



**Lot 1507 Eighty Road, Baldivis
Local Structure Plan**



APPENDIX E

FIRE MANAGEMENT PLAN

LOCAL STRUCTURE PLAN

Lot 1507 Eighty Road

Baldivis

CITY OF ROCKINGHAM

FIRE MANAGEMENT PLAN

A Report for : Taylor Burrell Barnett

Prepared by



May 2012

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1. Introduction

The subject land comprises Lot 1507 Eighty Road, Baldivis in the City of Rockingham. The total site area is 120 hectares in size and is located approximately 45 kilometres south of Perth (Appendix A).

A Fire Management Plan (FMP) was requested by the City of Rockingham in a letter dated 11th October, 2011. The following condition must be satisfactorily addressed.

“A Fire Management Plan FMP), including a Bush Fire Hazard Assessment, being undertaken in accordance with the Planning for Bush Fire Protection guidelines (Edition 2).”

The FMP provides performance criteria and acceptable solutions that fulfill the intent of the bushfire hazard management issues outlined in the Planning for Bushfire Protection guidelines - edition 2.

Community bushfire safety is a shared responsibility between governments, fire agencies, communities and individuals. The planning and building controls outlined in this plan if fully implemented, will mitigate the risk of bushfire to people and property, it will not remove the risk. How people interpret the risk, prepare and maintain their property and buildings and what decisions and actions they take (ie. evacuate early or stay and defend) greatly influences the outcome of a bushfire. Individual residents need to be self reliant, and not expect warnings or assistance from emergency services.

2. The Proposal

The proposal is to subdivide the subject land into 1130 single lots, 26 Group Housing (with 477 dwellings), 4 Commercial lots, 1 Primary School and 21 Public Open Space Reserves. Total dwellings will be a maximum of 1607. The land is zoned “Development” under the City of Rockingham’s Town Planning Scheme No. 2. Stage 1 of the estate has been approved, constructed and in most cases sold. There are 11 proposed stages in total. A copy of the local structure plan is found in Appendix B.

3. Objectives

The purpose of this FMP is to adequately address fire protection risks within the proposed subdivision and development. In particular, implementation of the Fire Management Plan will reduce the threat to residents, school staff and students, workers in the commercial precinct and fire fighters in the event of a bush fire within or near the site. It achieves this by setting out minimum requirements to implement.

The Fire Management Plan also seeks to ensure that the developer, land owners and occupiers, residents and relevant agencies are aware of their responsibilities.

Achievable and measurable goals of this plan include:

- Ensuring that the development of land use is located in an area where the bush fire hazard does not present an unreasonable level of risk to life and property.
- Ensuring vehicular access serving the development is safe in the event of a bushfire occurring.
- Ensuring water is available to the development to enable life and property to be defended from bushfire.
- Ensuring the siting of development minimises the level of bushfire impact.
- Ensuring that the design of the development minimises the level of bushfire impact.

This document sets out the roles and responsibilities of the developer and subsequent landowners of the proposed lots, the City of Rockingham, and other relevant agencies. Accordingly, it is important that the measures and procedures outlined in this FMP are reviewed as necessary.

The Fire Management Plan includes:

- a description of the site, the surrounding area, fire climate and bushfire history;
- a summary of the factors affecting building survival in bushfires;
- a summary of research into bushfire related fatalities;
- a bush fire hazard assessment;
- addressing resident and fire services vehicular access;
- building siting including building protection zones;
- water supply; and
- maps and plans of fire reduction measures.

4. Statutory and Policy Framework

Relevant key legislation, policy and guidelines include the following :

4.1 Bush Fires Act

The purpose of the Act is to make better provision for diminishing the dangers resulting from bush fires, for the prevention, control and extinguishment of bush fires and for other purposes. The Act addresses various matters including prohibited burning times, enabling Local Government to require owners/occupiers of land to plough or clear firebreaks, the control and extinguishment of bush fires and the establishment and maintenance of Bush Fire Brigades.

The Act also applies to Department of Environment and Conservation (DEC) managed lands throughout Western Australia. Sections 39 and 45 provide authorised CALM Act officers with powers to suppress fires in and near forest and Crown Lands. Other sections provide for authorised CALM Act officers to enforce the provisions of the Bush Fires Act. The Bush Fires Act however do not affect the provisions of the CALM Act and the Bush Fires Act does not generally bind the DEC.

The provisions of the Bush Fire Act can be enforced, in addition to this Fire Management Plan.

4.2 State Planning Policy No. 3.4 Natural Hazards and Disasters

The objectives of this Policy are to:

- include planning for natural disasters as a fundamental element in the preparation of all statutory and non-statutory planning documents, specifically town planning schemes and amendments, and local planning strategies; and
- through the use of these planning instruments, to minimise the adverse impacts of natural disasters on communities, the economy and the environment.

The Policy incorporates by reference the provisions and requirements contained in Planning for Bush Fire Protection edition 2 (WAPC et.al. 2010) to determine those areas that are most vulnerable to bush fire and where development is appropriate and not appropriate.

4.3 Planning for Bush Fire Protection Guidelines (2010)

This policy document was prepared by the Fire and Emergency Services Authority of Western Australia (FESA), the Western Australian Planning Commission (WAPC) and the Department of Planning. The document forms the foundation for fire risk management planning on private land in Western Australia.

The document addresses important fire risk management and planning issues and sets out performance criteria and acceptable solutions to minimise bush fire risk for new subdivisions and development. It addresses management issues including development location, vehicular access, water, design and siting of development.

5. Building Survival in Bushfires

Numerous factors affect building survival in a bushfire. Some factors relate to the bushfire behaviour experienced at the site, others relate to the design and construction materials in the building and siting of surrounding elements. Infrastructure, utilities and human behaviour are also factors. Leonard (2009) has identified the following factors :

- Terrain (slope);
- Vegetation - overall fuel load, steady state litter load, bark fuels, etc;
- Weather (temperature, relative humidity and wind speed);
- Distance of building from unmanaged vegetation;
- Individual elements surrounding the building that are either a shield or an additional fuel source;
- Proximity to surrounding infrastructure;
- Building design and maintenance;
- Human behaviour - probability to be present and capacity to fight the fire;
- Access to the building and how that influences human behaviour;
- Water supply for active and/or passive defence; and
- Power supply.

The likelihood of loss of a building is highly dependent on the vulnerability a building has to the mechanisms of bushfire attack. Buildings constructed to the Australian Standard (AS 3959) are more likely to survive a bushfire compared to buildings with no construction standards. However they are not guaranteed to survive a bushfire event. This is substantially due to the degree of vegetation management, the unpredictable nature and behaviour of fire, and extreme weather conditions (Standards Australia 2009).

6. Bushfire Related Fatalities

Significant studies on bushfire related fatalities prior to the Victorian Bushfires on February 9, 2009 (Black Saturday) suggested that people were likely to be killed by radiant heat or a vehicle accident when evacuating late from a bushfire. The research showed that well-prepared houses (and buildings) can be successfully defended from most bushfires and can provide safe refuge for people during the main passage of the fire front (McArthur and Cheney, 1967; Miller et al, 1984; Wilson and Ferguson, 1984; Lazarus and Elley, 1984; Leonard and McArthur, 1999; Leonard, 2003; Handmer and Tibbits, 2005; Blanche and Leonard, 2008).

The Victorian Bushfires Royal Commission (VBRC) final report into the Black Saturday bushfires provided the most comprehensive evidence regarding Australian bushfire fatalities. Where people died on Black Saturday contrasts strikingly with studies from previous bushfire fatalities (VBRC 2010). Historically about 32% of people have died in late evacuations (Risk Frontiers et al. 2008), however on Black Saturday the majority of people (113 out of 173) died inside or close to structures. The severity of the fire on Black Saturday was such that the only way to ensure one's safety was to leave early, well before any fire arrived. When the Fire Danger rating is "Catastrophic" most buildings are undefendable.

Elderly or ill people in the community are also overly represented in bushfire fatality statistics. An investigation by Krusel and Petris (1999) which examined the civilian deaths in the Ash Wednesday bushfires in Victoria in 1983 identified that the majority of victims died during a late evacuation as the fire front arrived or because they were incapable of implementing a safe strategy due to inadequate warning, age or infirmity. Vulnerable people in the community are overly represented in bushfire fatality statistics, 44% of the people who died on Black Saturday were considered to be potentially vulnerable to bushfire because of age, ill health or a combination of both (VBRC 2010).

Bushfires generate enormous amounts of radiant heat. Most people die in bushfires from exposure to radiant heat. Protection from radiant heat is essential if caught in a bushfire. Wearing long sleeved natural fibre clothing, and having solid barriers between people and the fire (ie. source of radiant heat) provides the best protection. Bushfires also generate enormous amounts of smoke and wind, these factors combine with the fire usually causing many trees to come down. Emergency vehicles are also using the roads. These circumstances make driving on roads near bushfires extremely hazardous.

7. Description of the Area

The site is bounded to the west by Eighty Road. West of Eighty road is an equine property and paddocks which have recently been cut for hay. North of the site is urban residential development and the adjoining lot to the east is currently under residential development construction. Larger rural residential blocks are located south of Sixty Eight Road and the vegetation is dominated by a banksia woodland. Baldivis - Karnup is a rapidly growing residential area, with substantial outlying rural areas.

Development of the area dates from the 1920s, spurred by the Government's settlement scheme. Land was used mainly for farming. Significant development did not occur until the 1950s. Rapid growth took place from the mid 1990s, with the population more than trebling between 1996 and 2006, a result of new dwellings being added to the area. Growth has been mainly in the western section of Baldivis (<http://www.rockingham.wa.gov.au/City-and-community/About-Rockingham/Profile-and-statistics.aspx>). Australian Bureau Statistics Census data from 2006 indicate that there were 5,952 people residing in Baldivis in 2128 dwellings. Of the 5,952 people, 877 (or 14 %) were aged over 55 years (see <http://www.abs.gov.au/>).

7.1 Description of the Subject Land

The subject land contains Lots 1507 Eighty Road, Baldivis within the City of Rockingham. It is located approximately 11 kilometres south-east of the central business district of Rockingham. The site has in the past been timbered in pine trees, these have been recently cleared and the site is now dominated by grass and pine tree slash in windrows. Stage 1 of the residential development is progressing in the north west corner.

The FMP focusses on the subject land and immediate surrounding area (Appendix B). In summary this land:

- is undulating with slopes ranging between 0-4 degrees across the site.
- is extensively covered in grassland with pine tree slash in windrows.
- will have development staged, with Stage 1 already approved, constructed and in most cases sold.
- has banksia woodland as the major vegetation type south of Sixty Eight Road where the highest bushfire risk occurs.
- adjoins existing urban development to the north and east.
- is surrounded by an equine and paddocks on the adjoining property to the west.
- has direct road frontage to Eighty and Sixty Eight Road.

