Appendix 5

Bushfire Management Plan

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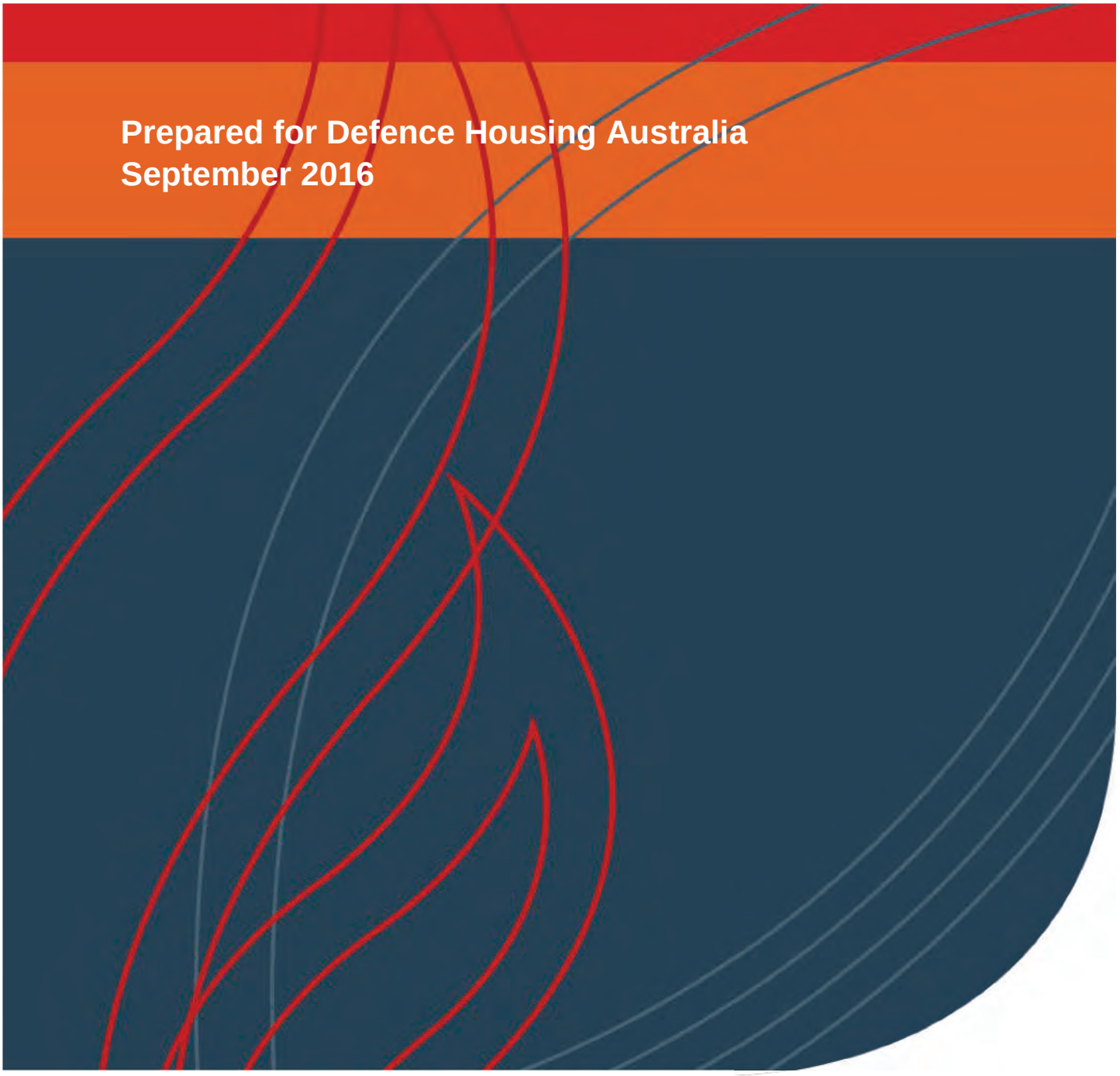
BUSHFIRE MANAGEMENT PLAN

PORTION OF LOT 16 MCDONALD ROAD, BALDIVIS

Project Number EP15-057(03)



Prepared for Defence Housing Australia
September 2016

Document Control

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				Rohan Carboon	RC
	Report for client review and comment.				
A	February 2016	Vanessa Keating	VMK	Jason Hick	JDH
	Updated following changes to the Structure Plan.				
B	February 2016	Vanessa Keating	VMK	Jason Hick	JDH
	Updated following feedback from the client and changes to the Structure Plan.				
C	September 2016	Vanessa Keating	VMK	Jason Hick	JDH
	Updated following feedback from the City of Rockingham and Department of Planning, and changes to the development layout.				

Disclaimer:

This document has been prepared in good faith and is derived from information sources believed to be reliable and accurate at the time of publication. Nevertheless, it is distributed on the terms and understanding that the author is not liable for any error in or omission in the information sources available or provided to us, or responsible for the outcomes of any actions taken based on the recommendations contained herein. It is also expected that our recommendations will be implemented in their entirety, and we cannot be held responsible for any consequences arising from partial or incorrect implementation of the recommendations provided.

This document has been prepared primarily to consider the layout of development and/or the appropriate building construction standards applicable to development, where relevant. The measures outlined are considered to be prudent minimum standards only based on the standards prescribed by the relevant authorities. The level of bushfire risk mitigation achieved will depend upon the actions of the landowner or occupiers of the land and is not the responsibility of the author. The relevant local government and fire authority (i.e. Department of Fire and Emergency Services or local bushfire brigade) should be approached for guidance on preparing for and responding to a bushfire.

Notwithstanding the precautions recommended in this document, it should always be remembered that bushfires burn under a wide range of conditions which can be unpredictable. An element of risk, no matter how small, will always remain. The objective of the Australian Standard AS 3959-2009 is to “prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire while the front passes” (Standards Australia 2009). Building to the standards outlined in AS 3959 does not guarantee a building will survive a bushfire or that lives will not be lost.

Executive Summary

This Bushfire Management Plan (BMP) has been prepared on behalf of Defence Housing Australia to support the preparation of a Structure Plan for a portion of Lot 16 McDonald Road, Baldivis. The Lot 16 area is herein referred to as "the site", and portion of the site covered by the Structure Plan is referred to as the "Structure Plan area". This BMP includes an assessment of the bushfire hazards within and surrounding the site (within 100 m), to inform the responses required (if any) for proposed development within the Structure Plan area.

The site is approximately two hectares and is located approximately 39 kilometres (kms) south of the Perth CBD, within the City of Rockingham, as shown in **Figure 1**. The site is bound by McDonald Road to the east, rural landholdings to the west, and landholdings zoned for future urban development to the north and south. The site and its immediate surrounds are shown in **Figure 2**.

Portions of the site have been identified as "Bushfire Prone Areas" under the state-wide *Map of Bushfire Prone Areas* recently released by the Office of Bushfire Risk Management (OBRM), as shown in **Figure 3**. The identification of Bushfire Prone Areas within any portion of the site requires a further assessment of the bushfire hazard implications on development proposed within the site, in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al*. 2015). This BMP has been prepared to assess and identify any potential bushfire risks that are likely to apply to the site, and to outline how the Structure Plan has responded to ensure any bushfire risk is appropriately managed as part of the future development process. The proposed Structure Plan (shown conceptually in **Figure 4**) provides a guide for future urban development within a portion of the site and creates a framework for the future subdivision of the Structure Plan area into residential lots and road reserves.

The aim of the BMP is to assess bushfire hazard levels in the vicinity of the site (within 100 metres) and to ensure the threat posed by the identified bushfire hazard can be mitigated to acceptable levels appropriate with a residential development. In doing so, this BMP aims to minimise the potential impact of bushfires on development within the site, and reduce the threat to life, property and the environment. The bushfire risk will be mitigated to acceptable levels as defined in the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al.* 2015).

This BMP sets out the roles and responsibilities of the developer/s, future residents and the City of Rockingham. It is important that the measures and procedures outlined in this BMP are adopted across the various stages of the land use planning and dwelling construction approvals processes. It is expected that the bushfire hazard mitigation measures outlined in this BMP will be largely implemented as part of future residential subdivision and associated development within the site.

All areas within 100 metres (m) of the site boundary have been assessed to determine the presence of bushfire prone vegetation and, where this occurs, associated vegetation classification and bushfire hazard rating levels. Permanent long term bushfire hazard considerations are posed by areas of remnant forest and woodland vegetation within rural landholdings west of the site. An assessment of the classified vegetation and associated bushfire hazard for the site and surrounding area has been undertaken to determine site specific Bushfire Prone Areas, in accordance with *AS 3959 Construction of Buildings in Bushfire Prone Areas* (AS 3959). These determined Bushfire Prone Areas may be used by the City of Rockingham to inform updates to OBRM's state-wide mapping of bushfire prone areas.

Any new dwellings constructed within the Structure Plan area that fall within 100 m of classified bushfire prone vegetation will require consideration of the need for increased construction standards in

accordance with AS 3959. In order to pre-empt this requirement, a detailed and site specific Bushfire Attack Level (BAL) assessment will be undertaken as part of the subdivision process to confirm the ultimate BAL ratings for each individual new lot created. Final BAL ratings **should not** be determined for future lots at the Structure Plan stage, as the ultimate lot locations/boundaries and dwelling setbacks will be determined through the subdivision process, and temporary hazards (or even hazards that were expected to be permanent) may not remain at that time, in particular those landholdings north and south of the site intended for future urban development. An indicative BAL assessment has been undertaken as part of this BMP in order to demonstrate that no areas within the Structure Plan area are exposed to an unacceptable level of bushfire risk (i.e. a BAL rating of greater than BAL-29).

Landholdings north of the site are intended for future urban development and are currently undergoing separate planning and approvals to support development, therefore Grassland vegetation within these landholdings will pose only a temporary bushfire risk to the site. Future detailed BAL assessment/s will outline specific BAL ratings for each stage of subdivision based on the classified vegetation remaining at that time, therefore providing a more accurate assessment of the post development hazards posed to future dwellings than can be achieved at Structure Plan stage.

As part of the subdivision process, any lots deemed to require bushfire management responses through the detailed BAL assessment (i.e. a BAL rating of BAL-12.5 or greater), will be subject to a notification pursuant to section 70A of the *Transfer of Land Act 1893* placed on the certificate(s) of title indicating that the lot is subject to the requirements of a Bushfire Management Plan (i.e. increased construction standards to meet increased BAL ratings).

The indicative BAL assessment provided in this BMP has been undertaken in accordance with Section 2 of AS 3959, which provides a basic assessment of radiant heat flux to calculate the required setback to achieve an acceptable level of radiant heat exposure (i.e. BAL-29). Based on the results of this indicative BAL assessment, the maximum BAL rating to which a small number of future lots within the Structure Plan area are exposed is BAL-19.

The proposed development will be provided with an adequate water supply (through the provision of reticulated water and fire hydrants) and sufficient vehicular access to and from the site, to ensure residents and fire fighters are able to respond appropriately in the event of a bushfire in the vicinity of the site.

It is expected that the implementation of this BMP will reduce the threat posed by bushfires to future residents, visitors and fire fighters in the areas proposed for urban development associated with this BMP.

Therefore, the recommendations from this BMP to inform the Structure Plan preparation process are as follows:

- By implementing this BMP, the bushfire risk to development within the site can be mitigated through the provision of appropriate APZs combined with increased construction standards in accordance with AS 3959.
- The indicative BAL assessment undertaken as part of this BMP indicates that no future lots within the Structure Plan area will be exposed to an unacceptable level of radiant heat flux (i.e. no greater than BAL-29).
- Future BAL assessment/s (undertaken to support future subdivision or development approval stage/s) will enable a more accurate reflection of the bushfire risk posed by surrounding classified vegetation at the time that development progresses within the site. This BAL assessment/s will specify ultimate BAL ratings for each lot as well as APZ requirements (where applicable).

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1 Introduction

1.1 Background

This Bushfire Management Plan (BMP) has been prepared on behalf of Defence Housing Australia to support the preparation of a Structure Plan for a portion of Lot 16 McDonald Road, Baldivis. The Lot 16 area is herein referred to as "the site", and portion of the site covered by the Structure Plan is referred to as the "Structure Plan area". This BMP includes an assessment of the bushfire hazards within and surrounding the site (within 100 m), to inform the responses required (if any) for proposed development within the Structure Plan area.

The site is approximately two hectares and is located approximately 39 km south of the Perth CBD, within the City of Rockingham, as shown in **Figure 1**. The site is bound by McDonald Road to the east, rural landholdings to the west, and landholdings zoned for future urban development to the north and south. The site and its immediate surrounds are shown in **Figure 2**. The site has historically been completely cleared of native vegetation to support agricultural (market garden) land uses, and now consists of weedy grassland with scattered planted non-native trees, an existing residence and several miscellaneous outbuildings.

Portions of the site have been identified as "Bushfire Prone Areas" under the state-wide *Map of Bushfire Prone Areas* recently released by the Office of Bushfire Risk Management (OBRM), as shown in **Figure 3**. The identification of Bushfire Prone Areas within any portion of the site requires a further assessment of the bushfire hazard implications on development proposed within the site to be undertaken in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al*. 2015), which is provided in this BMP.

1.2 Accreditation

This BMP has been prepared jointly by Emerge Associates and Bushfire Safety Consulting. Bushfire Safety Consulting is owned and operated by Rohan Carboon, an experience bushfire consultant to the urban planning industry. Rohan has provided all technical input and review for the bushfire hazard assessment included within this BMP. Rohan has undergraduate degrees in Environmental Management and postgraduate qualifications in Bushfire Protection and has been providing bushfire risk and hazard assessment and mitigation advice to the urban planning and development industry for more than six years. He first worked professionally in community bushfire safety education in 1999 and has been involved in land management including bushfire suppression since 1993.

