfire CRC, Australia.
3. Bushfire Collaborative Research Centre, PowerPoint presentation for *Program D1-People and Property Protection*, by J. Leonard (CMIT), R. Blanchi (CMIT), P.Bowditch (CMIT), M. Potter (CFA), Brian Ashe (ABCB), R.H. Leicester (CMIT) and Page 107 of *Natural Hazards in Australia, Identifying Risk Analysis Requirements*.
4. Available at http://www.abcb.gov.au/en/education-events-resources/publications/abcb-handbooks.aspx).
5. Community fire refuges are buildings located within a community where nearby community members may be a few hundred metres, or several kilometers away and therefore the ABCB information handbook includes access roadway management, carparking and other matters which will not be relevant to this bushfire refuge.
6. *Environmental circumstances surrounding bushfire fatalities in Australia 1901–2011*, Raphaele Blanchi, Justin Leonard, Katharine Haynes, Kimberley Opie, Melissa James, Felipe Dimer de Oliveira, Environmental Science & Policy (2013).
7. Pain after 8 second skin exposure occurs at 6.4 kW/m2, see Drysdale Table 2.7, *an Introduction to Fire Dynamics, 3rd Edition.*

Appendix: Qualifications & Experience of the Author

Statement of Qualifications and Experience

Stephen Kip

Director, SKIP Consulting Pty Ltd

Academic & Trade qualifications	▪ Master of Engineering (Victoria University, 1996) ▪ Graduate Diploma of Building Fire Safety & Risk Engineering (Victoria University, 1993) ▪ Graduate Diploma of Engineering in Building Project Management (Footscray Institute of Technology, now Victoria University,1989) ▪ Bachelor of Building (Deakin University, 1991) ▪ Certificate of Technology, Building Surveying (Footscray TAFE, 1986) ▪ Certificate of Proficiency in Carpentry (Industrial Training [Apprenticeship] Commission (Vic), 1981)
Professional qualifications & memberships	▪ Victorian registered building practitioner, *Fire Safety Engineer* ▪ Victorian registered building practitioner, *Building Inspector* ▪ Victorian registered building practitioner, *Building Surveyor* ▪ Victorian registered building practitioner, (currently voluntarily lapsed), *Domestic Builder (unlimited)* ▪ *Fellow* of the Institution of Engineers (Australia) ▪ *Immediate Past National President* of the Society of Fire Safety of Engineers Australia ▪ *Honorary Fellow* of the academic staff of the University of Melbourne, Faculty of Architecture, Building and Planning ▪ *Associate* of the academic staff of the Victoria University Centre for Environmental Safety and Risk Engineering ▪ Former *Member* of the Victorian Building Appeals Board (2007-2014)
Principal experience	▪ April 2007 - present, Director SKIP Consulting Pty Ltd (Fire Safety Engineering & Building Regulatory Consultancy) ▪ December 2002 - March 2007, Senior Fire Safety Engineer, Warrington Fire Research (Aust) P/L ▪ November 2000 - November 2002, Senior Fire Safety Engineer, Building Research Association of New Zealand (BRANZ) ▪ January 1999 - October 2000, Deputy to the Building Commissioner, Building Control Commission, Victoria ▪ December 1995 - January 1999, Principal Research & Development Officer, Building Control Commission, Victoria ▪ April 1988 - November 1995, Building Surveyor, Gardner Group P/L (Building Surveyors) ▪ January 1988 - April 1990, Principal of building company, KB Constructions ▪ November 1984 - December 1987, Building Surveyor, City of Geelong
Other related experience	▪ 1987 to present, part time lecturing positions in building and fire safety engineering related subjects at several universities including; the University of Melbourne, Victoria University, Deakin University and RMIT University. ▪ Member of the Victorian Emergency Management Commissions *Bushfire Construction Advisory Panel* which produced the *Design and construction of community bushfire refuges, information handbook 2014,* published by the Australian Building Codes Board ▪ Member of the Australian Building Codes Board committee on Private Bushfire Shelters which produced the *Performance Standard for Private Bushfire Shelters, 2010*, published by the Australian Building Codes Board.

FIRE SAFETY ENGINEERING AND BUILDING REGULATORY CONSULTANCY

P: 0438 262 400 F: (03) 5222 5672 E: stephen@skip.net.au W: www.skip.net.au

P.O. Box 397, Geelong, Vic, 3220 ABN 97 123 965 079

ecological AUSTRALIA

HEAD OFFICE
Suite 4, Level 1
2-4 Merton Street
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

SYDNEY
Level 6
299 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9264 0717

ST GEORGES BASIN
8/128 Island Point Road
St Georges Basin NSW 2540
T 02 4443 5555
F 02 4443 6655

CANBERRA
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

NEWCASTLE
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

NAROOMA
5/20 Canty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

COFFS HARBOUR
35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

ARMIDALE
92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

MUDGEE
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1230
F 02 6372 9230

PERTH
Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 08 9322 1358

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4268 4361

GOSFORD
Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897

DARWIN
16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601

BRISBANE
51 Amelia Street
Fortitude Valley QLD 4006
T 07 3503 7193

1300 646 131
www.ecoaus.com.au