7.2 Fire Climate

Weather conditions significantly affect the behaviour of bushfires. Bushfires burn more aggressively when high temperatures combine with low humidity and strong winds. Virtually all house losses occur during severe, extreme or catastrophic (ie when the Fire Danger Indices are over 50) conditions (Blanchi et al. 2010). Statistics from the Bureau of Meteorology weather station at Medina (12 kilometres north of the site) indicates the area experiences warm dry summers, cool wet winters (Figure 1), it is classified as a Mediterranean climate. Maximum and minimum temperatures vary from 31 degrees Celsius in January and February to 18 degrees Celsius in July. This combination of hot dry summers and cool wet winters (Figure 1) is classified as a Mediterranean climate.

The Bureau of Meteorology website (www.bom.gov.au/weather/wa/sevwx/perth/bushfires.shtml) states that extreme fire weather conditions in the Perth region typically occur with strong easterlies or north easterly winds associated with a strong high to the south of the state and a trough offshore. Easterly winds represent about 60% of extreme fire weather days (events) compared to less than 5% associated with southerly winds. About 15% of Perth events occurred in a westerly flow following the passage of a trough. This number increases inland from the west coast where the westerly or north-westerly winds can be strong and gusty while temperatures initially remain high with the trough change.

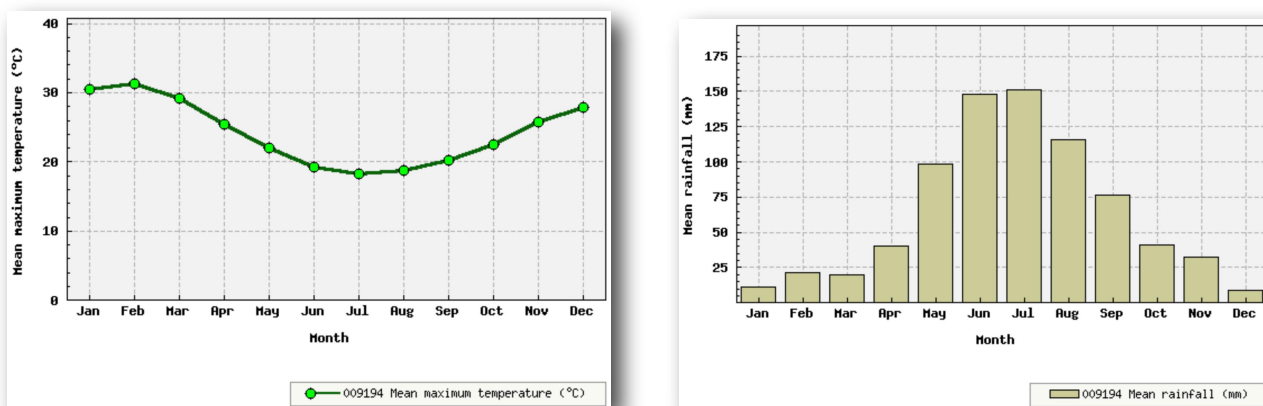


Figure 1 : Mean maximum recorded temperatures and mean rainfall for Medina Bureau of Meteorology Station between 1993 and 2011.

The site is 5.5 kilometers from the coast at Warnbro Sound and is thus influenced by land and sea breezes. These are created by the daily heating and cooling of the land surface adjacent to the ocean. The sea breeze occurs when the air over the land heats up and becomes more buoyant and rises, denser moist air over the ocean then flows inland. Sea breezes can strengthen prevailing wind, reduce it or even reverse it, depending on the strength and direction of the two airstreams (Cheney and Sullivan 2008).

The land breeze is the opposite and occurs when the land cools and air flows from the land towards the ocean to replace the rising warmer air. It is generally less turbulent than the sea breeze. The predominant winds in the summer months at 3pm at Medina are south-westerlies (Figure 2). In terms of strength, the most common wind strength is between 20-30 km/hr and occurs approximately 50% of the time. Winds between 30 - 40 km/hr occur 20% of the time from the south-west.

The predominant winds in the summer months at 3pm near the study site are south-westerlies. The wind roses from the nearby Medina Bureau of Meteorology Research Centre confirm this (Figure 2) from statistics taken over the past 27 years. In terms of wind strength, direction and frequency, the south west wind is clearly dominant occurring 40-50% of the time. Winds from the west and south occur 10-15% of the time.

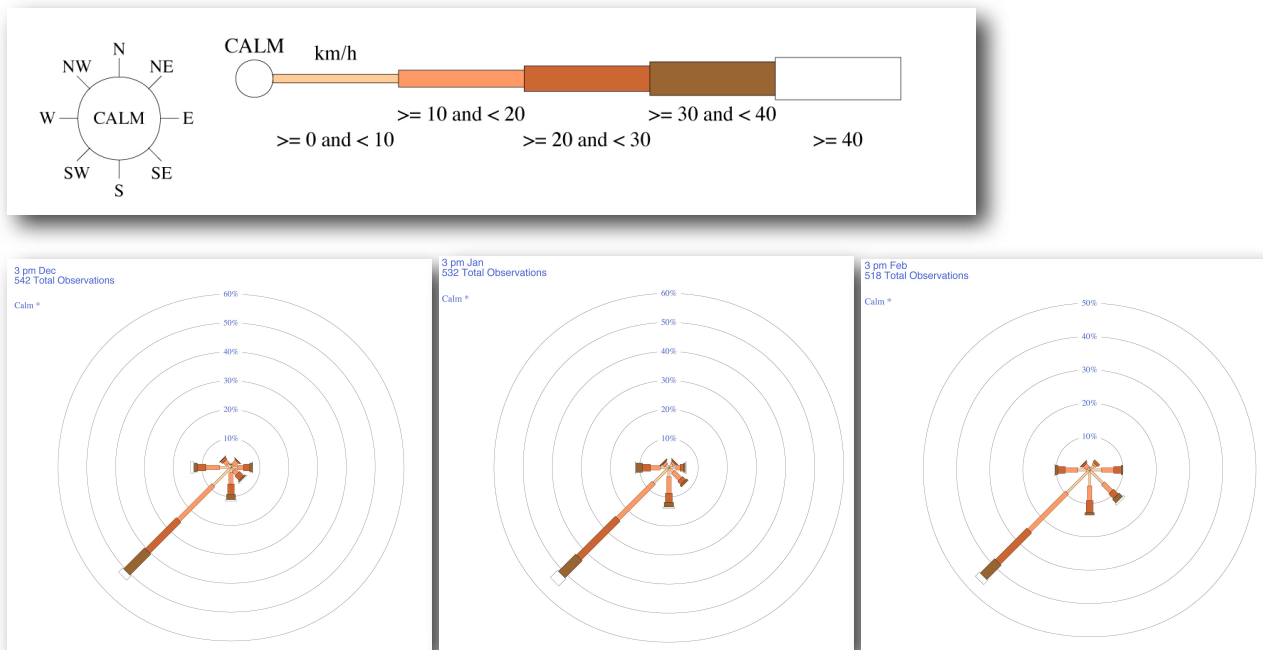


Figure 2: Rose of wind direction and wind speed in km/hr for December, January and February between 1983 - 2010 at the nearby Medina Bureau of Meteorology Research Centre.

Interpreting Figure 2 - Wind speed Vs Direction Plot

Wind roses summarise the occurrence of winds at a location, showing their strength, direction and frequency. The percentage of calm conditions is represented by the size of the centre circle - the bigger the circle, the higher is the frequency of calm conditions. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram. Eight directions are used. The branches are divided into segments of different thickness and colour, which represent wind speed ranges in that direction. Speed ranges of 10km/hr are used. The length of each segment within a branch is proportional to the frequency of winds blowing within corresponding range of speeds from that direction (BOM 2010).

7.3 Bushfire Fuels

The study site has grassfire fuels with pine tree slash in windrows. There is a small area of open woodland that has a disturbed understorey of predominantly grasses. Short grass fuels exist on the equine property and cut paddocks to the west. Grass fuels change rapidly according to the season and growth phase of the plants and whether annual or perennial grasses dominate.

The heaviest area of fuel loadings is in the banksia woodland south of the development, this woodland contains all fuel layers that commonly effect fire behaviour.

7.4 Assets

The site when fully developed will contain 1126 residential, 5 commercial, 25 public open space areas and one proposed school site. Assets most likely threatened will be lots within 100 metres of remnant vegetation on the southern boundary, however ember attack can impact on buildings over much longer distances. Urban developed areas east of the site and to a lesser extent north of the site could be impacted on by an uncontrollable bushfire.

7.5 Access

The proposed development will be serviced by 3 public road access ways onto Sixty Eight Road and four onto Eighty Road. All public roads within the site will be sealed and provide appropriate access and egress.

7.6 Water Supply

Reticulated water will be provided to the entire development. Fire hydrants will be spaced to Water Corporation / FESA standards and provide fire agencies access to an adequate water supply for fire suppression purposes.

8. Fire Problem

8.1 Bushfire History

A recent study has concluded that bushfires may have been in the Australian Landscape for 50 million years longer than previously thought. The adaption of eucalypts that allows them to recover from bushfires has been traced back more than 60 million years (Crisp et. al. 2011), indicating fire has been in the Australian landscape since that time. Documented evidence exists of frequent fires in the south west of Western Australia for the past 2.5 million years (Hassel and Dodson 2003).

Anthropological and historical evidence suggests that much of the Swan Coastal Plain was regularly burnt by the Aborigines until the middle of the 19th century (Abbott 2003).

Where populations of Aborigines were relatively large, such as in coastal areas of south western Australia, the collective evidence suggests that burning was conducted at near maximal frequencies in some parts of the landscape (Hassel and Dodson 2003). Consequently, due to limited fuel accumulation periods, many of the fires lit by the Aborigines would have been of low to moderate intensity and relatively small in extent (Burrows et al. 1995, Abbott 2003). A fine-scale mosaic comprising a complex of burn histories, from recently burnt to even long unburnt, was the likely result of this fire regime (Bowman 2003).

The practice of frequent burning was continued by European graziers across much of the coastal and near-coastal areas of the southwest into the first half of the 20th century (Abbott 2003). Depending on the location, the average fire frequency was thought to vary between two and ten years, with most fires lit in autumn just after the first rains (Abbott 2003).

Recent Bushfire history includes:

A grassfire burnt 20 hectares in East Baldivis on December 13, 2010. It occurred between the Kwinana freeway, Baldivis Road, Safety Bay Road and Zig Zag Road, 7 kms north of the study site. The grassfire moved in a north north-easterly direction with flames recorded up to 2 metres in height (<https://internet.fesa.wa.gov.au/alerts/Pages/Alert.aspx?ItemId=1380>).