Bushfire Safety Consulting is a Corporate Bronze Member of the Fire Protection Association of Australia. Rohan is in the process of obtaining BPAD Level 1 BAL Assessor accreditation under the Fire Protection Association of Australia's new Western Australian accreditation scheme and will also progress to Level 2 and Level 3 accreditation over time as this system is developed.

1.3 Aim of this document

The aim of this BMP is to assess bushfire hazard levels in the vicinity of the site (within 100 m) and to ensure the threat posed by the identified bushfire hazard can be mitigated within the Structure Plan to acceptable levels appropriate for a residential development. In doing so, this BMP aims to minimise

the potential impact of bushfires on development within the Structure Plan area, and reduce the threat to life, property and the environment. The bushfire risk will be mitigated to acceptable levels as defined in the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al.* 2015).

This BMP is expected to inform future bushfire assessment/s that will be prepared and implemented as part of the future subdivision, development approval processes and/or building licence.

1.4 Statutory policy and framework

The following key legislation, policies and guidelines are relevant to the preparation of a bushfire management plan.

1.4.1 *Fire and Emergency Services Act 1998*

Areas within Western Australia have been designated as bushfire prone by the Fire and Emergency Services (FES) Commissioner, through the release of the *Map of Bush Fire Prone Areas* (OBRM 2016). The *Fire and Emergency Services Act 1998* (FES Act) enables the statutory delineation of Bushfire Prone Areas, which are areas within 100 m of classified bushfire prone vegetation. In turn, Bushfire Prone Areas enable the implementation of the regulations and guidelines outlined below. The *Map of Bush Fire Prone Areas* (OBRM 2016) as currently mapped for the site is shown in **Figure 3**.

1.4.2 *Bush Fires Act 1954*

The *Bush Fires Act 1954* (Bush Fires Act) sets out provisions to reduce the dangers resulting from bushfires, prevent, control and extinguish bushfires, and for other purposes. The Bush Fires Act addresses various matters including prohibited burning times, enabling Local Government to require landowners and/or occupiers to plough or clear fire breaks to control and extinguish bushfires and to establish and maintain bushfire brigades.

Pursuant to the Bush Fires Act, the City of Rockingham publishes annual firebreak advice that can be accessed from: http://www.rockingham.wa.gov.au/Services/Safety-and-security-services/Fire-safety-and-emergencies#Firebreaks.

1.4.3 *Planning and Development (Local Planning Scheme Amendment) Regulations 2015*

The *Planning and Development (Local Planning Scheme Amendment) Regulations 2015* (WAPC 2015a) (the Regulations) include deemed provisions which reference the FES Commissioner's power to designate bushfire prone areas, and provide a mechanism to apply *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015) and the related assessment requirements through planning and development decisions.

1.4.4 *Building Regulations 2012*

All building work in Western Australia is required to comply with the requirements of the Building Code of Australia (BCA). The Building Regulations recognise that properties that are located within designated bushfire prone areas (within the *Map of Bush Fire Prone Areas* (OBRM 2016)) may require additional assessment for bushfire risk and for construction of dwellings to be in accordance with *Australian Standard (AS) 3959-2009 Construction of buildings in bushfire prone areas* (Standards Australia 2009).

1.4.5 *State Planning Policy 3.7 Planning in Bushfire Prone Areas*

The Department of Planning and WAPC have released *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (December 2015) (SPP 3.7). SPP 3.7 aims to:

- Avoid any increase in the threat of bushfire to people, property and infrastructure. The preservation of life and the management of bushfire impact are paramount.
- Reduce vulnerability to bushfire through the identification and consideration of bushfire risks in decision-making at all stages of the planning and development process.
- Ensure that higher order strategic planning documents, strategic planning proposals, subdivision and development applications take into account bushfire protection requirements and include specified bushfire protection measures.
- Achieve an appropriate balance between bushfire risk management measures and, biodiversity conservation values and landscape amenity, with consideration of the potential impacts of climate change.

SPP 3.7 (WAPC 2015) makes provision for further detailed bushfire hazard assessment to be undertaken for areas identified as bushfire prone within the *Map of Bush Fire Prone Areas*. It also outlines the information that is required to support the various stages of planning and the potential for bushfire conditions to be applied through the subdivision process.

1.4.6 *Guidelines for Planning in Bushfire Prone Areas* (WAPC et al. 2015)

The *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al.* 2015) ("the Guidelines") have been prepared by the WAPC and DFES, to assist in the interpretation of SPP 3.7 and provide advice on planning, designing or assessing a proposal within a bushfire prone area. The Guidelines are the predominant document to be used by decision-making authorities and referral agencies when considering the appropriateness of strategic planning proposals, subdivisions, and development applications.

The guidelines address important bushfire risk management and planning issues and outline performance criteria and acceptable solutions to minimise the risk of bushfires in new subdivisions and developments. The guidelines also address management issues including location, siting and design of the development (and consideration of Bushfire Attack Level (BAL) ratings), vehicular access and water requirements.

1.4.7 Australian Standard AS 3959 – 2009 Construction of buildings in bushfire prone areas

The Australian Standard *AS 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) specifies requirements for the construction of buildings in bushfire prone areas in order to improve their resistance to bushfire attack from embers, radiant heat, flame contact, and combinations of these attack forms.

The objective of AS 3959 is to provide detailed methods for assessing bushfire attack and to prescribe specific construction details for buildings to reduce the risk of ignition from a bushfire, appropriate to the:

- Potential for ignition caused by burning embers, radiant heat or flame generated by a bushfire.
- Intensity of the bushfire attack on the building.

2 Proposal and Objectives

Community bushfire safety is a shared responsibility between state and local governments, fire agencies, communities and individuals. The planning and building controls outlined in this BMP, when implemented, will reduce the risk to people and property within the site. How future residents interpret the risk, prepare and maintain their properties and buildings and what decisions and actions they take (i.e. evacuate early or stay and defend or other) will greatly influence the consequences of any bushfire that occurs in the local area in proximity to the site.

The proposed Structure Plan, as shown conceptually in **Figure 4** (and attached in **Appendix A**), provides a framework for future urban development within a portion of the site, in accordance with the land use zoning within the Structure Plan area. The objective of this BMP is to enable bushfire management issues to be addressed through the Structure Plan. If there is a bushfire within or near the site, implementing this BMP will reduce the threat to residents, property and emergency response personnel.

Achievable and measurable goals of this plan include ensuring:

- Development is located in an area where the bushfire hazard does not present an unreasonable level of risk to life and property.
- Vehicular access to the development is safe if a bushfire occurs.
- Water is available to the development, so that life and property can be protected from bushfire.
- Development is sited and designed to minimise the effects of a bushfire.

This document sets out the roles and responsibilities of the future developer/s, future residents and the City of Rockingham. It is important that the measures and procedures outlined in this BMP are adopted across the various stages of the land use planning and dwelling construction approvals processes.

The bushfire hazard mitigation measures outlined in this BMP will be implemented as part of future residential subdivision within the site, which will be undertaken in accordance with the proposed Structure Plan (provided in **Appendix A**).

This BMP provides:

- Identification of those portions of the site designated as Bushfire Prone Areas under the OBRM's *Map of Bushfire Prone Areas* (WAPC *et al*. 2015)
- A description of the site, the surrounding area, fire climate and bushfire history
- A summary of research into the related effects of a bushfire
- A bushfire hazard assessment
- Identification of determined site specific Bushfire Prone Areas based on the assessment of classified vegetation within the site and surrounding 100 m
- A description of the proposed road network and how this addresses vehicular access for bushfire risk purposes
- An outline of the water supply requirements within the site for firefighting purposes
- An outline of the requirements for the internal siting of buildings to include asset protection zones
- An indicative BAL assessment to outline the acceptable siting and design of the proposed development in accommodating appropriate bushfire hazard mitigation measures.

It is expected that further detailed bushfire hazard and risk assessment/s will be undertaken for the site as part of future subdivision or development stages in order to further assess the bushfire risk and determine specific radiant heat exposure levels for future lots created in line with the Structure Plan.

3 Description of the Area

3.1 General

The site currently supports a residential dwelling and several miscellaneous outbuildings, and has historically been completely cleared of remnant vegetation for agricultural (market garden) purposes. The majority of the site is now dominated by weedy grassland, with scattered planted non-native trees in the west of the site, in the vicinity of the existing residence.

The Chimes residential estate is located immediately east of the site, east of McDonald Road, as shown in **Figure 2**. Landholdings north and south of the site are intended for future urban development in accordance with the City of Rockingham's Baldivis (North) District Structure Plan (DSP) and the land use zoning over the area.

3.2 Climate and fire weather

The behaviour of bushfires is significantly affected by weather conditions. They burn more aggressively when high temperatures combine with low humidity and strong winds. In Perth and surrounding coastal areas, the fire risk is greatest from summer through autumn when the moisture content in vegetation is low. Summer and autumn days with high temperatures, low humidity and strong winds are particularly conducive to the spread of fire. This threat is increased if thunderstorms develop, accompanied by lightning and little or no rain.

Research indicates that virtually all house losses occur during severe, extreme or catastrophic conditions (i.e. when the Fire Danger Index is over 50) (Blanchi et al. 2010). The Bureau of Meteorology (2014) states that extreme fire weather conditions in the Perth region typically occur with strong easterly or north-easterly winds associated with a strong high to the south of the state and a trough offshore. Easterly winds represent approximately 60% of extreme fire weather days (events) compared to fewer than 5% associated with southerly winds. About 15% of Perth events occurred in a westerly flow following the passage of a trough.

Very dangerous fire weather conditions often follow a sequence of hot days and easterly winds that culminate when the trough deepens near the coast and moves inland. Winds can change from easterly to northerly and then to westerly during this sequence of climatic events.

Data from the Medina Research Centre (approximately 8 km north of the study site) indicate the area experiences warm dry summers and cool wet winters (see **Plate 1**), and is classified as a Mediterranean climate. Mean maximum temperatures vary from 31.5°C in February to 18.3°C in July.

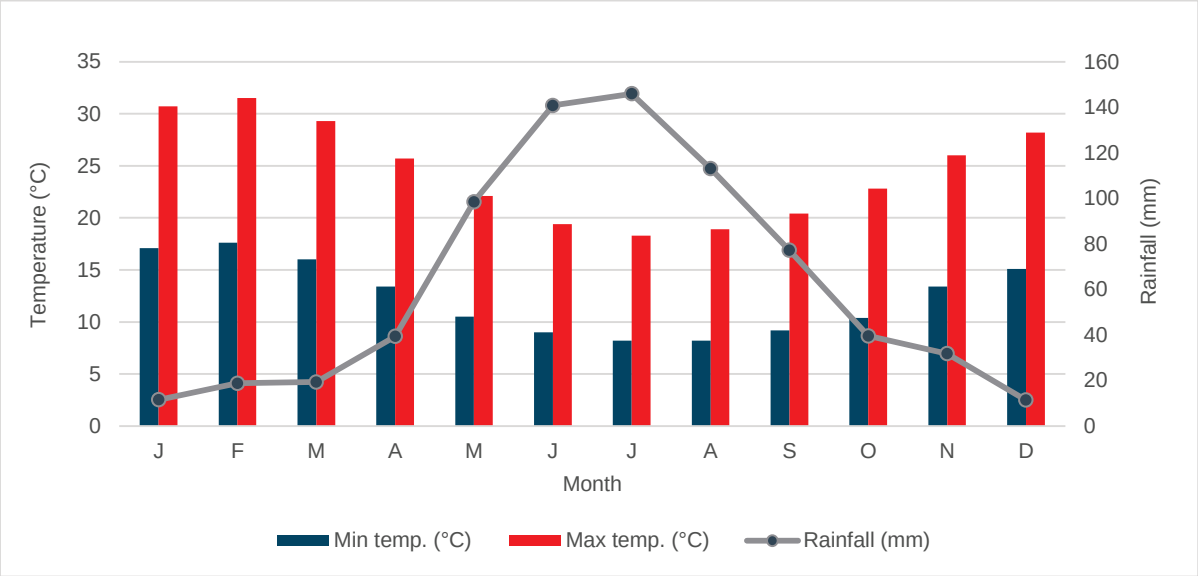

Plate 1: Mean minimum and maximum temperatures and mean rainfall recorded at the Medina Research Centre weather station between 1983 and December 2015 (BoM 2015)

Data from the weather station indicate that the predominant winds near the study site in the summer months at 3 pm are south-westerly (**Plate 2**). Easterly and south-easterly winds are more common in February than the other summer months. Wind strength, direction and frequency from the south-west are dominant and occur 45% to 55% of the time.

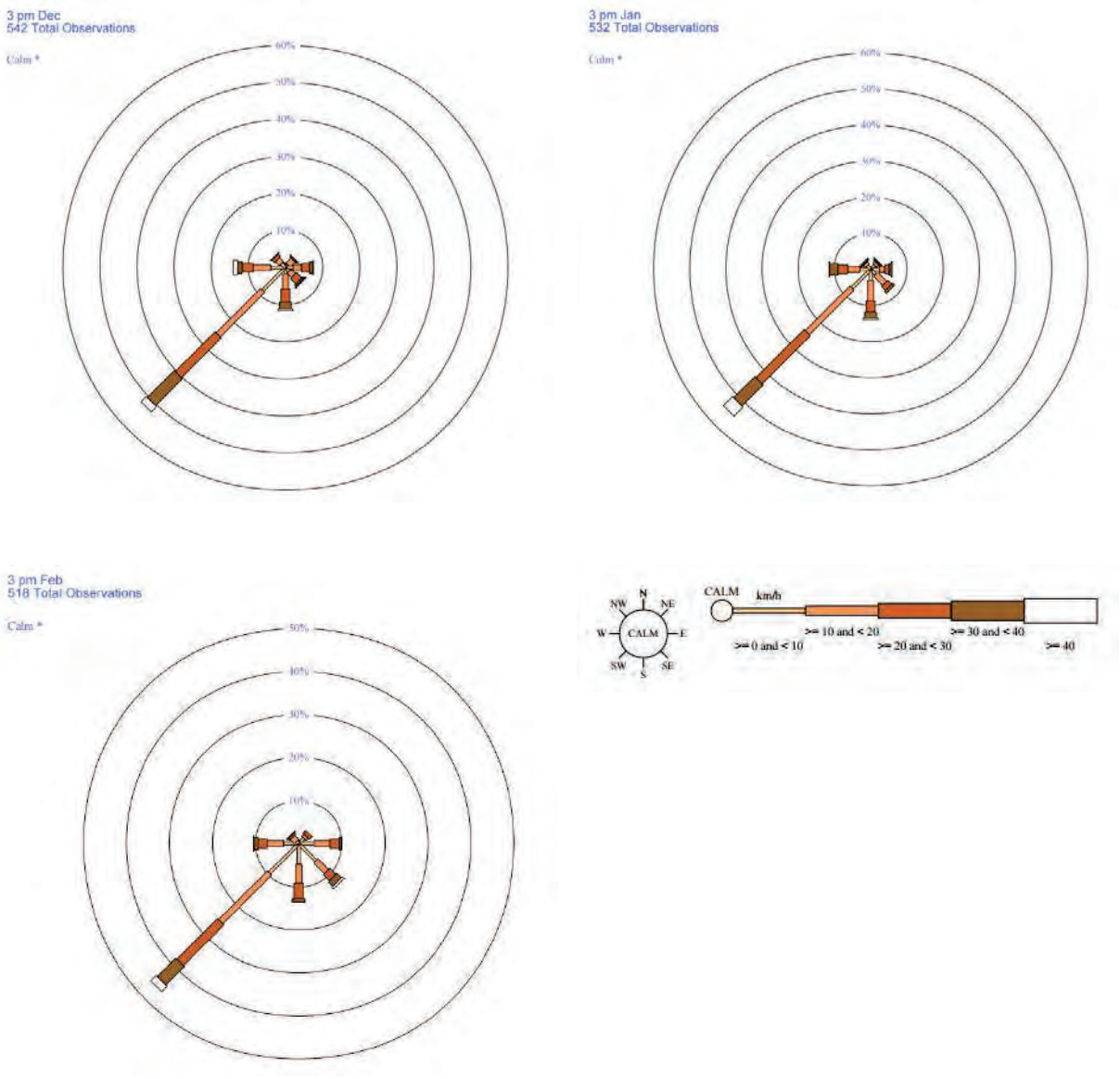

Plate 2: Rose of wind direction and wind speed in km/hr for December, January and February between 1983 – September 2010 at the Medina Research Centre Bureau of Meteorology Station (Bureau of Meteorology 2015)

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 the frequency of calm conditions. Each branch of the rose represents wind coming from that direction, with north found at 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 10 km/h 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).

3.3 Topography

Topographical contours indicate that the site is generally flat, with elevation ranging from approximately 4 metres Australian Height Datum (m AHD) in north-west corner and 5 m AHD in the south-east of the site, with a high point of approximately 7 m AHD located in the centre of the site, as shown in **Figure 5**.

3.4 Bushfire fuels

The site is dominated by grassland vegetation with scattered planted non-native trees in the western portion of the site. Remnant vegetation occurs west of the site, within rural landholdings, and consists of forest and woodland dominated by Tuart (*Eucalyptus gomphocephala*) and Marri (*Corymbia calophylla*). The long term bushfire hazard implications for development within the site are discussed further in **Section 4.3** below.

3.5 Land use

The site is currently supports one residence and several miscellaneous outbuildings, and has been historically used for rural land uses, primarily market garden activities. The site has been completely cleared of remnant vegetation and now supports predominantly weedy grassland. The majority of the site is zoned “Urban” under the MRS and “Development” under the City of Rockingham’s LPS No. 2, with the western portion zoned “Rural” under both the MRS and local scheme. Current MRS zoning for the site and surrounding area is shown in **Figure 6**.

3.6 Assets

In accordance with the proposed Structure Plan (attached in **Appendix A**), the site will support the future development of residential lots/dwellings and road reserves. Dwellings exposed to any bushfire hazard will be those located around the perimeter of the Structure Plan area, within 100 m of permanently retained classified vegetation.

3.7 Access

The proposed internal road network shows two direct access points to the existing McDonald Road to the east of the site, and connecting with areas intended for future residential development to the north, as shown in **Figure 4**. The main point of access into the site will be from McDonald Road, east of the site (see **Figure 4**), and all residents and fire fighters will have at least two access options at all times.

While there is no access provided out to the west of the site, the main point of access to the east allows the movement of residents away from the main source of bushfire hazard posed by remnant vegetation west of the site. Access is provided via McDonald Road to Fifty Road in the south, and existing urban development to the east of the site.

3.8 Water supply

Reticulated water will be provided to the entire development. Fire hydrants will be spaced according to Water Corporation and DFES standards and provide emergency services with access to an

adequate water supply. Fire hydrants on land zoned as residential are required to be sited at or within 200 m of residential dwellings (Class 1a).

4 Bushfire Context and Current Situation

4.1 Bushfire history

Fires have been common on the Swan Coastal Plain for thousands of years and the anthropological and historical evidence suggests that Aboriginal people regularly burnt this area (Hallam 1975, Abbott 2003).

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.

Bushfires are common in the City of Rockingham. As land use intensification occurs and urban development replaces rural land and/or areas of native vegetation, bushfire hazards are removed thereby reducing areas that can carry a bushfire. At the same time however, the number of people and assets in the community increases thereby increasing the risk at the bushland interface.

On 12 January 2014, and 16 March 2014, the Tamworth Swamp fire and Millar Road fire occurred respectively on days with a Low-High Fire Danger Rating (FDR) and typical coastal sea breezes. The Miller Road fire occurred north of the site on the eastern side of the intersection of Millar and Baldivis Roads. The cause of both fires is unknown, however they are suspected to have been started deliberately.

Fire weather conditions were typical coastal south-west sea breezes which pushed the head fires to the north-west. Both fires had ember attack causing spot fires ahead of the head fire and outside of the eventually contained fire ground.

The Tamworth Swamp was difficult for fire fighters to access due to the vegetation for both combat and eventual creation of control lines. The wind direction was favourable for this fire which significantly aided suppression activities. The Millar Road fire had rapid forward rate of spread and the ground fire quickly developed into a canopy fire.

Both fires required multi agency resources and were of a prolonged duration, requiring road closures. No major infrastructure damage or property was lost.

On 27 January 2015 a fire started on the eastern side of Baldivis Road and south of Millar Road (north-east of the site), and moved north towards Johnson Road. The Kwinana Freeway was closed in both directions between the Mortimer Road and Safety Bay Road exits. Flame heights reached approximately 10 metres and over 200 firefighters were involved in supressing the fire.

Given that bushfires are common in the City of Rockingham, this BMP plays an important role in ensuring that the development of the land appropriately mitigates the risk and threat posed from bushfire.

4.2 Bushfire risk

The risk management process described in AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines* is a systematic method for identifying, analysing, evaluating and treating emergency risks.

Bushfire risk is determined by assessing:

- Bushfire hazard (i.e. bushfire prone vegetation)
- Threat level (i.e. proximity of the hazard to assets and people)
- Vulnerability of the asset
- Consequence rating (i.e. a rating for the potential outcome once the 'incident' has occurred)
- Likelihood rating (i.e. the chance of an event).

It is not necessary to undertake a standalone site specific bushfire risk assessment in accordance with AS/NZS ISO 31000:2009 as part of this BMP, as risk has been considered in the context of the bushfire hazard assessment that has been undertaken (as outlined in **Section 4.3**) in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC et al. 2015) and AS 3959.

The vulnerability of assets such as dwellings is impacted by several factors. Some relate to the way a bushfire behaves at a site, others to the design and construction materials in the building and siting of surrounding elements. Infrastructure, utilities and human behaviour are also factors. Leonard (2009) 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 (ability 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
- Power supply.

Where buildings are lost, this is likely to occur as a result of their vulnerability to the mechanisms of bushfire attack. Buildings constructed to increased standards under AS 3959 are more likely to survive a bushfire than buildings that do not conform to these construction standards, although building survival is not guaranteed.

The OBRM recently released state-wide *Maps of Bushfire Prone Areas*, which designates bushfire prone areas within Western Australia. Portions of the site are identified as bushfire prone (as shown in **Figure 3**) and as such the requirements of AS 3959 apply (as well as the State bushfire management framework in SPP 3.7, discussed in **Section 1.2**).

The vulnerability of people is determined by several factors, including age, fitness levels, gender, level of preparation, and number of occupants who can actively defend a property. The development will be comprised of individual residential dwellings and areas of public open space.

4.3 Bushfire hazard

Assessing bushfire hazards takes into account the classes of vegetation within the site and surrounding area for a minimum of 100 m, in accordance with Table 2.3 of AS 3959, as shown in **Figure 7**. Fuel layers in a typical forest environment can be broken-down into five segments as

illustrated in **Plate 3** below. These defined fuel layers are used in the following descriptions regarding vegetation types, fuel structure and bushfire hazard levels.

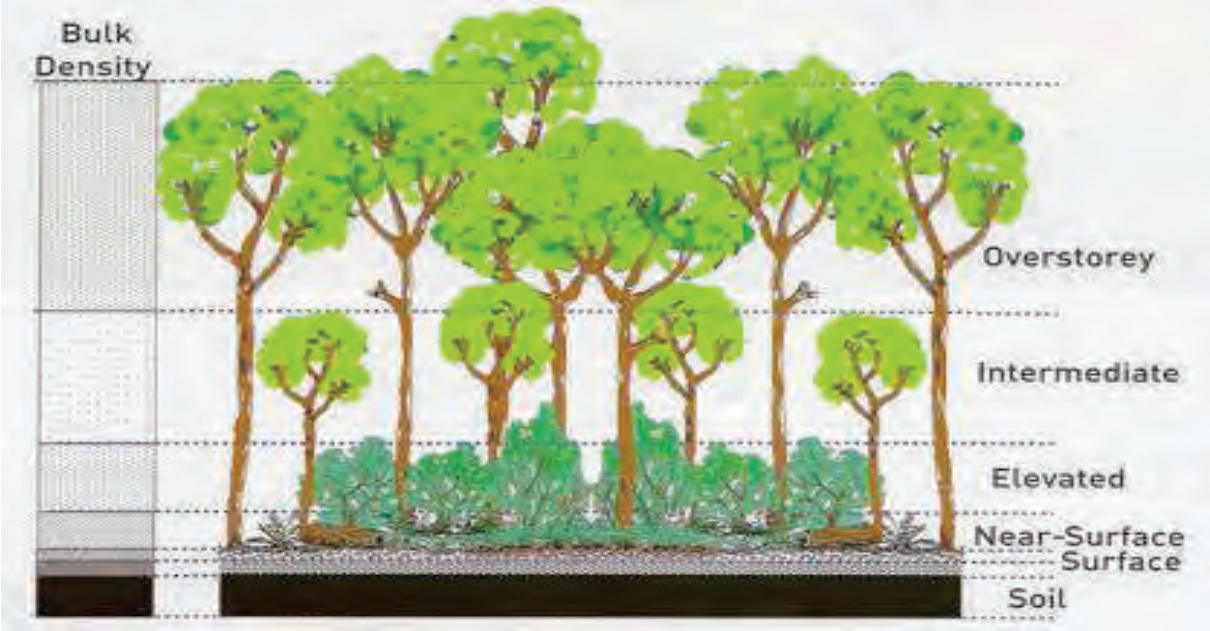

Plate 3: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)

4.3.1 Vegetation type and structure

4.3.1.1 Vegetation within the site

The site has been historically cleared of remnant vegetation to support agricultural (market garden) land uses and now supports areas of grassland dominated by weeds, with scattered planted non-native trees in the west of the site, as shown in **Plate 4** and **Plate 5** below. These areas have been classified as a mixture of grassland and low threat vegetation (according to Section 2.2.3.2(f) of AS 3959), as shown in **Figure 7**, based on the maintenance of grass fuels observed at the time of the site assessment.

Plate 4: Planted non-native trees over weedy grassland in the west of the site (Photo Point 1)

Plate 5: Planted, non-native trees over managed weedy grassland in the west of the site (Photo Point 2)

4.3.1.2 Vegetation surrounding the site

Landholdings surrounding the site have historically been used for general rural purposes such as livestock grazing, market gardens etc. and as such support mostly grassland vegetation, as shown in **Figure 7**. The majority of fuel loads within the landholding south of the site are managed through ongoing rural residential land uses, as shown in **Plate 6**, and this area is therefore considered low threat under Section 2.2.3.2(f) of AS 3959.

Areas of remnant woodland and forest vegetation occur south and west of the site, consisting of Tuart and Marri overstorey over an elevated layer of Sheoak, Banksia and emergent Jarrah, as shown in **Plate 7** to **Plate 9**. Scattered paddock trees surrounding the site to the north have been classified according to their understorey of grassland, as their distribution and fuel loads to not warrant higher classification under Table 2.3 of AS 3959, as shown in **Plate 10**.