A bushfire in Rockingham Regional Park that started on November 30th, 2010 seven kilometres south of the study site started which travelled primarily on south westerly winds. It took several days to contain and control, over 40 homes were threatened and over 530 hectares were burnt. Forests and woodlands surrounded by urban areas are also particularly susceptible to frequent bushfires due to the high risk of arson and great potential for accidental ignitions (Walker 1981, Burrows and Abbott 2003). Bushfires are common in the City of Rockingham.

8.2 Bushfire Hazard Assessment

The assessment of bushfire hazard at the strategic level takes into account the predominant vegetation class on the site and surrounding area for 100 metres minimum. Fuel layers in a typical forest environment can be broken down into 5 obvious segments (Figure 3). These defined fuel layers are used in the following discussion regarding vegetation types and bushfire hazard levels.

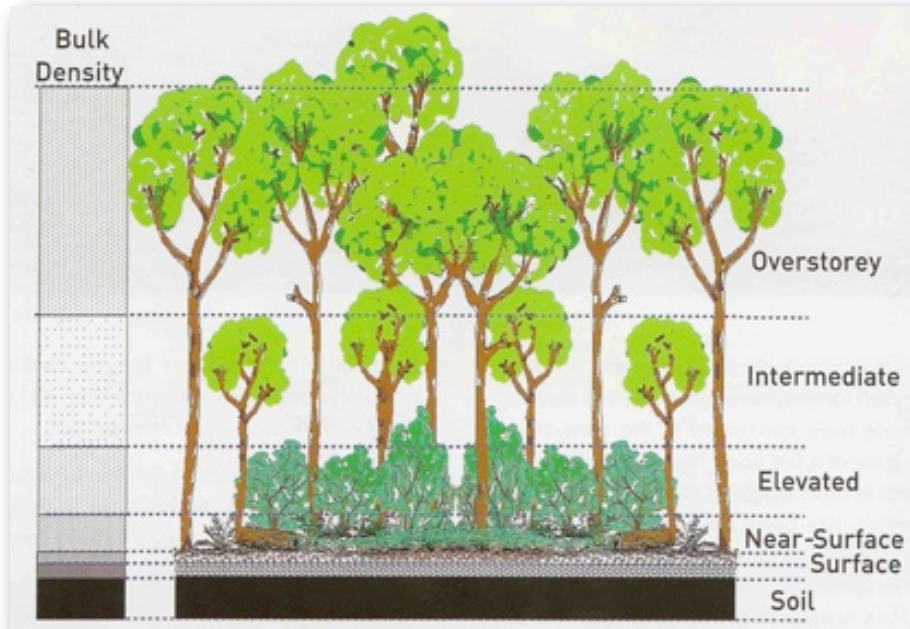


Figure 3: The five obvious fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)

Vegetation type and class

The vegetation class map for the site and surrounding area for a minimum of 100 metres is found in Appendix C. Approximately 75% of the site is occupied by grass fuels and windrows of pine tree slash. Another 20% of the site is already under development meaning it has either been cleared and is mineral earth surface or has housing constructed. A small area of open woodland with Marri (*Corymbia calophylla*) and remnant pine trees occurs on the western boundary.

West of the site and west of Eighty Road paddocks are the dominant feature, during site inspection in November 2011, the paddocks had been cut for hay and had low grass fuel levels. South of Sixty Eight Road is a banksia woodland that exists in a relatively undisturbed state. The fuel structure in the woodland contains all 5 obvious fuel layers as pictured in Figure 3. The Banksia woodland occurs in an area identified as Urban Investigation Area (2011-2020) and it is likely that it will be modified and fuel reduced prior to the completion of the adjacent stages of development. Prior to the creation of titles on all lots within 100 metres of the Banksia woodland south of Sixty Eight Road, the vegetation and fuel loads will be re-assessed to determine Bushfire Attack Levels ratings (as per AS3959) for all effected lots.

Slope

The site is undulating with a ridge of high ground running roughly north-south. Site slopes are generally in the range of 2 - 5 degrees. Extensive site works are proposed that involve removing material from the high ground and filling the low areas. The site will be relatively flat after site works are complete. The cut and fill plan for the site is found in Appendix D.

The Bushfire Hazard Assessment Levels

The vegetation class map (Appendices C) outlines the dominant vegetation types on the study site and surrounding area for a minimum of 100 metres. The bushfire hazard assessment levels were determined using “Appendix 1” in Planning for Bushfire Protection (PBP) - guidelines (2010) . The study site has bushfire hazard ratings of predominantly moderate and low. The grassland and pine tree slash is rated as moderate. One small area of open woodland is currently rated as extreme (Appendix E).

External to the site, extreme hazard rating occurs south of Sixty Eight Road in the banksia woodland. The Melaleuca Woodland west of the site is also rated as extreme bushfire hazard. Near the south east corner of the site in the adjoining property currently being developed two small areas of open woodland are currently rated as extreme. This site is being rapidly developed and has an approved structure and subdivision plan. The hazard will be removed prior to any construction occurring adjacent to this site.

The following representative photos provide a picture of fuel quantity and structure in the different vegetation types and these are related to bushfire hazard ratings as follows :

Low Bushfire Hazard Level



Figure 4a) : Grass fuels in cut paddocks.



4b) Grass fuels on equine property.

Medium Bushfire Hazard Level



Figure 5 : Grass fuels with pine tree slash on development site.

Extreme Bushfire Hazard Levels



Figure 6a : Banksia Woodland.



6b) Melaleuca Woodland .



Figure 6c) : Open Woodland.

9. Fire Mitigation Strategies

This report adopts an acceptable solution and performance-based system of control for each bushfire hazard management issue. It is consistent with Appendix 2 in Planning for Bushfire Protection (WAPC et.al 2010). The management issues are :

1. Development Location
2. Vehicular Access
3. Water
4. Siting of development
5. Design of development

Acceptable solutions are provided for 4 out of the 5 management issues and each illustrates one example of satisfactorily meeting the corresponding performance criteria. A performance based approach is provided for one management issue.

9.1 Element : Development Location

Intent

To ensure that development/intensification of land use is located in areas where bush fire hazard does not present an unreasonable level of risk to life and property.

Acceptable Solution

Bushfire hazard levels are rated as predominantly moderate and low on the development site due to the existing grass and pine tree slash. Where earth works and residential development has been undertaken the bushfire hazard rating levels are low. The small area of open woodland is highly modified with a grass understory, it is rated as extreme hazard level. All bushfire hazard on the site will be removed during development and the public open space areas will have vegetation established and maintained to building protection zone standards and “low threat vegetation” as defined in the Australian Standard AS3959.

The area of most concern is the banksia woodland vegetation south of Sixty Eight Road. The most vulnerable dwellings or buildings will be those located on the southern perimeter of the development adjacent to this bushfire hazard.

Some isolated areas of extreme hazard occurs east of the site which will be removed as this site develops into the residential estate called “The Dales”. A melaleuca woodland extends to just within 100 metres distance from proposed development in the north west corner providing a source of ember attack to the development. All buildings will be constructed to AS3959 standards to mitigate bushfire hazard, 20 metre minimum building protection zones will be established and BAL-29 will not be exceeded where development adjoins bushfire hazard.

Sixty Eight Road and Eighty Road provide good access and also provide a separation distance between the bushfire hazard from development. This combined with internal roads, setback distances on lots facing the hazard and management of vegetation on the development side of the public roads provide an adequate building protection zone.

9.2 Element : Vehicular Access

Intent

To ensure that the vehicular access serving a subdivision development is safe in the event of a bush fire occurring.

Acceptable Solutions

The performance criteria is : The internal layout, design and construction of private vehicular access in the subdivision/ development allows emergency and other vehicles to move through it easily and safely at all times.

Vehicular access throughout the development is outlined in Appendix B. This proposal complies with the performance criteria by applying the following acceptable solutions :

Acceptable Solution : Two access routes

There are three access routes into and out from the development onto Sixty Eight Road and a further two linking onto Eighty Road. A minimum of two trafficable access routes will be available at all stages of development.

Acceptable Solution : Public Roads

A substantial number of public roads will be developed for the public to access their residences and drive throughout the subdivision (Appendix B). Every residential lot and the proposed high school has access to a 6 metre wide public road. All main access and collector public roads will comply with the following minimum standards :

- Minimum trafficable surface : 6 metres
- Horizontal clearance : 6 metres
- Vertical clearance : 4 metres
- Maximum grades : 1 in 8
- Maximum grades over < 50 metres : 1 in 5
- Maximum average grade : 1 in 7
- Minimum weight capacity : 15 tonnes
- Maximum crossfall : 1 in 33
- Curves minimum inner radius : 12 metres

There is no proposed emergency or fire service access ways and there are no battle axe access ways proposed. Depending on the future road layout, a fire break may be required when the school site is designed and must be a minimum of 3 metres wide and comply with the City of Rockingham annual Fire Control Notice (i.e. slashing of all vegetation to a height of 50mm).

Acceptable Solution : Cul-de-sacs

A number of short cul-de-sacs are proposed and outlined in the site plan in Appendix B. They will comply with the following minimum standards :

- Maximum length : 200 metres
- Minimum trafficable surface : 6 metres
- Horizontal clearance : 6 metres
- Maximum grades : 1 in 8
- Maximum grades over < 50 metres : 1 in 5
- Maximum average grade : 1 in 7
- Minimum weight capacity : 15 tonnes
- Maximum crossfall : 1 in 33
- Curves minimum inner radius : 12 metres
- As per turn around area requirements - (see Appendix F)

9.3 Element : Water

Intent

To ensure that water is available to the development to enable life and property to be defended from bush fire.

Acceptable Solution

The development is provided with a reticulated water supply, together with fire hydrants, in accordance with the specifications of the Water Corporation and FESA. The 'Water Corporation's No. 63 Water Reticulation Standard' is deemed to be the baseline criteria for developments and should be applied.

Fire services require ready access to an adequate water supply during fire emergencies. Water supplies have to be easily accessible and located at regular intervals. Fire hydrant location and identification markings are found in Appendix I. These will be installed and marked by the Developer during the construction of stages to the satisfaction of the City of Rockingham.

9.4 Element : Siting of Development

Intent

To ensure that the siting of development minimises the level of bushfire impact.

Performance Solution

All areas of Public Open Space will be highly modified and landscaped. They will have bushfire fuels established and managed to building protection zones standards. The proposed primary school site will also have bushfire fuels reduced to building protection zone standards.

The bushfire hazard will be removed from the site entirely, leaving development on the perimeter exposed to bushfire hazard from adjoining properties only. The bushfire hazard rating north of the site is low and there is no requirement for a Building Protection Zone. Likewise the eastern boundary of the development has been designed to marry with the final stages of the adjoining development (The Dales Development). Bushfire hazard in this area will be removed as the residential development is completed.