Plate 6: Vegetation south of the site assessed as low threat under Section 2.2.3.2(f) of AS 3959 (Photo Point 3)

Plate 7: Woodland vegetation south of the site (Photo Point 4)

Plate 8: Forest vegetation south-west of the site (Photo Point 5)

Plate 9: Forest vegetation within rural landholdings west of the site (Photo Point 6)

Plate 10: Small patch of mature trees over grassland north of the site, classified according to its grassland understorey (Photo Point 7)

4.3.2 Vegetation in public open space

While there are no areas of public open space proposed within the Structure Plan, there is one area of public open space east of the site, within existing residential development as shown in **Figure 4**. This area of public open space provides a drainage function for the adjacent residential area and contains a number of remnant native trees within a managed open space environment, as shown in **Plate 11** below. This area has been landscaped and designed to a low threat standard in accordance with Section 2.2.3.2 of AS 3959 and will therefore pose no hazard to development within the site.

Plate 11: Managed parkland east of the site, within existing urban development (Photo Point 8)

4.3.3 Bushfire hazard assessment – existing site conditions

The existing site condition vegetation classification across the site and surrounding 100 m are shown in **Figure 7**. Descriptions of the vegetation types, structure and fuel layers are outlined in **Section 4.3.1**.

The bushfire hazard assessment levels were determined using Appendix Two of the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al*. 2015).

Most areas within the site and surrounding area have a 'Moderate' bushfire hazard rating associated with the grassland vegetation that covers the site, with 'Extreme' hazard posed by woodland and forest vegetation south and west of the site, as shown in **Figure 8**.

Bushfire hazards surrounding the site are limited to classified vegetation within rural zoned landholdings west of the site, and landholding intended for future urban development north and south of the site, as shown in **Figure 7** and **Figure 8**. 'Low' bushfire hazards surround the site to the east, associated with existing urban development.

Bushfire hazards within urban zoned landholdings north of the site are considered temporary, as this area is currently undergoing a separate urban structure planning process and will be developed for urban purposes. Once these landholdings are cleared to support urban development, the associated hazard will be removed.

4.3.4 Bushfire hazard assessment – post development site conditions

The post development site condition vegetation classifications for the site are shown in **Figure 9**, and outline the dominant vegetation types that will remain within the site and surrounding 100 m after development within the site has been completed.

The bushfire hazard assessment levels were determined using Appendix Two of the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al*. 2015). The post-development bushfire hazard rating changes substantially compared to the pre-development conditions due to the removal of most classified vegetation within the site to accommodate the development.

The post development hazard assessment (shown in **Figure 10**) has been based on the assumption that urban development will progress north and south of the site, in accordance with the land use zoning over the area, and the road reserve leading north of the site will continue into this future residential development north of the site once development occurs in this area.

The western portion of the site is not included within the Structure Plan, and is intended to be utilised as a rural/rural residential lot in accordance with its existing land sue zoning. This area will be managed by the proponent and any subsequent owner/s to a low fuel level in accordance with the City of Rockingham's Fire Control Notice, and will pose a long term low bushfire hazard to the Structure Plan area.

In addition to the above, it is assumed that a three metre firebreak will be maintained by adjacent landowner/s within the rural landholding west of the site, in accordance with their requirements under the City of Rockingham's Fire Control Notice.

4.3.5 Effective slope

The effective slope under areas of classified vegetation surrounding the site is shown in **Figure 11**, and ranges from effectively flat or upslope, to downslope zero to five degrees beneath surrounding vegetation.

Classified vegetation on a downslope gradient from the site can influence the movement of a bushfire through surrounding vegetation and towards the site. For this reason, increased setbacks may be required from vegetation at a downslope from the site. This is discussed further in **Section 5.1.2**.

4.4 Summary of bushfire threat

Bushfires are common in the City of Rockingham and there is a possibility of a bushfire impacting the site primarily from vegetation within rural landholdings west of the site, unless these hazards are managed and/or reduced.

The bushfire threat for the Structure Plan area has been determined by undertaking a preliminary BAL assessment (**Section 5.2.4**) to ensure no areas within the Structure Plan are exposed to an unacceptable level of bushfire risk (i.e. greater than BAL-29) .

Based on the preliminary assessment outlined in **Section 5**, the maximum long-term predicted radiant heat flux exposure for a small number of dwellings within the Structure Plan area is BAL-19. Further detailed BAL assessment will be undertaken as part of future subdivision or detailed design stages. This further detailed assessment is likely to provide a more accurate assessment of the surrounding bushfire risk at the time of development within the site.

5 Bushfire Mitigation Strategy

This BMP provides an outline of the mitigation strategies that will ensure that as development progresses in accordance with the Structure Plan, an acceptable solution and/or performance-based system of control is adopted for each bushfire hazard management issue. This approach is consistent with Appendix Four of the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al.* 2015).The management issues addressed as part of this BMP are:

- Location of the development
- Siting and design of the development
- Vehicular access
- Water supply.

For the residential development of the Structure Plan area, acceptable solutions are proposed for all four management issues in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al*. 2015), and each illustrates a means of satisfactorily meeting the corresponding performance criteria, as discussed in **Section 5.1** below.

5.1 Bushfire risk management

As previously discussed, it is not necessary to undertake a specific bushfire risk assessment as per AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines*. Land use planning bushfire risk mitigation and building control strategies are detailed in the following sections and provide responses to the bushfire protection performance criteria outlined in Appendix Four of the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al.* 2015). The compliant checklist is attached as **Appendix B**.

5.1.1 Element: Location

5.1.1.1 Intent

To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.

5.1.1.2 Acceptable Solution A1.1 Development location

The majority of the proposed development will be subject to either ‘Low’ or ‘Moderate’ bushfire hazard, where meeting the acceptable solution. Where development within the site will be progressed within 100 m of areas of ‘Extreme’ bushfire hazard, as shown in **Figure 10**, by addressing the siting and design of development within the site, no portion of the proposed development within the Structure Plan area will be exposed to an unacceptable level of radiant heat flux (i.e. BAL-29 is not exceeded). This is detailed further in **Section 5.1.2**.

5.1.2 Element: Siting and design of development

5.1.2.1 Intent

To ensure the siting and design of development minimises the level of bushfire impact.

5.1.2.2 Background

The extent of post-development classified vegetation (shown in **Figure 9**) is restricted to the Forest, Woodland and Grassland vegetation west of the site, within rural zoned landholdings.

Landholdings north of the site are undergoing separate urban development approvals, therefore Grassland vegetation within this landholding are considered temporary, and will pose only temporary bushfire risk to the site. Once vegetation is removed to accommodate urban development (in line with the relevant subdivision approvals) the bushfire risk posed to the site from this area will also be removed. Temporary bushfire risks have been considered further below.

5.1.2.3 Building siting and potential management considerations

AS 3959 has six categories of Bushfire Attack Level (BAL) which trigger varying degrees of increased construction standards in residential developments within 100 m of classified vegetation.

5.1.2.4 Methodology and assumptions

An indicative BAL assessment has been undertaken in order to determine the maximum level of radiant heat flux to which proposed future dwellings within the Structure Plan area could be exposed, and has been carried out based on the post development vegetation classification and effective slopes outlined in **Section 4**.

The criteria used to undertake the BAL assessment is as follows:

- Designated FDI: 80
- Flame temperature: 1090
- Effective slope: flat/upslope, downslope 0 to 5 degrees
- Vegetation classification: Forest (Class A), Woodland (Class B), Grassland (Class G)
- Distances/setback to classified vegetation: As per Table 2.4.3 of AS 3959, and shown in **Table 1** below.

5.1.2.5 BAL outcome

BAL ratings for the exposed areas of the Structure Plan area were determined using the methodology in Appendix A of AS 3959. This methodology is also outlined in Appendix Four of the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al*. 2015). Through the provision of appropriate Asset Protection Zones (discussed further below), there are no areas in the development exposed to a BAL rating above BAL-29.

The outcomes of this indicative BAL assessment are shown in **Table 1**, and **Figure 12**. The BAL implications of both permanent and temporary classified vegetation are outlined below.

Table 1: Results of indicative BAL assessment

AREA OF CLASSIFIED VEGETATION	VEGETATION CLASSIFICATION	EFFECTIVE SLOPE BENEATH CLASSIFIED VEGETATION	DISTANCE / SETBACK FROM CLASSIFIED VEGETATION	BAL RATING
Permanent considerations				
South-west of the site	Forest (Class A)	Downslope 0-5 degrees	<20 m	BAL-FZ
			20-27 m	BAL-40
			27-37 m	BAL-29
			37-50 m	BAL-19
			50-100 m	BAL-12.5
			>100 m	BAL-LOW
South-west of the site	Woodland (Class B)	Downslope 0-5 degrees	<13 m	BAL-FZ
			13-17 m	BAL-40
			17-25 m	BAL-29
			25-35 m	BAL-19
			35-100 m	BAL-12.5
			>100 m	BAL-LOW
West of the site	Grassland (Class G)	Downslope 0-5 degrees	<7 m	BAL-FZ
			7-9 m	BAL-40
			9-14 m	BAL-29
			14-20 m	BAL-19
			20-50 m	BAL-12.5
			>50 m	BAL-LOW
North-west of the site	Grassland (Class G)	Flat/upslope	<6 m	BAL-FZ
			6-8 m	BAL-40
			8-12 m	BAL-29
			12-17 m	BAL-19
			17-50 m	BAL-12.5
			>50 m	BAL-LOW
Temporary considerations				
North of the site	Grassland (Class G)	Flat/upslope	<6 m	BAL-FZ
			6-8 m	BAL-40
			8-12 m	BAL-29

AREA OF CLASSIFIED VEGETATION	VEGETATION CLASSIFICATION	EFFECTIVE SLOPE BENEATH CLASSIFIED VEGETATION	DISTANCE / SETBACK FROM CLASSIFIED VEGETATION	BAL RATING
			12-17 m	BAL-19
			17-50 m	BAL-12.5
			>50 m	BAL-LOW

The BAL ratings occurring within the site include:

- BAL-29, which means there is an increased risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to an increased level of radiant heat (AS 3959). The risk is considered to be high. It is expected that the construction elements will be exposed to a heat flux not greater than 29 kW/m^2. In this case, the recommended construction sections in AS 3959 are 3 and 7.
- BAL-19, which means the risk is considered to be moderate. It is expected that the construction elements will be exposed to a radiant heat flux not greater than 19 kW/m^2. There is a risk of ember attack and burning debris ignited by wind borne embers and a likelihood of exposure to radiant heat (AS 3959). The recommended construction sections in AS 3959 are 3 and 6.
- BAL-12.5, which means the risk is considered to be low. It is expected that the construction elements will be exposed to a radiant heat flux not greater than 12.5 kW/m^2. There is a risk of ember attack and burning debris ignited by wind borne embers and a likelihood of exposure to radiant heat (AS 3959). The recommended construction sections in AS 3959 are 3 and 5.
- BAL-LOW, which means the risk from bushfire is considered to be very low. There is insufficient risk to warrant any specific construction requirements but there is still some risk.

Proposed development within the Structure Plan area will require further detailed bushfire hazard and risk assessment to be undertaken as part of future subdivision or development stages, in order to determine the ultimate BAL ratings for future lots, and the subsequent increased construction standards to which future dwellings within these lots must be built. The ultimate BAL ratings **should not** be determined for future lots at the Structure Plan stage, as the ultimate lot locations/boundaries will be determined through the subdivision process, and temporary hazards (or even hazards that were expected to be permanent) may not remain at that time (e.g. temporary grass fuels north of the site).

Landholdings north of the site are intended for future urban development and are currently undergoing separate planning and approvals to support development, therefore Grassland vegetation within these landholdings will pose only a temporary bushfire risk to the site. The BAL implications of temporary vegetation are reflected in **Figure 12**. It is expected that temporary grass fuels will be removed prior to the progression of development within the northern portion of the site, therefore removing any temporary BAL requirements. If temporary grass fuels remain at the time development proceeds within the northern portion of the site, temporary BAL considerations will apply, as shown in **Figure 12**.

Future detailed BAL assessment/s will outline specific BAL ratings for each stage of subdivision based on the classified vegetation remaining at that time, therefore providing a more accurate assessment of the post development hazards posed to future dwellings than can be achieved at Structure Plan stage.

As part of the subdivision process, any lots deemed to require fire management responses through the detailed BAL assessment, will be subject to a notification pursuant to section 70A of the *Transfer*

of Land Act 1893 placed on the certificate(s) of title indicating that the lot is subject to the requirements of a Bushfire Management Plan (i.e. increased construction standards to meet BAL ratings of BAL-12.5 or greater).

5.1.2.6 Acceptable solution A2.1: Asset Protection Zone

One of the most important bushfire protection measures influencing the safety of people and property is to create an Asset Protection Zone (APZ) around buildings. The APZ is a low fuel area immediately surrounding a building. Non-flammable features such as irrigated landscapes, gardens, driveways and roads can form parts of an APZ.

Recent research into land management and house losses during the 'Black Saturday' Victorian bushfires concluded that the action of private landholders who managed fuel loads close to their houses was the single most important factor in determining house survival when compared with other land management practices, such as broad scale fuel reduction burning remote from residential areas (Gibbons et al., 2012).

The provision of a perimeter APZ where the site is adjacent to external bushfire hazard will ensure fuel loads in close proximity to the first row of buildings are managed to reduce the likelihood of ignition fuels adjacent to dwellings.

Managing vegetation in the APZ has two main purposes:

- To reduce direct flame contact and radiant heat from igniting the building during the passage of a fire front.
- To reduce ember attack and provide a safer space for people to defend (if required) before, during and after a fire front passes.

Those portions of the site that are situated in proximity to identified bushfire hazards have an internal (within the site) APZ applied to them as shown in **Figure 13**. Vegetation south and west of the site triggers perimeter APZ requirements for those lots in the west of the site. For the proposed residential lots within the Structure Plan area, this APZ will be accommodated within the proposed road reserve in the west of the site, as shown in **Figure 13**, which will provide a setback of 15 m to 23 m. Additional setback is provided by the three metre firebreak located within the adjacent rural landholdings, as discussed in **Section 4.3**. The fuel managed areas of future road reserves can act as APZ areas because the City of Rockingham roadside maintenance program will ensure hazard remains low. This APZ will be implemented at subdivision stage through the development and application of a Local Development Plan for the subject lots.

Landholdings north of the site are intended for future urban development and are currently undergoing separate planning and approvals to support development, therefore Grassland vegetation within these landholdings will pose only a temporary bushfire risk to the site, as shown in **Figure 9**. The provision of a temporary 8 m APZ in the north of the site will accommodate the minimum setback required to achieve BAL-29 from adjacent temporary Grassland vegetation within landholdings north of the site. This temporary APZ is accommodated within the rear of lots, as shown in **Figure 13**. It is expected that temporary grass fuels will be removed prior to the progression of development within the northern portion of the site, therefore removing any temporary APZ requirements. If temporary grass fuels remain at the time development proceeds within the northern portion of the site, APZ considerations will apply, as shown in **Figure 13**. APZ requirements will be revisited as part of future detailed BAL assessment to support subdivision approval/lot clearances within the site.

For the remaining rural portion of the site (i.e. rural balance lot in the western portion of the site), the required setbacks have been calculated based on the current fuel loads with the adjacent classified vegetation south and west of the site, driven by the AS 3959 framework, as previously outlined in **Section 5.1.2.5**. Should future development be proposed within this portion of the site, setbacks ranging from 8 m to 17 m will be required to achieve an acceptable level of radiant heat flux exposure (i.e. BAL-29) from the adjacent woodland and grassland vegetation. These setbacks can be accommodated through a combination of an internal lot setback within the rural lot and an additional three metre setback from vegetation provided through the firebreak maintained within the adjacent rural landholdings (in accordance with the City of Rockingham's Fire Control Notice). Any future development within this rural lot will be required to comply with the minimum required setbacks to achieve an acceptable level of radiant heat flux exposure (i.e. no greater than BAL-29).

Overall, the provision of an APZ, along with the provision of increased construction standards in accordance with AS 3959 will ensure that Performance Principle P2 under the *Guidelines for Planning in Bushfire Prone Areas* (WAPC et al. 2015) is met.

The APZ/s must be established and maintained to the following standards:

- Width: as identified in **Figure 13** and **Table 2** below
- Fine fuel load: reduced to and maintained at two tonnes per hectare
- Trees (crowns) are a minimum distance of ten metres apart. A small group of trees within close proximity to one another may be treated as one crown provided the combined crowns do not exceed the area of a large or mature crown size for that species
- No tall shrubs or trees located within two metres of a building
- No tree crowns overhang the building
- Fences within the APZ are constructed using non-combustible materials (e.g. iron, brick, limestone, metal post and wire)
- Sheds within the APZ should not contain flammable materials.

It is the responsibility of the developer to ensure that any APZ requirement is established by appropriate design, and that the construction of buildings is restricted within the APZ when it extends into lot areas.

As outlined above, the APZ for the residential lots is provided by the proposed road reserve, as shown in **Figure 13**, therefore the width of the APZ reflects the width of the road reserve, and the subsequent BAL rating that this setback achieves. The APZs for the rural lot in the west of the site, as outlined in **Table 2** below, have been based on the minimum setbacks required to achieve an acceptable level of radiant heat flux (i.e. BAL-29). Both approaches utilise the assumed 3 m firebreak within adjacent rural landholdings, as is required under the City of Rockingham's Fire Control Notice as attached in **Appendix C**.

Table 2: Asset Protection Zone requirements

AREA OF CLASSIFIED VEGETATION	VEGETATION CLASSIFICATION	EFFECTIVE SLOPE	APZ WIDTH	BAL ACHIEVED
Residential lots/Structure Plan area				
South-west of the site	Woodland	Downslope 0-5 degrees	23 m	BAL-19
West of the site	Grassland	Downslope 0-5 degrees	15 m	BAL-12.5

AREA OF CLASSIFIED VEGETATION	VEGETATION CLASSIFICATION	EFFECTIVE SLOPE	APZ WIDTH	BAL ACHIEVED
North-west of the site	Grassland	Flat/upslope	15 m	BAL-19
North of the site	Grassland	Flat/upslope	8 m	BAL-29
Rural lot				
South-west of the site	Woodland	Downslope 0-5 degrees	17 m	BAL-29
West of the site	Grassland	Downslope 0-5 degrees	9 m	BAL-29
North-west of the site	Grassland	Flat/upslope	8 m	BAL-29

Temporary APZ

5.1.2.7 Acceptable solution A2.2: Hazard separation zone

A Hazard Separation Zone (HSZ) is a fuel managed zone to create separation between dwellings and bushfire hazards. This generally extends out to 100 metres from buildings. In the case of subdivision within the site, the provision of a HSZ is not an appropriate method to respond to relevant bushfire hazards.

The need for a HSZ is avoided through the provision of an appropriate Asset Protection Zone (as outlined above) and an increase in construction standards for dwellings (where applicable) in accordance with AS 3959. The indicative BAL assessment within this BMP demonstrates that these provisions will achieve acceptable levels of risk for the development, and BAL-29 is not exceeded.

5.1.3 Element: Vehicular access

5.1.3.1 Intent

To ensure vehicular access serving a subdivision/development is available and safe during a bushfire event.

5.1.3.2 Background

The indicative road network of the proposed Structure Plan is shown in **Figure 4**. The network integrates with the existing McDonald Road to the east, which provides access to Fifty Road to the south and connects with the road network of the existing residential development east of the site. Access will be provided to future residential development north of the site when such development occurs in line with the land use zoning of the area.

5.1.3.3 Acceptable solution A3.1: Two access routes

The proposed road system provides a loop through the site, back to McDonald Road in the east, as shown in **Figure 4**, which provides all residents and fire fighters with two road access options at all times. Additional access will be provided through to future residential development north of the site, at such a time as development progresses in this area (in accordance with the land use zoning shown in **Figure 6**).The Structure Plan shows two access points to McDonald Road in the east, which provides access to Fifty Road in the south, and through the adjacent residential development to the east.

5.1.3.4 Acceptable solution A3.2: Public roads

Surrounding public roads and all new public roads and laneways within the site will comply with the following minimum standards:

- Minimum trafficable surface: 6 metres
- Horizontal clearance: 6 metres
- Vertical clearance: 4.5 metres
- Maximum grades over <50 metres: 1 in 10
- Minimum weight capacity: 15 tonnes
- Maximum crossfall: 1 in 33
- Minimum inner radius of curves: 8.5 metres.

5.1.4 Element: Water

5.1.4.1 Intent

To ensure water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.

5.1.4.2 Acceptable Solution A4.1: Reticulated water

The development is located within an Emergency Services Levy (ESL) Category 3 area, which indicates that emergency bushfire response is provided by a volunteer fire and rescue service brigade, with the assistance of career fire stations. Fire response services require ready access to an adequate water supply during bushfire emergencies.

The development will be provided with a reticulated water supply, together with fire hydrants that will be installed by the developer/s to meet the specifications of Water Corporation (Design Standard DS 63) and DFES. Fire hydrants on land zoned as residential are required to be sited at or within 200 m of residential dwellings (Class 1a).

The Water Corporation would be responsible for all hydrant maintenance and repairs.

5.2 Future development

This BMP is expected to inform future detailed bushfire hazard and risk assessment/s that will be prepared and implemented as part of future subdivision or development stage, undertaken in accordance with the Structure Plan.

5.3 Access and fire breaks

Compliance with the City of Rockingham Fire Control Notice, attached in **Appendix C**, is required across the entire site until such a time as development is completed, and public road access must provide two access options at all stages of development.

It is assumed that a minimum three metre wide firebreak will be maintained (adjacent to the western boundary of the site, as shown in **Figure 9**) by the landholder/s of the adjacent rural landholdings west of the site, in accordance with their requirements under the City of Rockingham's Fire Control Notice.

5.4 Public education

Community bushfire safety is a shared responsibility between individuals, the community, government and fire agencies. DFES has an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. Prepare. Act. Survive. (DFES, 2012) provides excellent advice on preparing for and surviving the bushfire season. Other downloadable brochures are available from http://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/pages/publications.aspx.

The City of Rockingham provides bushfire safety advice to residents available from their website http://www.rockingham.wa.gov.au/Services/Safety-and-security-services/Fire-safety-and-emergencies. It also provides details on how to become a volunteer at either of the local volunteer Bush Fire Brigades. Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in high risk areas.

5.5 Assessment of bushfire management strategies

The bushfire hazard that could threaten this development is concentrated to the west of the site, associated with remnant vegetation within rural landholdings. These hazards have been considered through the strategic placement of road reserves to achieve the required APZs, and to ensure that dwellings are not exposed to an unacceptable level of risk (i.e. BAL-29 is not exceeded).

5.6 Implementing the Bushfire Management Plan

The following table outlines the future and/or ongoing responsibilities of the future developer/s, lot owners or residents, and the City of Rockingham relating to bushfire risk mitigation.

As outlined in **Table 3** below, the future owners/occupiers of lots within the site, as created through future subdivision stages, are to maintain a reduced level of risk from bushfire within their properties (where applicable), and will be responsible for undertaking, complying and implementing measures to protect their own assets (and people under their care) from the threat and risk of bushfire.

Table 3: Responsibilities for the implementation of the BMP

MANAGEMENT ACTION	TIMING
DEVELOPER/S	
Undertake further detailed bushfire assessment to determine ultimate BAL ratings for the site, with assessment recommendations to be submitted to the City of Rockingham and accommodated in the lot clearances and/or Detailed Area Plan outcomes.	As part of the subdivision approval or Detailed Area Plan preparation process (whichever comes first).
For each new lot created within areas exposed to a BAL rating exceeding BAL-LOW, lodge a Section 70A Notification on the Certificate of Title in order to alert purchasers and successors in title of the existence of the overarching BMP and specifically the requirements associated with meeting the AS 3959 construction standards.	At the creation of titles within future subdivision stage/s.
Install the public roads to standards outlined in **Section 5.1.3** and ensure two access ways are provided at all times.	As part of subdivision and development.
On all vacant land, comply with the City of Rockingham Fire Control Notices as published.	Ongoing, where applicable.
Install reticulated water supply and hydrants to Water Corporation, DFES and the City of Rockingham standards.	As part of subdivision and development.
Establish and maintain the APZs within the site to standards as specified in this document.	As part of subdivision and development.
Provide detailed hydrant plans to the City of Rockingham and DFES local fire station for monitoring.	At subdivision approval stage.
Make a copy of this BMP available to each lot owner subject to AS 3959 construction standards, along with the *Homeowners Bush Fire Survival Manual, Prepare, Act, Survive* (or similar suitable documentation) and the City of Rockingham's Fire Control Notice.	As part of the sale of lots.
PROPERTY OWNER/OCCUPIER	
Ensuring that all lots comply with the City of Rockingham Fire Control Notices as published.	Ongoing, where applicable.
Maintaining each property in good order to minimise bushfire fuels, and maintaining APZ areas (where applicable) in accordance with the requirements outlined in this BMP.	Ongoing, where applicable.
Ensuring that where hydrants are located, they are not obstructed and remain visible at all times.	Ongoing, where applicable.
Ensuring construction of dwelling/s complies with AS 3959, if required.	As part of dwellings design and construction.
If dwellings are subject to additional construction in the future, such as renovations, AS 3959 compliance is required.	As part of design and construction.
CITY OF ROCKINGHAM	
Providing fire prevention and preparedness advice to landowners upon request, including the *Homeowners Bush Fire Survival Manual, Prepare, Act, Survive* (or similar suitable documentation) and the City of Rockingham's Fire Control Notice.	Ongoing, as requested.
Monitoring bush fuel loads in road reserves and liaising with relevant stakeholders to maintain fuel loads at safe levels.	Ongoing.

MANAGEMENT ACTION	TIMING
Ensuring emergency response is provided via the Baldivis Volunteer Bush Fire Brigade.	Ongoing.
Maintaining public roads to appropriate standards and ensuring compliance with the City of Rockingham Fire Control Notices.	Ongoing.
BALDIVIS VOLUNTEER BUSH FIRE BRIGADE	
The Baldivis Volunteer Bush Fire Brigade is responsible for responding to emergency situations relating to bushfire within the City of Rockingham. Where bushfire threatens the site, the local brigade will utilise the internal road network of the site to protect life and property.	Ongoing, as required.
WATER CORPORATION	
The Water Corporation is responsible for the repair of water hydrants.	Ongoing, when required.

6 Conclusions and Recommendations

6.1 Conclusion

The site is designated as bushfire prone within the state *Map of Bushfire Prone Areas*. This BMP has been prepared to address the requirements of SPP 3.7 and the *Guidelines for Planning in Bushfire Prone Areas* (WAPC *et al.* 2015). It has been demonstrated that the bushfire protection performance criteria outlined in the guidelines (WAPC *et al.* 2015) can be achieved through:

- Providing appropriate vehicular access options, or as an alternative a designated FSA or CFR.
- Providing sufficient water supply to ensure emergency services are able to respond to a bushfire event.
- Siting of development to ensure buildings are not exposed to an unacceptable level of radiant flux, without appropriate mitigation measures.