Vegetation of greatest concern exists south and to a lesser extent west of the site. The hazard in these areas require the establishment of a Building Protection Zone to separate hazard from development. The area south of Sixty Eight Road (ie. Banksia Woodland) is identified as Urban Investigation Area (2011-2020). This means it is possible that prior to the completion of stages 10 and 11 of the development (which border Sixty Eight Road), the Banksia Woodland may have been modified and fuel reduced. Vegetation types, hazard levels and fuel loads need to be re-assessed in the Banksia Woodland prior to the creation of titles along the southern perimeter so as accurate Bushfire Attack Level ratings can be applied. This reassessment is to be carried out by the Developer.

The existence of grassland bushfire hazard on the site, requires management of fuels within 100 metres of the locations of dwellings. As the development is staged a 100 metre low fuel zone buffer must be incorporated into the stages to ensure a bushfire cannot carry in grassland fuels and threaten new dwellings in the development.

9.4.1 Dwelling locations, predicted Bushfire Attack Level and Building Protection Zones

The Australian Standard 'Construction of buildings in bushfire-prone areas (AS 3959-2009)' has six categories of Bushfire Attack Level, namely BAL-LOW, BAL-12.5, BAL19, BAL-29, BAL-40 and BAL-FZ. These categories are based on heat flux exposure thresholds.

The method for determining the BAL involves a site assessment of vegetation and local topography. The assumed Fire Danger Index (FDI) for Western Australia is 80. The BAL identifies the appropriate construction standard that applies as a minimum standard in Construction of Buildings in Bushfire-Prone Areas (AS 3959-2009).

Methodology and Assumptions

The following Bushfire Attack Level (BAL) examples were determined using the methodology in Appendix A in the Australian Standard (AS 3959-2009) Construction of Buildings in Bushfire-prone Areas. The Appendix A methodology is also outlined in the Planning for Bush Fire Protection guidelines. Six representative lots on the development perimeter were chosen, 3 on the southern perimeter and 3 on the western perimeter as representative sites (Table 1 & Appendix H & I). The sites were selected to provide BAL examples of the most exposed representative dwellings. The results of BAL assessments for all exposed dwellings can be found in Table 1 and Appendix G & H.

The criteria to determine the BAL is outlined as follows:

Designated Fire Danger Index	:	80
Flame Temperature	:	1090 K
Slope	:	Various (See Table 1)
Vegetation Type	:	Woodland
Vegetation Classification	:	Woodland vegetation
Building setback distances	:	Various (See Table 1)

BAL Example No.	Vegetation Class	Setback Distance	Effective Slope	BAL Rating
1	Woodland	22 metres	Downslope 2 degrees	BAL-29
2	Woodland	21 metres	Downslope 3 degrees	BAL-29
3	Woodland	37 metres	Downslope 2 degrees	BAL-12.5
4	Woodland	94 metres	Downslope 1 degrees	BAL-12.5
5	Woodland	95 metres	Downslope 1 degrees	BAL-12.5
6	Woodland	> 100 metres	Downslope 2 degrees	BAL-LOW

Table 1 : Bushfire Attack Level (BAL) Assessments for example dwellings (See Appendix G & H)

The example Bushfire Attack Level (BAL) assessment undertaken demonstrates that dwellings sited at example sites (1-6) fall within the acceptable level of risk (ie. BAL-29 and lower) and will have construction standards increased according to AS3959. BAL examples 1 and 2 have the highest level of exposure but still maintain a setback distance of not less than 21 metres from woodland vegetation. Development on the western side of the site is exposed to BAL 12.5 where classified vegetation is within 100 metres. This only occurs for a few dwellings on the far north west perimeter due to the distance from the melaleuca woodland.

The Banksia Woodland Area south of Sixty Eight Road has been identified as Urban Investigation Area (2011-2020) and therefore the future and timing of further development in this area is uncertain but likely at some stage. It is possible vegetation will be modified and fuel reduced south of Sixty Eight Road prior to Stages 10 and 11 of the development being completed. It is therefore important that vegetation types and fuel loads are re-assessed in the existing Banksia Woodland prior to the creation of titles in the adjoining 100 metre development zone. This will ensure appropriate and accurate Bushfire Attack Level ratings (and building construction standards) are applied to adjoining development.

The building protection zones (BPZ) will meet the following standards :

- Width: to all lot boundaries on all residential lots. Houses on the southern and western perimeter of the development will have a building protection zone that includes the Eighty Road Reserve and Sixty Eight Road Reserve.
- All areas of public open space and the road side vegetation on the development side of Eighty Road and Sixty Eight Road are included in the Building Protection Zone (location outlined in Appendix G & H).
- Location: within the boundaries of the lot on which the building is located or overlapping with the BPZ on adjoining lots.
- Fuel load: reduced to and maintained at 2 tonnes per hectare.
- All tree crowns are a minimum of 10 metres apart.
- All trees to have lower branches pruned to a height of 2 metres.
- All tall shrubs or trees are not to be located within 2 metres of a building (including windows).
- No tree crowns or foliage is to be within 2 metres of any building, this includes existing trees and shrubs and new plantings.
- All fences and sheds are constructed with non combustible materials.

- All shrubs to contain no dead material within the plant.
- No tall shrubs are to be in clumps within 3 metres of the building.
- No trees are to contain dead material in the crown or on the bole.

By achieving these standards, it will be possible to construct buildings to the appropriate construction standard (ie. BAL-29 or lower) under the Australian Standard (AS 3959-2009) Construction of buildings in bushfire-prone areas. Further site specific assessment should be undertaken prior to the creation of titles to accurately determine individual site BAL ratings.

Because increased construction standards will apply for buildings under AS 3959-2009, the requirement for a hazard separation zone (HSZ) can be removed. The design of the development does not include bushland areas within the development boundary between extreme hazard and dwellings that could be fuel reduced to HSZ standards. All available area is occupied by the more intensively managed Building Protection Zone. The lot sizes obviously do not allow a HSZ of any size to fit within the individual lot boundaries.

9.4.2 Landscaping considerations

Bushfires can impact deep into urban environments. Landscaping can both assist in the survival of the building and be a determining measure in its destruction. Landscaping can protect homes by forming a barrier or deflector for windborne debris and radiant heat. It can also bring the fire directly to the building and therefore a degree of care in the selection and location of landscaping needs to be exercised.

All plants will burn under the right conditions and plants do not achieve a “fire resistance level” in accordance with the BCA (Building Code of Australia). Placing plants too close to a building, under timber decks or next to windows will provide a direct threat to the building. Having a clearance around the building will achieve the desired effect of breaking the vegetation from the building. A pathway around the building may be one way of achieving this requirement. The landscaping can then be provided further out from the building.

Bark chips and combustible mulch near a building is not favoured and is a particular problem when the windows have low sill heights. The flames can have a direct connection with the glass which was identified as a major issue during the Canberra bushfires of 2003 where over 500 homes were destroyed.

Work from Ramsay and Rudolf (2006) has identified fourteen (14) major plant attributes that assists people in determining suitable plant species for gardens surrounding homes (ie. building protection zones). A brief discussion on each follows :

a) Moisture content of leaves

The presence of water in fuel retards combustion, enhances smoke formation and has a slight cooling effect as heat is used to evaporate water. The rate of combustion is significantly reduced by increased moisture content.

Most Australian trees and shrubs have low moisture contents of between 80% and 150% of oven-dried weight. By comparison, exotic deciduous trees have a high water content of between 250% and 400% of oven-dried weight. Introduced evergreen hardwoods and conifers fall between these two extremes. The introduced species will most likely be lost in the fire but their higher moisture content means they are less likely to contribute to the fire.

b) Volatile oil content of leaves

Oils are readily volatile. They promote flaming in the early stages and encourage combustion particularly when leaves are green.

c) Mineral content of leaves

The higher the level of total minerals present in leaves the lower the flammability.

d) Leaf fineness

A narrow leaf has a greater area to volume ratio than a broad leaf and will therefore be more easily ignited and burn more intensely.

e) Density of Foliage

Dense foliage will tend to filter out wind-blown embers, block radiation and flame and reduce or deflect wind forces. Combustion is increased when fuel is scattered and ample supplies of oxygen can reach the flame zone.

f) Continuity of Plant form

A broken form of plant is one, which has large spaces between separate branches or concentrations of foliage. The greater the separation between branches and/or concentrations of foliage, the less likely is the spread of fire by radiation and flame.

g) Height of lowest foliage

The characteristic of some trees and shrubs to have foliage near the ground makes it easier for the transfer of heat and flame from the ground level up into the foliage. This characteristic of plants can be modified by pruning lower branches, but this reduces the ability for the plant to act as a wind break.

h) Size of plant.

The protection provided by a plant depends on how its shape relates to the shape of the building or opening its designed to protect. Generally a tall-narrow tree is not as good a barrier as a wide spreading tree, even though both may be large in volume. The greater the volume of a plant, the larger the amount of embers, radiation and flame it can produce, provided other attributes favour their production.

i) Dead foliage on plants

Dead leaves and twigs still attached or suspended in a plant increase embers, radiation and flame. Many deciduous trees, eucalypts and other natives shed the dead lower limbs naturally. Conifers, however are less self-pruning than natives.

j) Bark texture.

Loose flaky, stringy, papery or ribbon-like bark provides a path for fire to spread up into foliage which contributes to flame generation, radiation and ember attack.

k) Quantity of ground fuel available in fire season.

In most forest or grassland fuel types, the rate of spread of ground fire increases directly proportional to the quantity of fine fuel available. Only fuel which is present during a fire season needs to be considered. The aim is to maintain levels less than 2 tonnes per hectare in the Building Protection Zone. Many Australian natives species drop fuel throughout the year and the process is accelerated in the summer when under heat and drought conditions.

l) Particle size of ground fuel

The finer the fuel the greater the spread of ignition and the rate of spread of fire. Coarse material is not readily ignited unless fine fuels are present.

m) Compactability of ground fuel

The placement of individual pieces of fuel in relation to one another influences heat transfer and thus the rate of spread.

n) Mineral content of ground fuel

The greater the mineral content the lower the flammability of leaves in ground litter. Once the leaves become ground fuel the moisture and volatile oils dry out sufficiently to be not relevant.

Ramsay and Rudolph (2006) summarises the effects of plant attributes in table 3 and some useful diagrams are outlined in Figure 7 concerning vegetation management techniques to maintain low fuel hazards.