This BMP is expected to inform future bushfire assessment/s that will be prepared and implemented as part of the future subdivision or development approval process.

Dwellings located within 100 m of identified classified vegetation will have the bushfire risk mitigated through the use of appropriate APZs and via compliance with AS 3959. The indicative BAL assessment included in this BMP demonstrates that BAL-29 would not be exceeded and APZs can be accommodated within the proposed future road reserves in the south and west of the site, in response to the adjacent hazards.

Landholdings north of the site are undergoing separate urban development approvals, therefore Grassland vegetation within this landholding are considered temporary, and will pose only temporary bushfire risk to the site. Once vegetation is removed to accommodate urban development (in line with the relevant subdivision approvals) the bushfire risk posed to the site from this area will also be removed.

Appropriate APZs have been accommodated where required in order to provide an adequate setback to ensure dwellings are not exposed to an unacceptable level of radiant heat flux (i.e. greater than BAL-29) from potential bushfires in adjacent classified vegetation. Loop roads and reticulated water supply and hydrants are provided. The proposed development will fall within the acceptable level of risk.

6.2 Recommendations

Based on the bushfire hazard assessment contained within this BMP, the following key recommendations should be considered for the implementation of the Structure Plan:

- By implementing this BMP, the bushfire risk to development within the site can be mitigated through the provision of appropriate APZs combined with increased construction standards in accordance with AS 3959.
- The indicative BAL assessment undertaken as part of this BMP indicates that no future lots within the site will be exposed to an unacceptable level of radiant heat flux (i.e. no greater than BAL-29).
- Future BAL assessment/s (undertaken to support future subdivision or development approval stage/s) will enable a more accurate reflection of the bushfire risk posed by surrounding classified vegetation at the time that development progresses within the site. This BAL assessment/s will specify ultimate BAL ratings for each lot as well as APZ requirements (where applicable).

7 References

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8 Glossary

AS	Australian Standard
AHD	Australian Height Datum
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
BCA	Building Code of Australia
BMP	Bushfire Management Plan
BOM	Bureau of Meteorology
DFES	Department of Fire and Emergency Services (was FESA)
ESL	Emergency Services Levy
FESA	Fire and Emergency Services (now DFES)
HSZ	Hazard Separation Zone
LPS	Local Planning Scheme
POS	Public Open Space
TPS	Town Planning Scheme
VBRC	Victorian Bushfires Royal Commission
WAPC	Western Australian Planning Commission

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FIGURES

Figure 1:	**Location Plan**
Project:	Bushfire Management Plan Portion of Lot 16 McDonald Road, Baldivis
Client:	Defence Housing Australia

Plan Number: EP15-057(03)--F03b			
Drawn:	KNM	Date:	31/08/2016
Approved:	JDH	Date:	07/09/2016
Checked:	VMK	Scale:	1:5,000@A4

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Bushfire Safety CONSULTING

emerge ASSOCIATES Integrated Science & Design

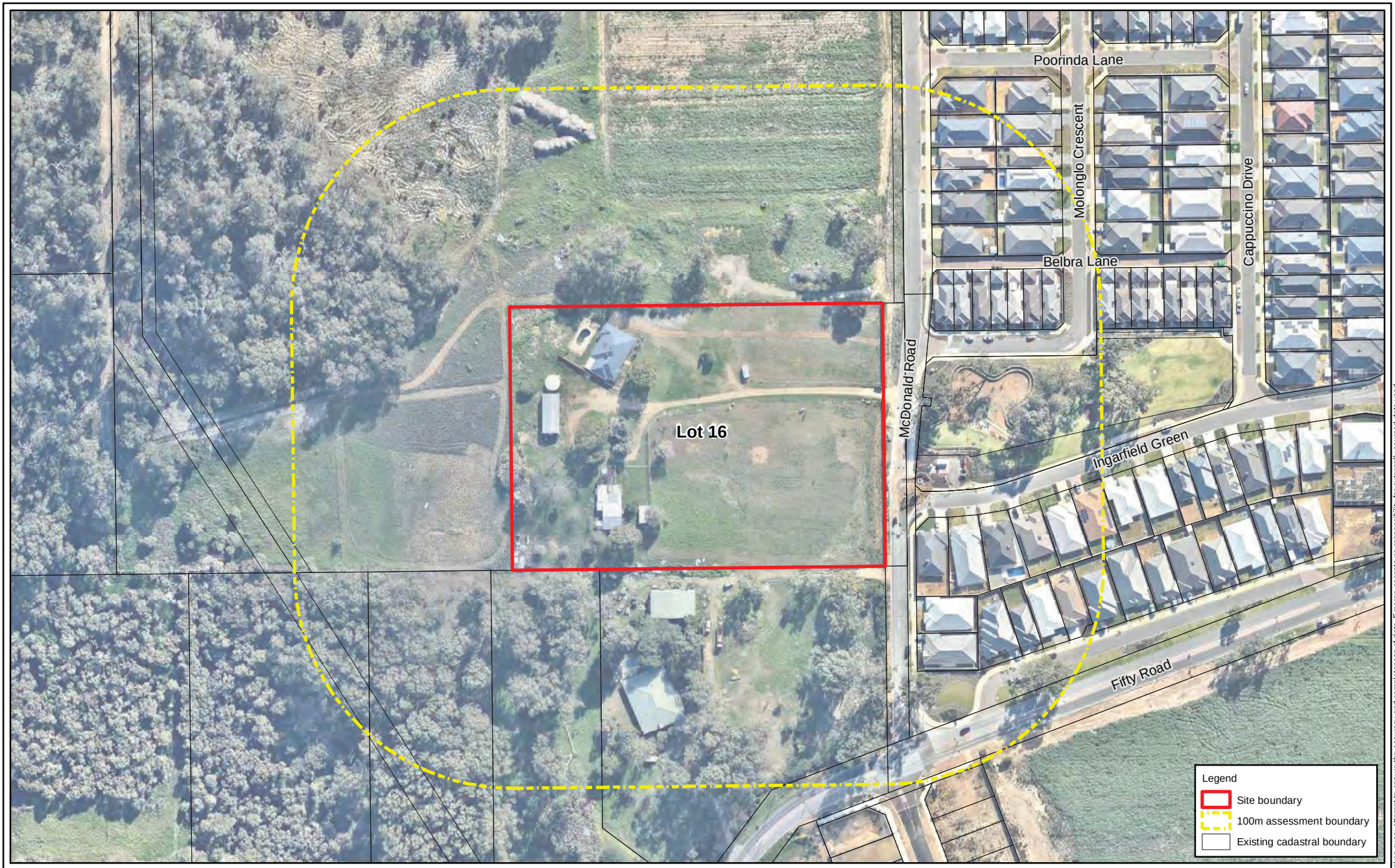

Figure 2:	**Site Plan and Assessment Area**
Project:	Bushfire Management Plan Portion of Lot 16 McDonald Road, Baldivis
Client:	Defence Housing Australia

Plan Number: EP15-057(03)--F04b

Drawn:	KNM	Date:	31/08/2016
Approved:	JDH	Date:	07/09/2016
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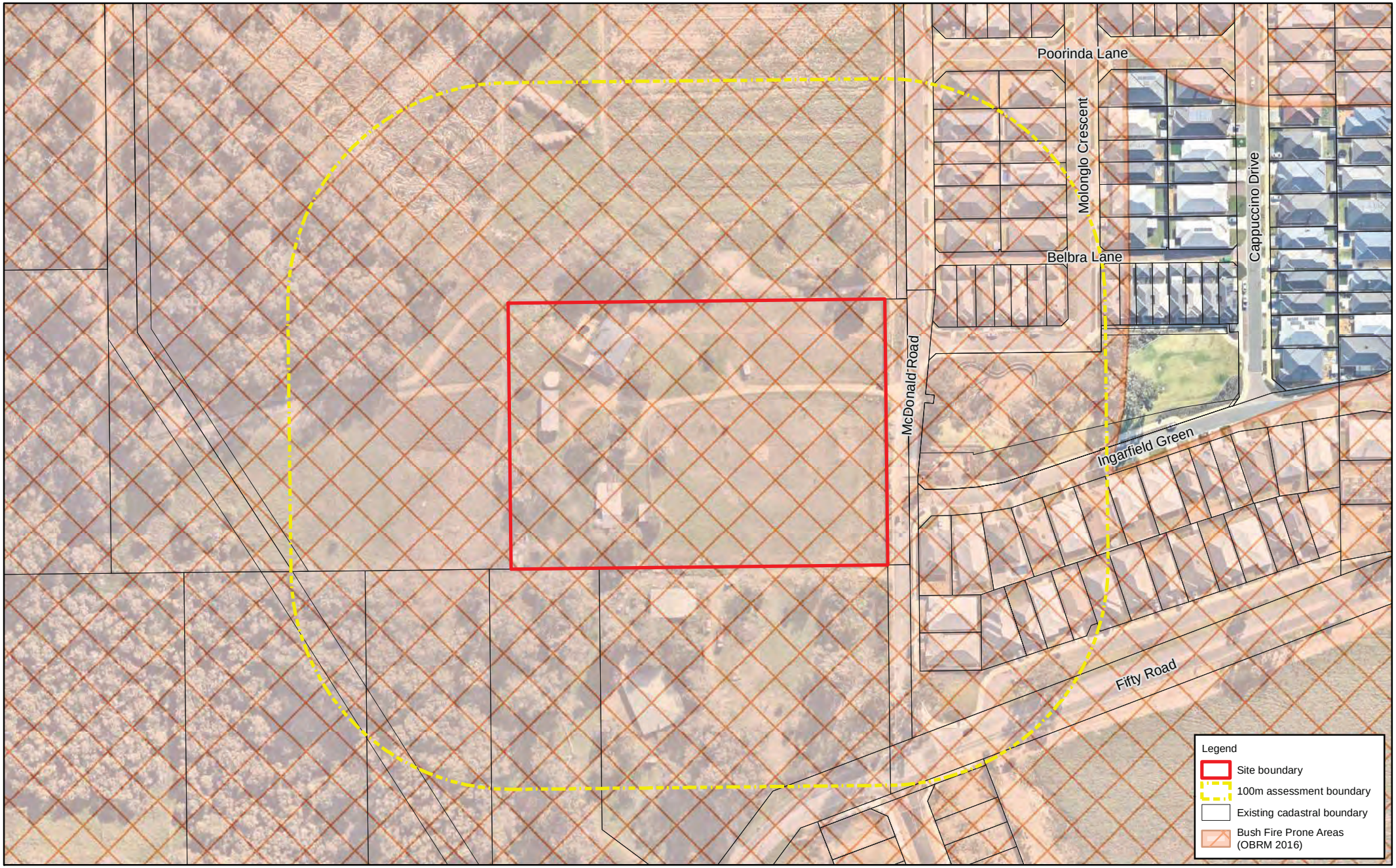

Figure 3: Map of Bushfire Prone Areas

Project: Bushfire Management Plan
Portion of Lot 16 McDonald Road, Baldivis

Client: Defence Housing Australia

Plan Number: EP15-057(03)--F05b

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Approved:	JDH	Date:	07/09/2016
Checked:	VMK	Scale:	1:2,250@A4

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Figure 4: Proposed Structure Plan

Project:	Bushfire Management Plan Portion of Lot 16 McDonald Road, Baldivis
Client:	Defence Housing Australia

Plan Number: EP15-057(03)--F06c

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Approved:	JDH	Date:	07/09/2016
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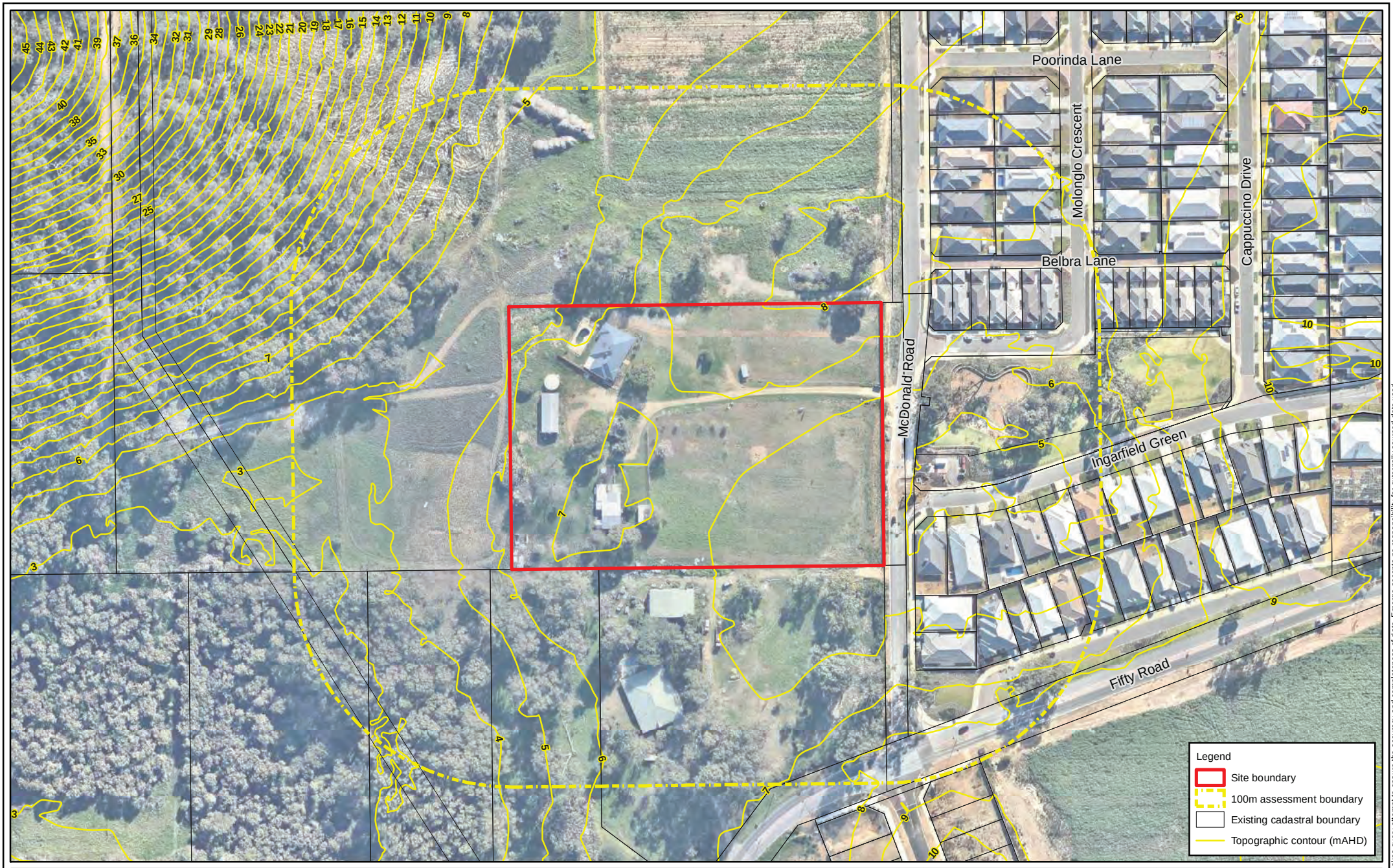