Plant attribute	Degree of attribute	Performance characteristic		
		Flammability	Provision of ground fuel	Barrier forming ability
Moisture content of leaves	High	Decrease	*	Negligible
	Low	Increase		
Volatile oil content of leaves	High	Increase	*	Negligible
	Low	Decrease		
Mineral content of leaves	High	Decrease	*	Negligible
	Low	Increase		
Leaf fineness	Broad	Decrease	*	Increase
	Narrow	Increase		Decrease
Density of foliage	Closely spaced	Increase	*	Increase
	Sparse	Decrease		Decrease
Continuity of plant form	Connected	Increase	*	Increase
	Broken	Decrease		Decrease
Height of lowest foliage above ground	High	Decrease	*	Decrease
	Low	Increase		Increase
Size of plant (Volume)	Large	Increase	*	Increase
	Small	Decrease		Decrease
Size of plant (Spread)	Wide	Increase	*	Increase
	Narrow	Decrease		Decrease
Dead Foliage on plant	Heavy	Increase	*	Negligible
	Light	Decrease		
Bark texture	Loose	Increase	*	Negligible
	Tight	Decrease		
Quantity of ground fuel available in fire season	Heavy	Increase	Increase	Negligible
	Light	Decrease	Decrease	
Fineness of ground fuel	Fine	Increase	Increase	Negligible
	Coarse	Decrease	Decrease	
Compactability of ground fuel	Packed close	Decrease	Decrease	Negligible
	Packed loose	Increase	Increase	
Mineral content of ground fuel	High	Decrease	Decrease	Negligible
	Low	Increase	Increase	

Table 2: Plant attributes that effect the performance of plants in bushfires.

To provide an overall assessment for a particular species, its a

matter of assessing as many positives as possible. This way of presenting the information allows the general public to assess any species without the need to be a Botanist. The scheme provides an important basis for decisions to be made with regard to managing vegetation on a site.

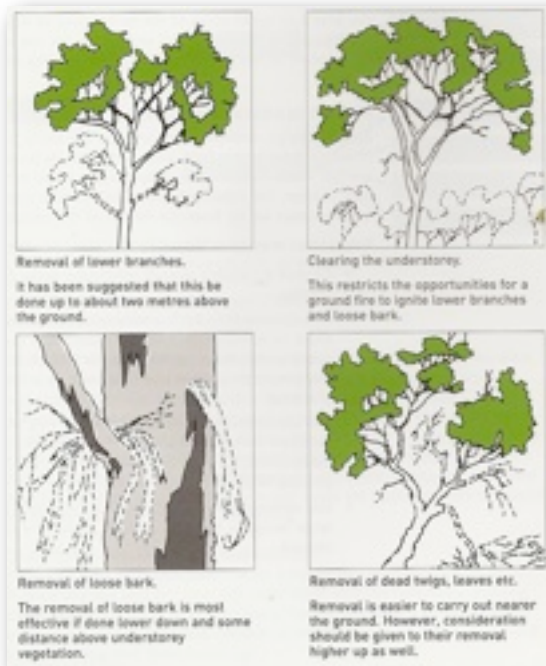


Figure 7: Vegetation management techniques to create and maintain low fuel hazards (Ramsay & Rudolf 2006)

9.5 Design of Development

Performance Criteria

The design of the development is appropriate to the level of bush fire hazard that applies to the development site.

Acceptable Solution

All development on-site will comply with the performance criteria or acceptable solutions 1 - 4 in the "Planning for Bushfire Protection guidelines. All buildings within 100 metres of classified vegetation are to comply with AS 3959-2009 Construction of buildings in bushfire-prone areas. The predicted highest BAL level for all proposed dwellings is BAL-29.

9.6 Public Education and Community Awareness

Community Bushfire Safety is a shared responsibility between individuals, the community, government and fire agencies. The Fire and Emergency Services Authority of Western Australia (FESA) have an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. The Prepare, Act, Survive 30 page booklet provides excellent advice on preparing for and surviving the bushfire season. Other downloadable brochures include : 'Fire Danger Ratings and what they mean for you' and 'Bushfire Warnings and what you should do'.

The City of Rockingham local volunteer bushfire brigades provide bushfire safety advice to residents. There are many benefits to joining the local volunteer bushfire brigade. Research into the devastating bushfires on the Eyre Peninsula in South Australia confirmed residents were much more likely to make good decisions if they were current or past members of the local bushfire brigade. Invaluable experience can be gained by being a member of the local bushfire brigade. The Baldvis volunteer Bushfire brigade is located at 801A Eighty Road (corner Eighty Road and Tranby Drive) in Baldvis. Professional consultants also offer bushfire safety advice and relevant services to residents.

9.7 Community Fire Refuges and Fire Safer Areas

There are no designated Community Fire Refuges in the City of Rockingham. However, the selection of an evacuation centre is usually made at the time of the emergency by the relevant authorities, these details are then advised to residents by FESA, the Shire and Police.

A predetermined centre cannot be nominated because there are no purpose built structures (such as bunkers) designed to withstand the impacts of a bushfire. Therefore the location of an evacuation centre is not determined until the position of the fire and the characteristics of a specific event are considered by authorities. There would be nothing more dangerous than sending residents to a centre which is in the direct path of a fire.

The safest place to be during a bushfire is away from it. This obviously requires evacuating to a destination away from the fire that is not in a bushfire prone area. Where to go is an important element in people relocating during a time of emergency (NSW Rural Fire Service 2004). The preferred option for all residents is to designate a destination that is not in a bushfire prone area and that will be safe to travel to before a bushfire impacts.

Those who find themselves threatened by a bushfire need options (VBRC 2009). This may be because their plan to leave is no longer possible because they cannot reach a place away from the fire front, or their plan to defend their property fails. Residents may also be caught away from their home when a bushfire threatens.

The concept of a “Neighbourhood Safer Place” and Neighbourhood Safer Precincts” has arisen from recommendations by the Victorian Bushfire Royal Commission into the Black Saturday bushfires.

There are large areas within the City of Rockingham that are not bushfire prone, but they have not been declared. Obviously a non bushfire prone area can provide a safe location for people during a bushfire. There is no official criteria in Western Australia yet to determine these areas. In the absence of criteria to guide this process the following general advice from FESA will assist residents to determine where to go as a last resort when their household bushfire survival plans have failed: As a last resort, a safer place is a local open space or building where people may go to seek shelter from a bushfire (FESA 2010). Larger urban areas such as the Settlers Hills area or urban parks or shopping centres more than 300 metres from native vegetation could provide a safe place to shelter from life threatening radiant heat.

10. Conclusion

This plan provides acceptable solutions and responses to the performance criteria that fulfill the intent of the bushfire hazard management issues outlined in Planning for Bushfire Protection guidelines - edition 2 (WAPC et. al. 2010). However community bushfire safety is a shared responsibility between governments, fire agencies, communities and individuals.

The planning and building controls outlined in this plan will reduce the risk of bushfire to people and property, it will not remove the risk. How people interpret the risk, prepare and maintain their property and buildings and what decisions and actions they take (ie. evacuate early or stay and defend or other) greatly influences their personal safety during a bushfire. Individual land holders need to be self reliant, and not expect warnings or assistance from emergency services.

10.1 Compliance checklist for performance criteria and acceptable solutions

Element 1: Location

Does the proposal comply with the performance criteria by applying acceptable solution A1.1 ?

YES

Element 2: Vehicular access

Does the proposal comply with the performance criteria by applying acceptable solution A2.1 ?

YES

Does the proposal comply with the performance criteria by applying acceptable solution A2.2 ?

YES

Does the proposal comply with the performance criteria by applying acceptable solution A2.3 ?

YES

Does the proposal comply with the performance criteria by applying acceptable solution A2.4 ?

N/A

Does the proposal comply with the performance criteria by applying acceptable solution A2.5 ?

N/A

Does the proposal comply with the performance criteria by applying acceptable solution A2.6 ?

N/A

Does the proposal comply with the performance criteria by applying acceptable solution A2.7 ?

N/A

Does the proposal comply with the performance criteria by applying acceptable solution A2.8 ?

N/A

Does the proposal comply with the performance criteria by applying acceptable solution A2.9 ?

N/A

Does the proposal comply with the performance criteria by applying acceptable solution A2.10 ?

N/A

Element 3: Water

Does the proposal comply with the performance criteria by applying acceptable solution A3.1 ?

YES.

Does the proposal comply with the performance criteria by applying acceptable solution A3.2 ?

N/A

Does the proposal comply with the performance criteria by applying acceptable solution A3.3 ?

N/A

Element 4: Siting of Development

Does the proposal comply with the performance criteria by applying acceptable solution A4.1 ?

YES - A HSZ is not required and exposed dwellings will have a their construction standards increased to align with the appropriate bushfire attack level for each site.

Does the proposal comply with the performance criteria by applying acceptable solution A4.2 ?

YES

Does the proposal comply with the performance criteria by applying acceptable solution A4.3 ?

NO - Lots sizes are to small for BPZ to be contained within the lot boundaries however the proposal does satisfactorily comply with performance criterion P4. Building Protection Zones (BPZ) will overlap with neighbouring BPZ zones on adjoining properties. The BPZ is also a minimum of 20 metres for all exposed lots. Construction standards will be increased to the appropriate BAL assessment for exposed dwellings which will not exceed BAL-29.

Does the proposal comply with the performance criteria by applying acceptable solution A4.4 ?

NO - However the proposal does satisfactorily comply with performance criterion P4 because the Hazard Separation Zone is removed and the building construction standards will be increased to the exposed dwellings to comply with AS3959-2009 to offset the removed Hazard Separation Zone. Construction standards will achieve a maximum of BAL-29. The north and eastern sides of the development is sited over 100 metres from classified vegetation meaning increased construction standards are not required.

Does the proposal comply with the performance criteria by applying acceptable solution A4.5 ?

N/A - Shielding not applicable.

Element 5: Design of Development

Does the proposal comply with the performance criteria by applying acceptable solution A5.1 ?

YES

Does the proposal comply with the performance criteria by applying acceptable solution A5.2 ?

NO - However the proposal does comply with the performance criteria P5 because building construction standards will be increased to all dwellings within 100 metres of classified vegetation to comply with AS3959-2009 to offset the reduced setback distances.