Figure 5:	**Site Topography**
Project:	Bushfire Management Plan Portion of Lot 16 McDonald Road, Baldivis
Client:	Defence Housing Australia

Plan Number: EP15-057(03)--F07b

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Approved:	JDH	Date:	07/09/2016
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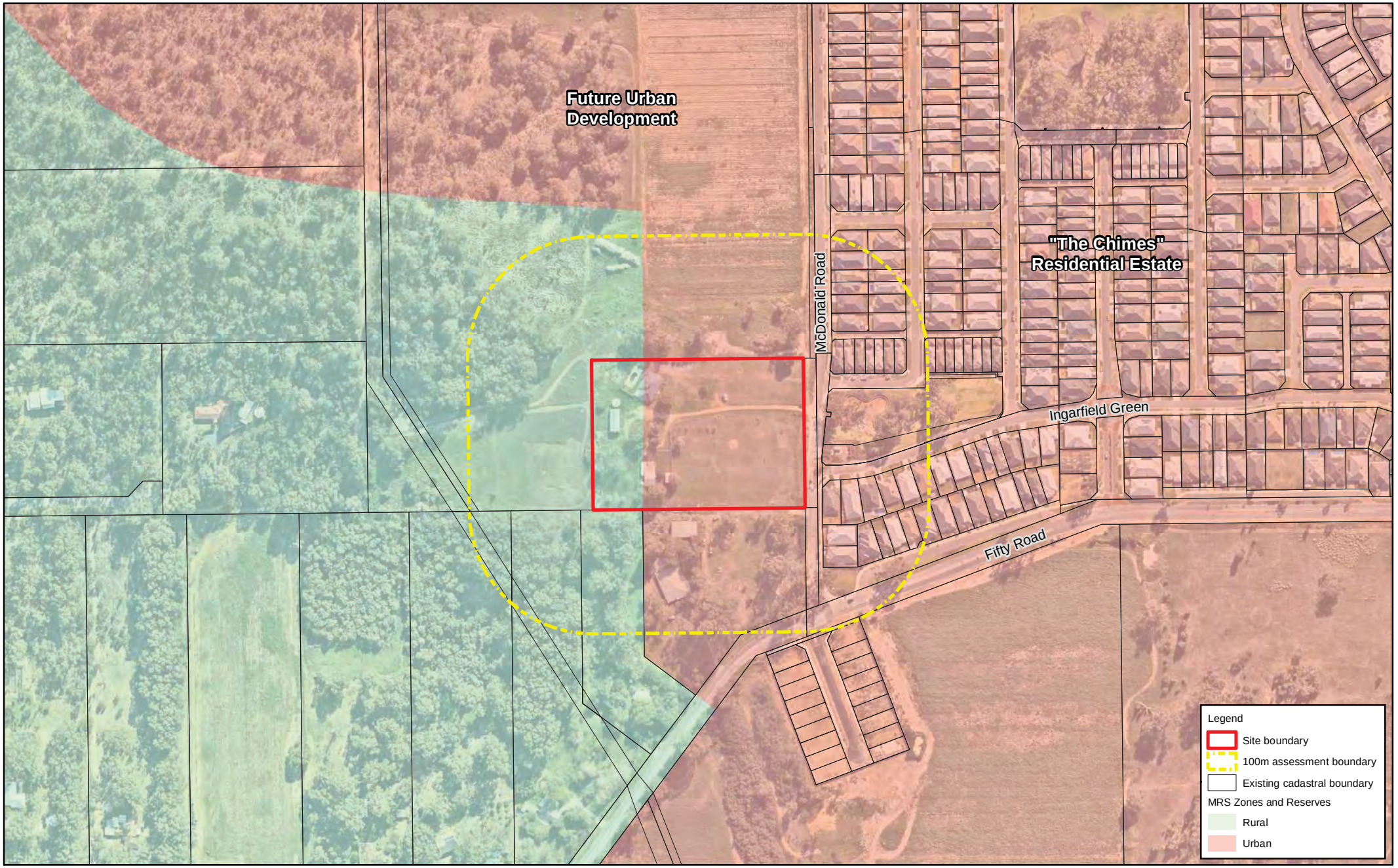

Figure 6: Local Context and Surrounding Land Uses

Project: Bushfire Management Plan
Portion of Lot 16 McDonald Road, Baldivis

Client: Defence Housing Australia

Plan Number: EP15-057(03)--F08b

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Approved:	JDH	Date:	07/09/2016
Checked:	VMK	Scale:	1:4,000@A4

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Figure 7:	**Existing Site Conditions – AS 3959 Vegetation Classification**
Project:	Bushfire Management Plan Portion of Lot 16 McDonald Road, Baldivis
Client:	Defence Housing Australia

Plan Number: EP15-057(03)--F09b			
Drawn:	KNM	Date:	31/08/2016
Approved:	JDH	Date:	07/09/2016
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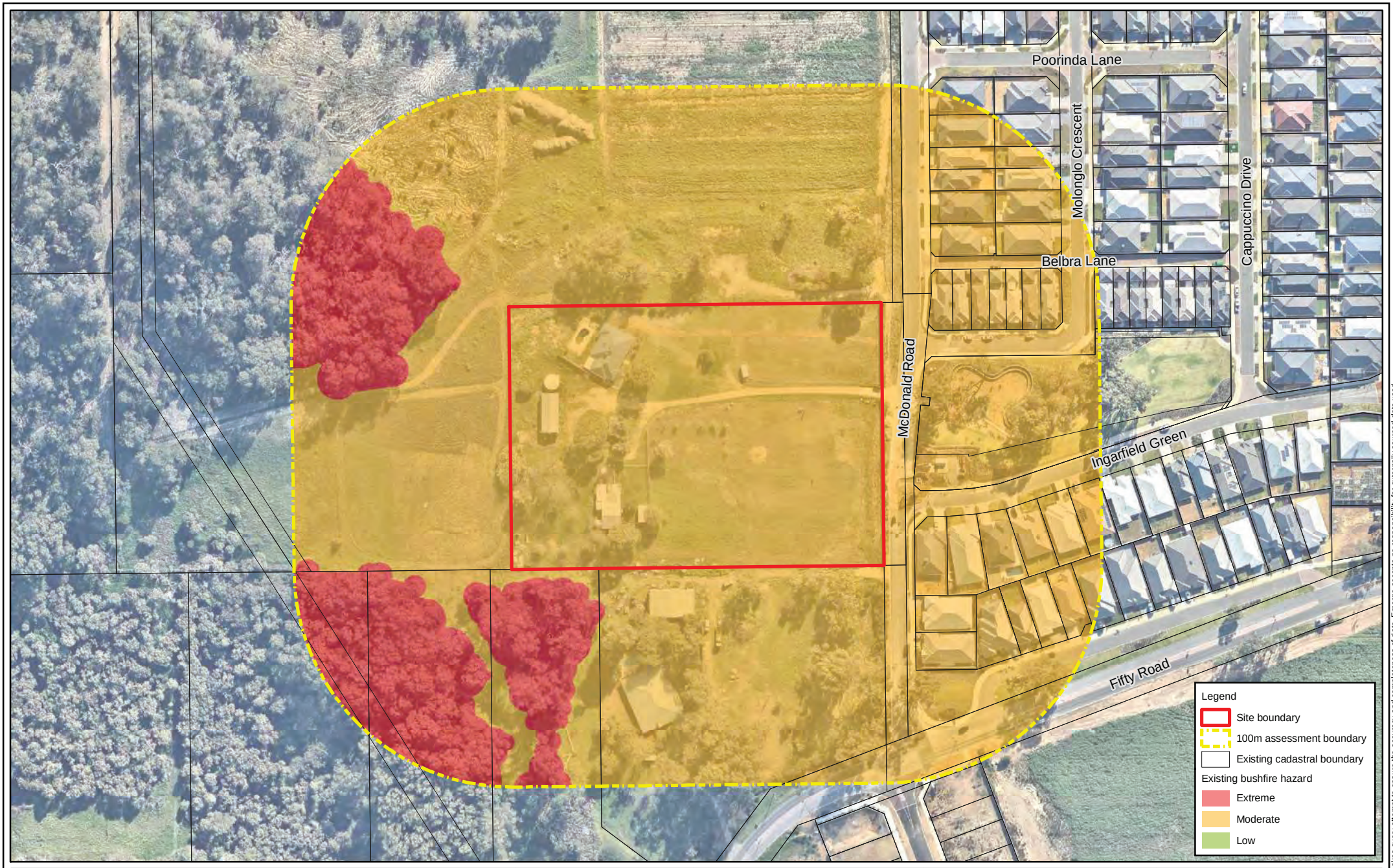

Figure 8: Existing Site Conditions – Bushfire Hazard Assessment

Project: Bushfire Management Plan
Portion of Lot 16 McDonald Road, Baldivis

Client: Defence Housing Australia

Plan Number: EP15-057(03)--F10b			
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Approved:	JDH	Date:	07/09/2016
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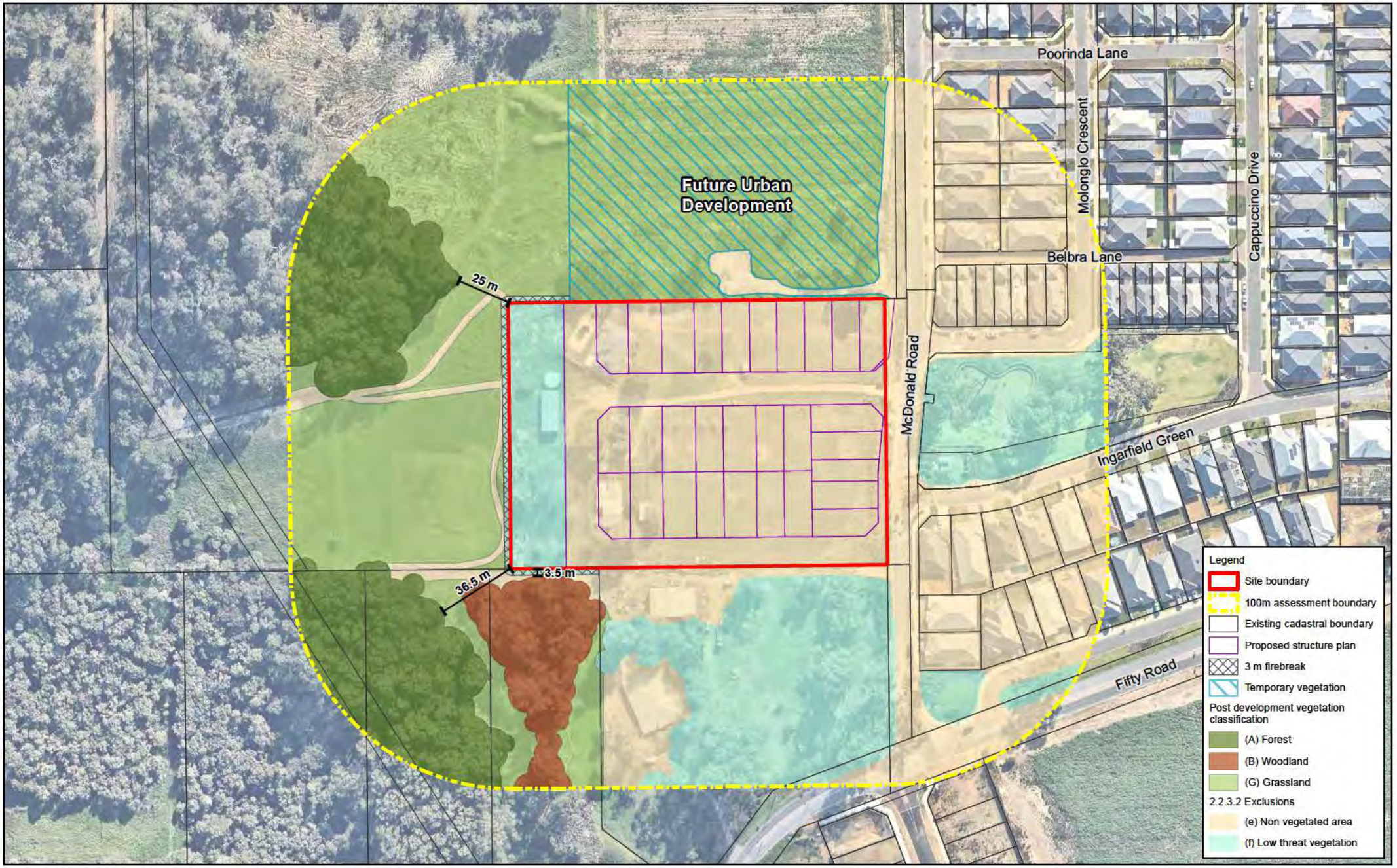