11. Implementation of Fire Management Plan

11.1 Developers Responsibilities

To maintain a reduced level of risk from bushfire, the developers responsibilities are to:

- Landscape the public open space areas to building protection zone standards and consider the criteria in 9.4.2 Landscaping Considerations.
- Construct public roads and cul-de-sacs to minimum standards set out in Section 9.2 and design requirements of the City of Rockingham.
- Install reticulated water supply and hydrants to Water Corporation, FESA and City of Rockingham standards.
- Ensure all lots are connected to scheme water.
- Prior to the creation of Titles on all lots within 100 metres of the Banksia Woodland south of Sixty Eight Road re-assess the vegetation type and fuel loads and assign Bushfire Attack Levels ratings (as per AS3959) for all effected lots.
- All internal roads are to comply with the design requirements of this plan and the City of Rockingham.
- All purchasers/new property owners are to be advised of the location of any hydrant that is positioned on their Lot or verge and the requirement for the hydrant to remain unobstructed at all times;
- Developer is to notify any landscaping contractor's, under direction of the developer, of relevant hydrant locations and the requirement to ensure the hydrant is not obstructed, covered over or damaged;
- All land is to comply with the City of Rockingham Fire Control Notice as published,
- Supply a copy of this Fire Management Plan and The Homeowners Bush Fire Survival Manual, Prepare, Act Survive (or similar suitable documentation) and the City of Rockingham Fire Break Notice to each lot owner subject to AS3959 construction standards.
- The developer is required to lodge a Section 70A Notification on each Certificate of Title exposed to AS3959 construction standards, proposed by this subdivision. This is restricted to lots within 100 metres of classified vegetation. The notification shall alert purchasers and successors in title to these exposed lots the responsibilities of the Fire Management Plan and bush fire building construction requirements;

11.2 Property Owners Responsibilities

To maintain a reduced level of risk from bushfire, the owners / occupiers of lots created by this proposal will be responsible for undertaking, complying and implementing measures protecting their own assets from the threat and risk of bushfire. The owners will be responsible for:

- Maintain the property in good order to minimize potential bushfire fuels to mitigate the risk of fire on the property;
- Comply with the City of Rockingham annual Fire Control notice.
- Ensure that where hydrants are located on private property or their verge, the hydrant is not to be obstructed and remain accessible at all times;
- Ensure construction of dwellings is in accordance with AS 3959 as identified;
- Establish and Maintain Building Protection Zones within lot boundaries at the Property owner/occupiers own cost.
- As part of the building license application, the property owner of a lot within 100 metres of vegetation identified (Appendix G) or the City of Rockingham (at the property owners expense) shall have the proposed dwelling reassessed for Bushfire Attack Level (at the time of construction) with results to be submitted as part of the Building License application.
- If existing established properties be subject to additional construction in the future, AS 3959 compliance is required.

11.3 City of Rockingham Responsibilities

The responsibility for compliance with the law rests with individual property owners and occupiers and the following conditions are not intended to unnecessarily transfer some of the responsibilities to the City of Rockingham.

The City of Rockingham shall be responsible for:

- Provide fire prevention and preparedness advice to landowners upon request.
- Maintain low bush fuel loads in all areas of public open space and road reserve sites and liaise with relevant stakeholders to maintain at safe levels.
- Maintain public roads to appropriate standards.
- Maintain district fire fighting capabilities for structural and bush fires.
- Ensure compliance with the City of Rockingham Fire Control Notice.
- Ensure dwellings are constructed to AS 3959 where applicable.
- Endorse a section 70A notification on each lot title within 100 metres of classified vegetation advising of the need to construct in accordance with AS3959.

11.4 Fire and Emergency Services Authority Responsibilities

The Fire and Emergency Services Authority will be responsible for:

- Developing and maintaining District Fire Fighting Facilities including fire hydrants under its control.

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Appendices

Appendix A: Site Location



Site Location

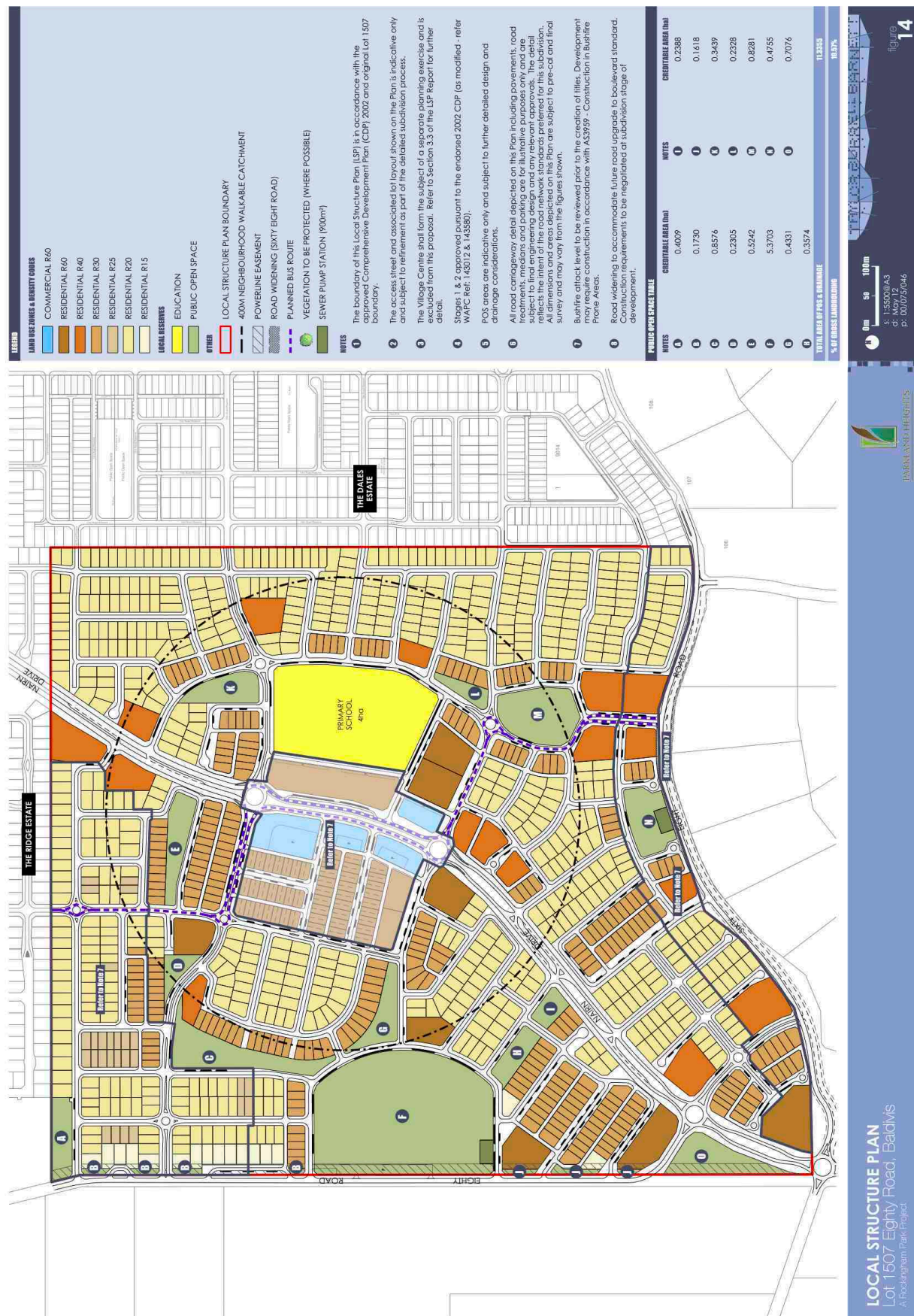
Parkland Heights
Lot 1507 Eighty Road
BALDIVIS
City of Rockingham

0m 2km

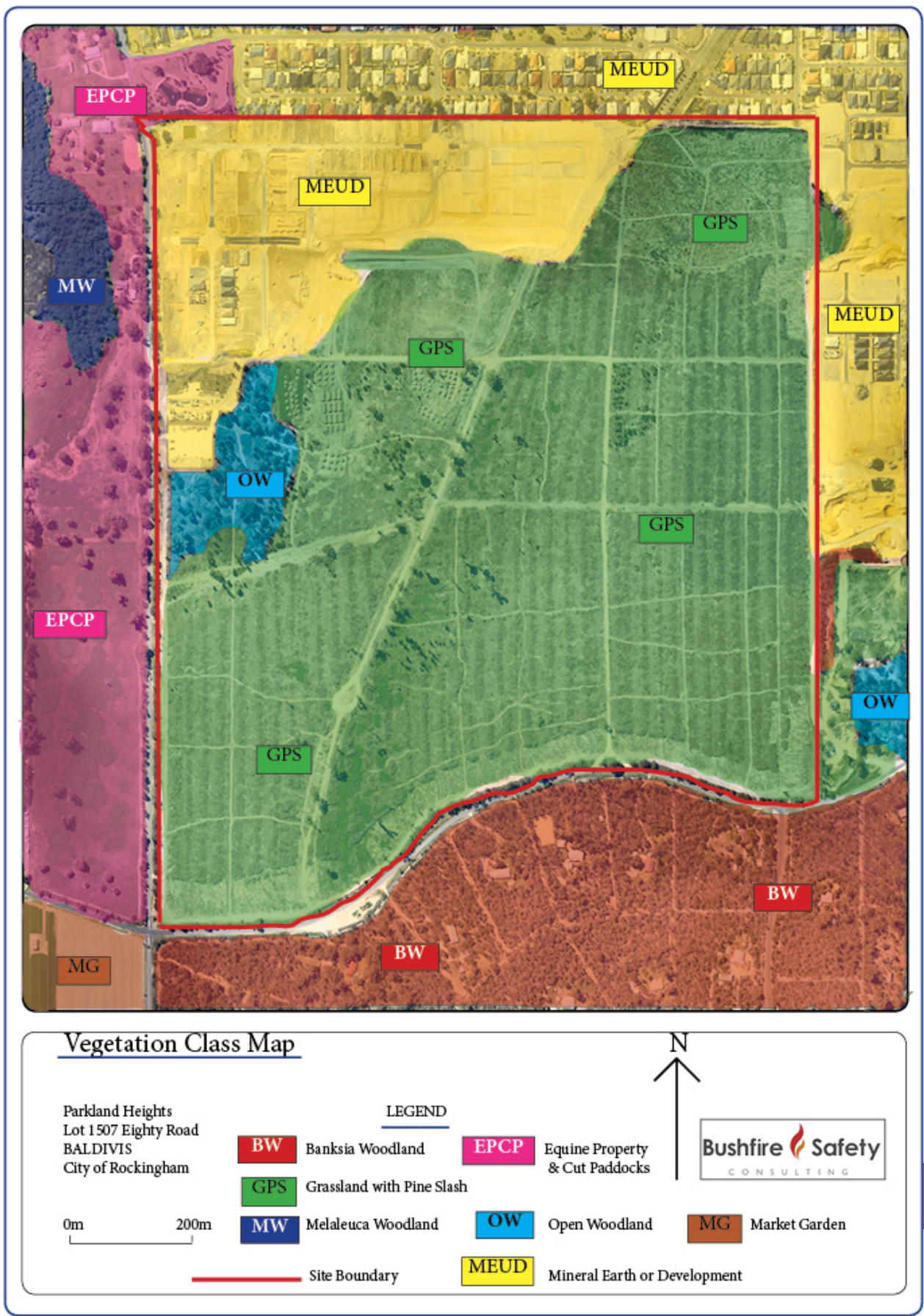


Bushfire Safety
CONSULTING

Appendix B: Local Structure Plan



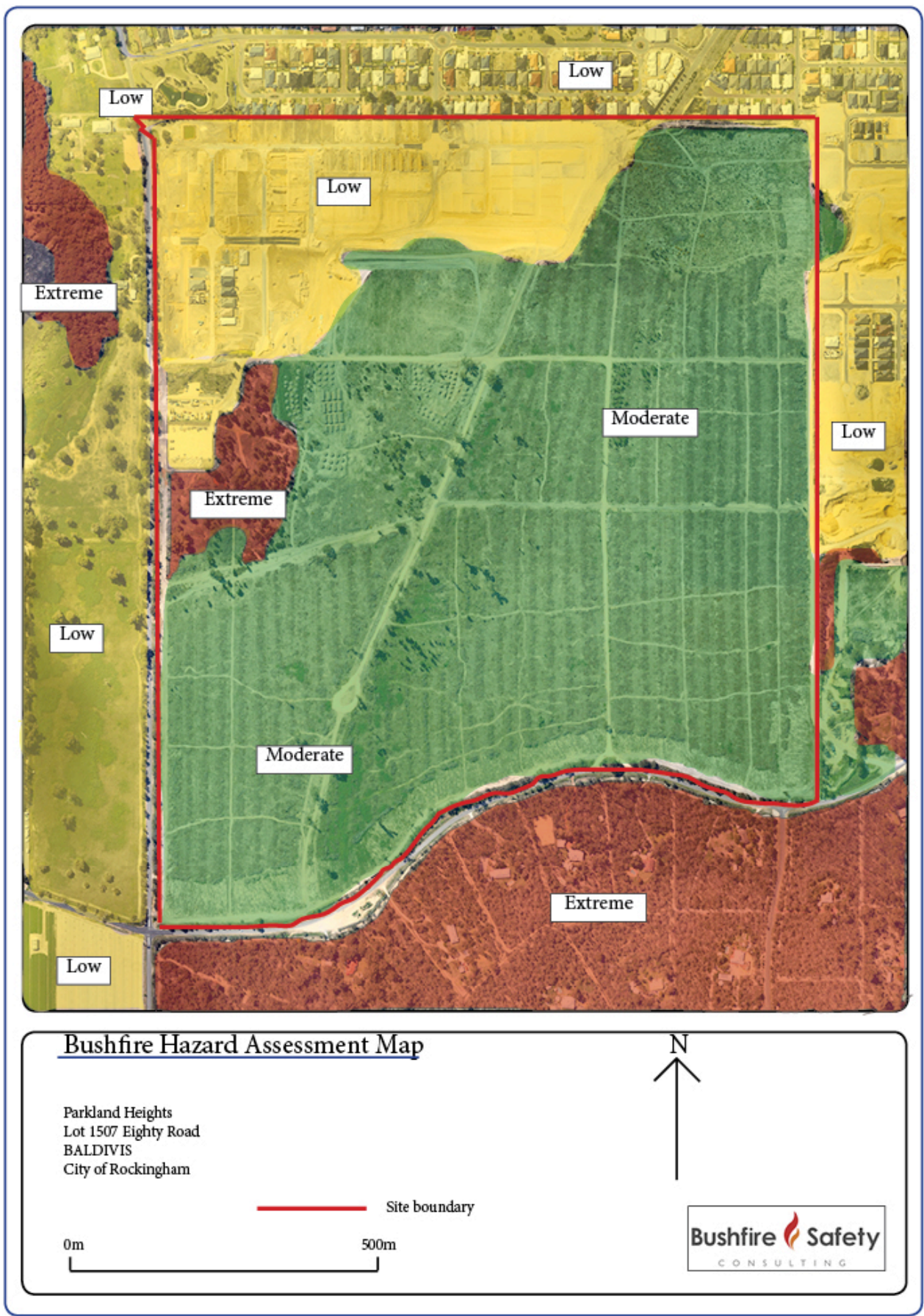
Appendix C: Vegetation Class Map



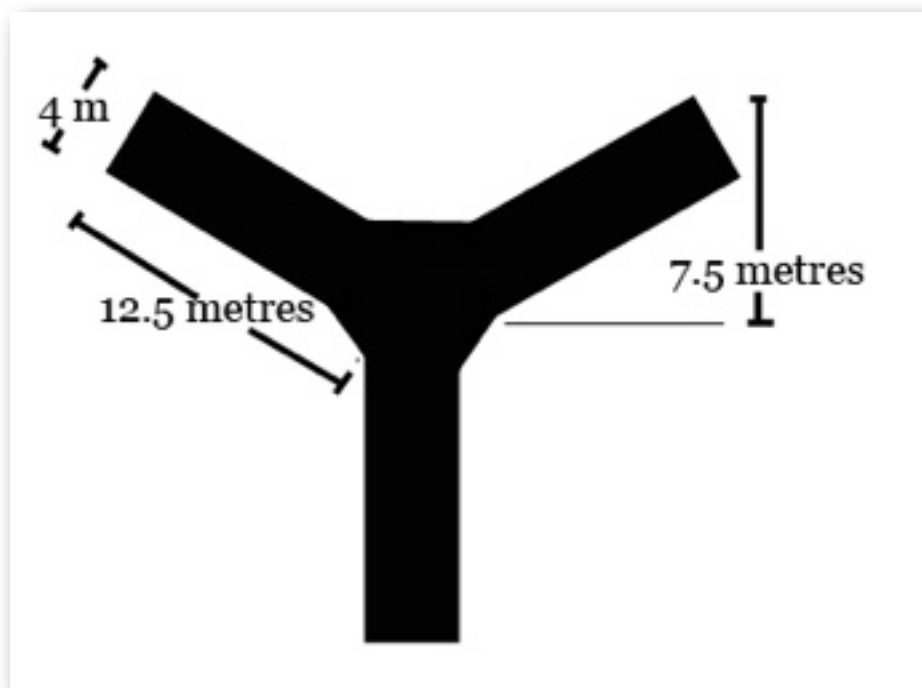
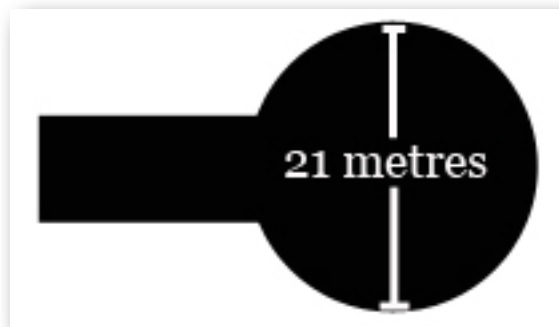
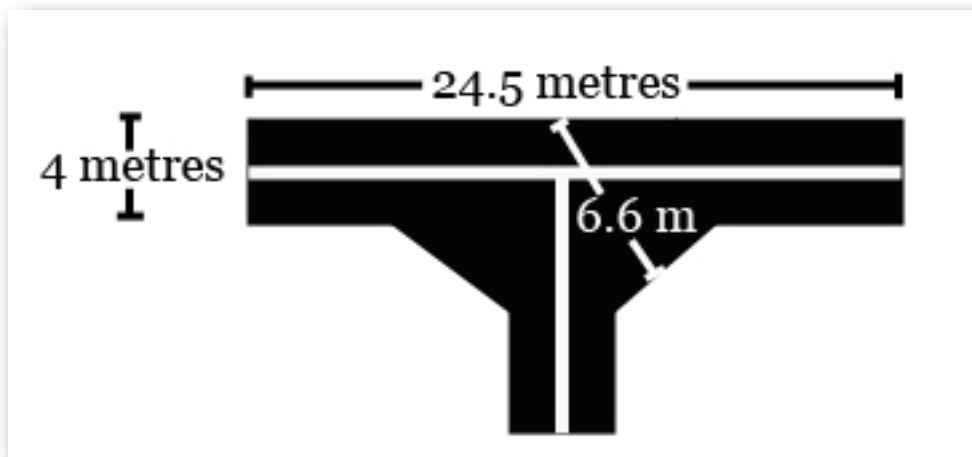
DEPTH KEY

SOIL	DEPTH KEY
1.00m to 1.25m	1.00m to 1.25m
1.25m to 1.50m	1.25m to 1.50m
1.50m to 1.75m	1.50m to 1.75m
1.75m to 2.00m	1.75m to 2.00m
2.00m to 2.25m	2.00m to 2.25m
2.25m to 2.50m	2.25m to 2.50m
2.50m to 2.75m	2.50m to 2.75m
2.75m to 3.00m	2.75m to 3.00m
3.00m to 3.25m	3.00m to 3.25m
3.25m to 3.50m	3.25m to 3.50m
3.50m to 3.75m	3.50m to 3.75m
3.75m to 4.00m	3.75m to 4.00m
4.00m to 4.25m	4.00m to 4.25m
4.25m to 4.50m	4.25m to 4.50m
4.50m to 4.75m	4.50m to 4.75m
4.75m to 5.00m	4.75m to 5.00m
5.00m to 5.25m	5.00m to 5.25m
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5.50m to 5.75m	5.50m to 5.75m
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6.00m to 6.25m	6.00m to 6.25m
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6.50m to 6.75m	6.50m to 6.75m
6.75m to 7.00m	6.75m to 7.00m
7.00m to 7.25m	7.00m to 7.25m
7.25m to 7.50m	7.25m to 7.50m
7.50m to 7.75m	7.50m to 7.75m
7.75m to 8.00m	7.75m to 8.00m
8.00m to 8.25m	8.00m to 8.25m
8.25m to 8.50m	8.25m to 8.50m
8.50m to 8.75m	8.50m to 8.75m
8.75m to 9.00m	8.75m to 9.00m
9.00m to 9.25m	9.00m to 9.25m
9.25m to 9.50m	9.25m to 9.50m
9.50m to 9.75m	9.50m to 9.75m
9.75m to 10.00m	9.75m to 10.00m
10.00m to 10.25m	10.00m to 10.25m
10.25m to 10.50m	10.25m to 10.50m
10.50m to 10.75m	10.50m to 10.75m
10.75m to 11.00m	10.75m to 11.00m
11.00m to 11.25m	11.00m to 11.25m
11.25m to 11.50m	11.25m to 11.50m
11.50m to 11.75m	11.50m to 11.75m
11.75m to 12.00m	11.75m to 12.00m
12.00m to 12.25m	12.00m to 12.25m
12.25m to 12.50m	12.25m to 12.50m
12.50m to 12.75m	12.50m to 12.75m
12.75m to 13.00m	12.75m to 13.00m
13.00m to 13.25m	13.00m to 13.25m
13.25m to 13.50m	13.25m to 13.50m
13.50m to 13.75m	13.50m to 13.75m
13.75m to 14.00m	13.75m to 14.00m
14.00m to 14.25m	14.00m to 14.25m
14.25m to 14.50m	14.25m to 14.50m
14.50m to 14.75m	14.50m to 14.75m
14.75m to 15.00m	14.75m to 15.00m
15.00m to 15.25m	15.00m to 15.25m
15.25m to 15.50m	15.25m to 15.50m
15.50m to 15.75m	15.50m to 15.75m
15.75m to 16.00m	15.75m to 16.00m
16.00m to 16.25m	16.00m to 16.25m
16.25m to 16.50m	16.25m to 16.50m
16.50m to 16.75m	16.50m to 16.75m
16.75m to 17.00m	16.75m to 17.00m
17.00m to 17.25m	17.00m to 17.25m
17.25m to 17.50m	17.25m to 17.50m
17.50m to 17.75m	17.50m to 17.75m
17.75m to 18.00m	17.75m to 18.00m
18.00m to 18.25m	18.00m to 18.25m
18.25m to 18.50m	18.25m to 18.50m
18.50m to 18.75m	18.50m to 18.75m
18.75m to 19.00m	18.75m to 19.00m
19.00m to 19.25m	19.00m to 19.25m
19.25m to 19.50m	19.25m to 19.50m
19.50m to 19.75m	19.50m to 19.75m
19.75m to 20.00m	19.75m to 20.00m
20.00m to 20.25m	20.00m to 20.25m
20.25m to 20.50m	20.25m to 20.50m
20.50m to 20.75m	20.50m to 20.75m
20.75m to 21.00m	20.75m to 21.00m
21.00m to 21.25m	21.00m to 21.25m
21.25m to 21.50m	21.25m to 21.50m
21.50m to 21.75m	21.50m to 21.75m
21.75m to 22.00m	21.75m to 22.00m
22.00m to 22.25m	22.00m to 22.25m
22.25m to 22.50m	22.25m to 22.50m
22.50m to 22.75m	22.5

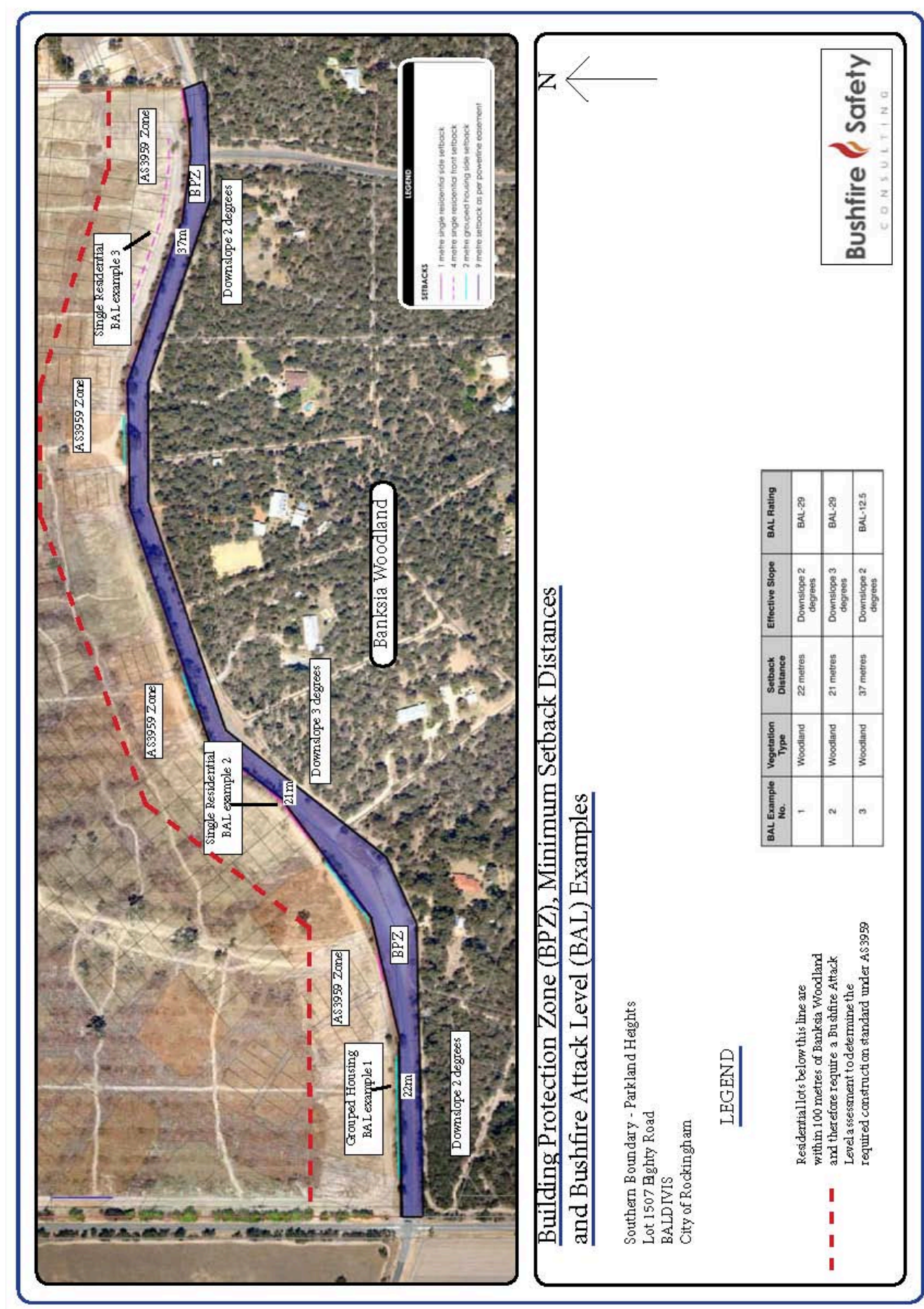
Appendix E : Hazard Assessment Level Map



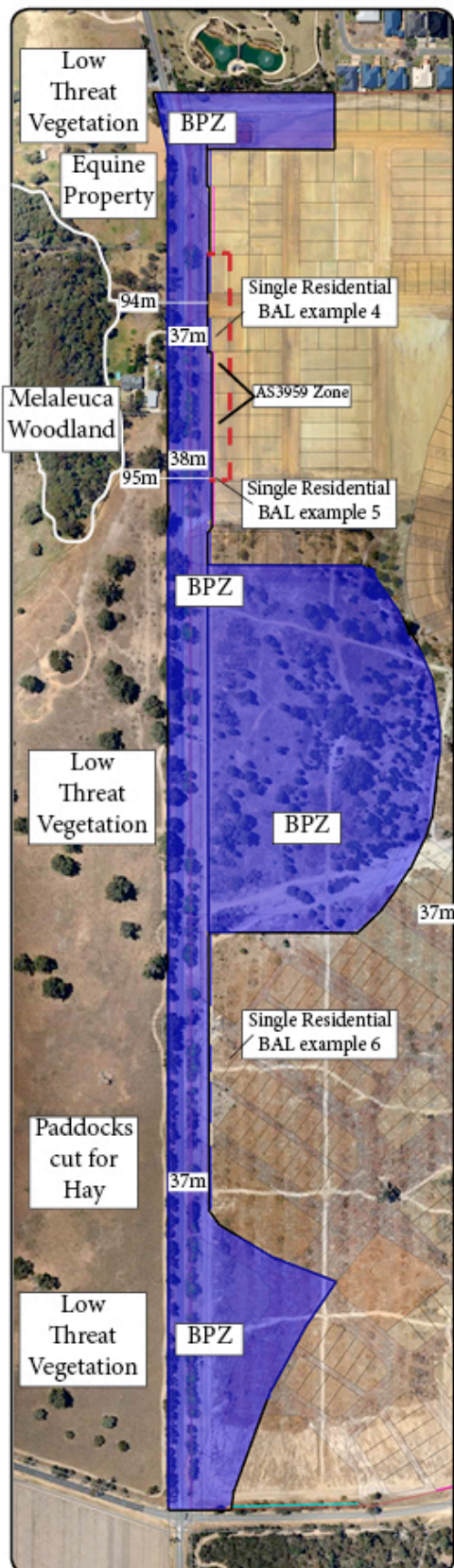
Appendix F : Turn Around Standards



Appendix G : Example BAL Assessments - South Boundary



Appendix H : Example BAL Assessments - West Boundary



Building Protection Zone (BPZ), Minimum Setback Distances and Bushfire Attack Level (BAL) Examples

Western Boundary - Parkland Heights
Lot 1507 Eighty Road
BALDIVIS
City of Rockingham

BAL Example No.	Vegetation Type	Setback Distance	Effective Slope	BAL Rating
4	Woodland	94 metres	Downslope 1 degrees	BAL-12.5
5	Woodland	95 metres	Downslope 1 degrees	BAL-12.5
6	Woodland	> 100 metres	Downslope 2 degrees	BAL-LOW

LEGEND



Residential lots west of this line are within 100 metres of Melaleuca Woodland and therefore require a Bushfire Attack Level assessment to determine the required construction standard under AS3959



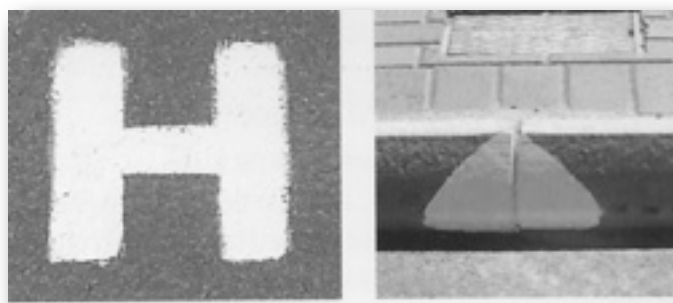
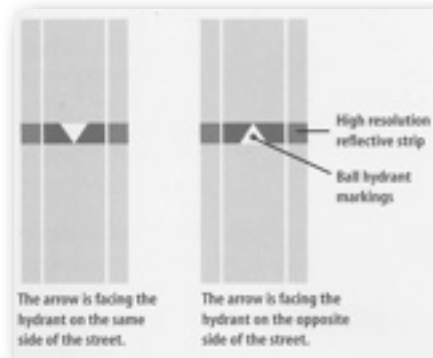
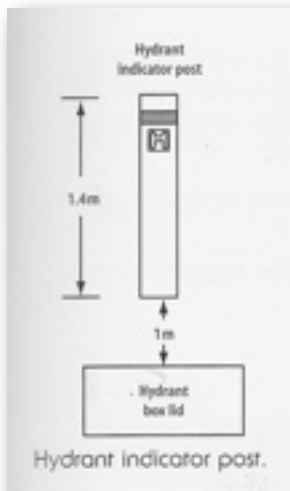
0m 100m



Appendix I : Fire hydrant location and identification markings (FESA 2007).

Ball hydrant indicating

To enable visual identification of ball hydrants from hydrant indications fixed to street poles, a red reflectorised disc will be fixed to the band of aluminium lattice. It will be placed in the centre of the white aluminium lattice directly in line with the centre of the H plate.



Road markings



Retro Road pavement marking