Figure 9:	**Post Development Site Conditions – AS 3959 Vegetation Classification**
Project:	Bushfire Management Plan Portion of Lot 16 McDonald Road, Baldivis
Client:	Defence Housing Australia

Plan Number: EP15-057(03)--F12c			
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Approved:	JDH	Date:	07/09/2016
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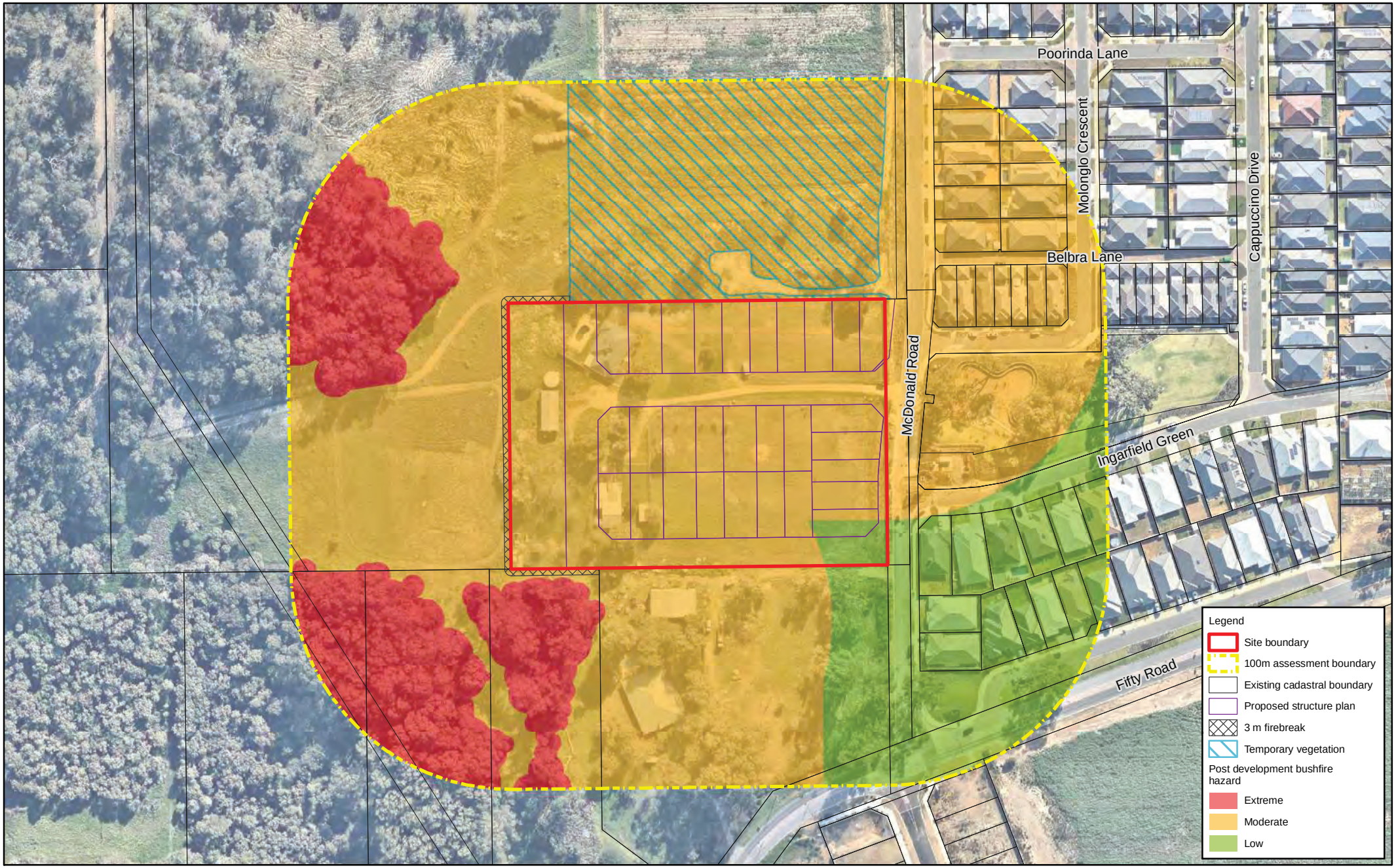

Figure 10: Post Development Site Conditions – Bushfire Hazard Assessment

Project:	Bushfire Management Plan Portion of Lot 16 McDonald Road, Baldivis
Client:	Defence Housing Australia

Plan Number: EP15-057(03)--F13c

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Approved:	JDH	Date:	07/09/2016
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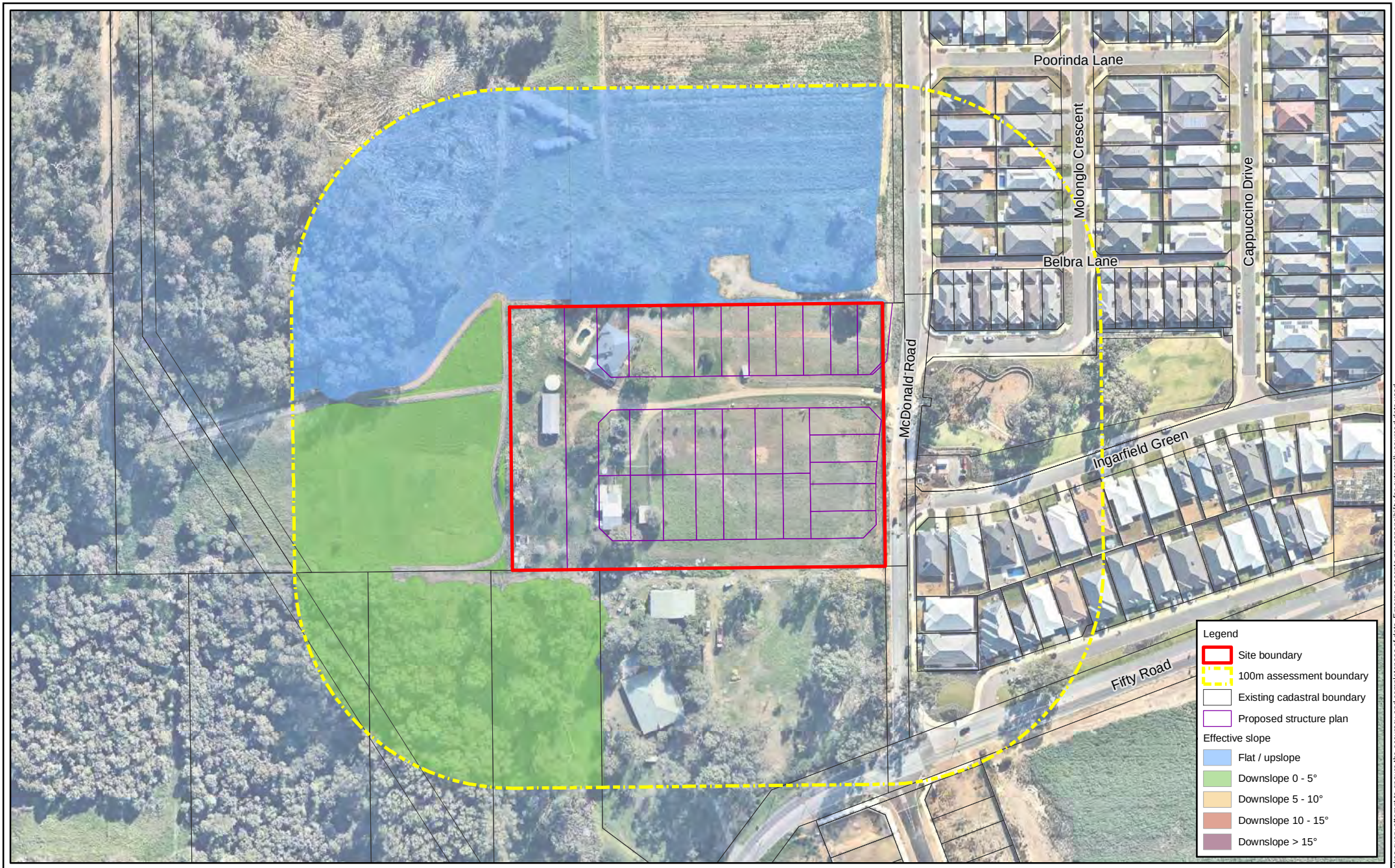

Figure 11: Effective Slope

Project:	Bushfire Management Plan Portion of Lot 16 McDonald Road, Baldivis
Client:	Defence Housing Australia

Plan Number: EP15-057(03)--F14c			
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Approved:	JDH	Date:	07/09/2016
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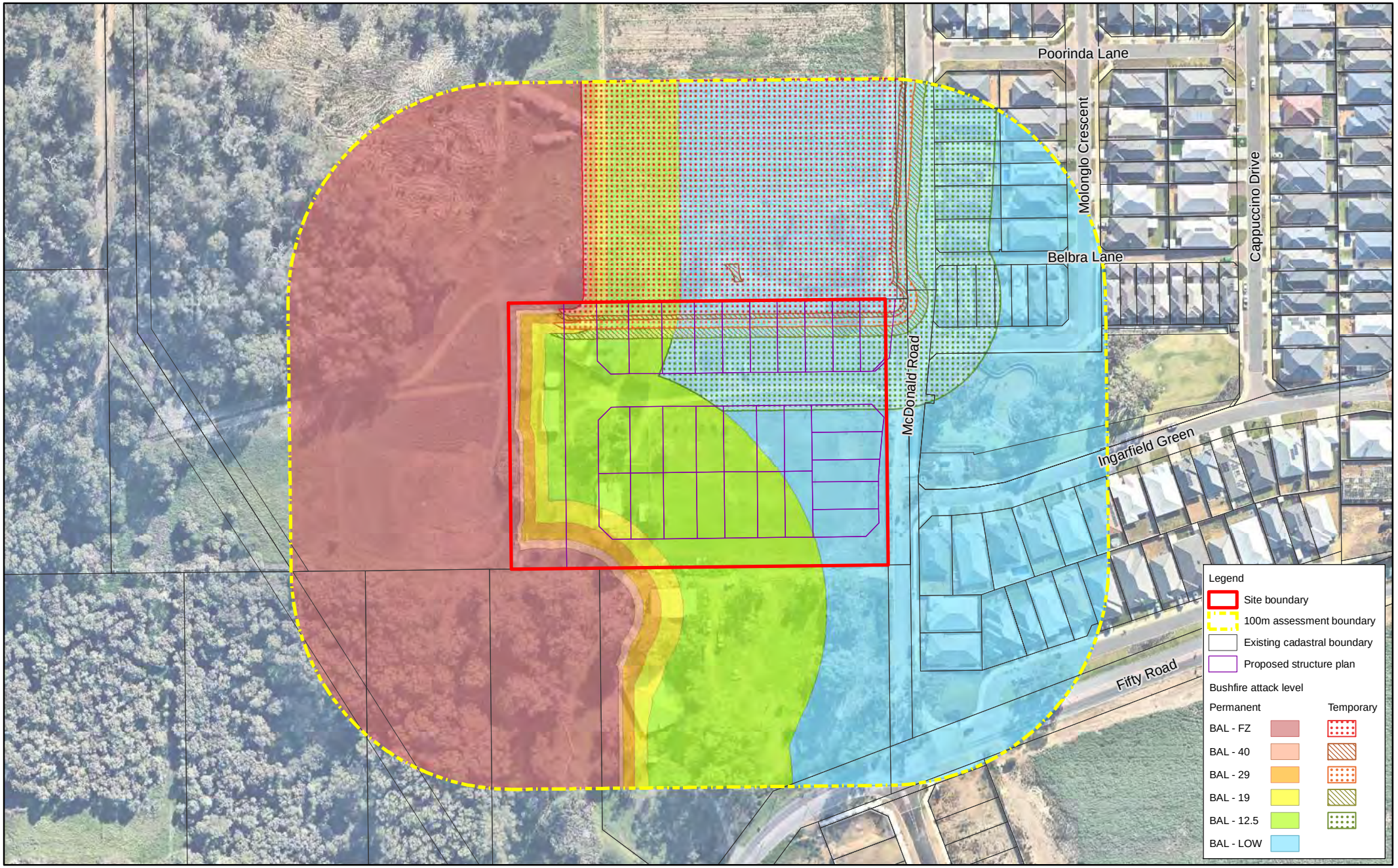

Figure 12: Indicative Bushfire Attack Levels

Project:	Bushfire Management Plan Portion of Lot 16 McDonald Road, Baldivis
Client:	Defence Housing Australia

Plan Number: EP15-057(03)--F15c			
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Approved:	JDH	Date:	07/09/2016
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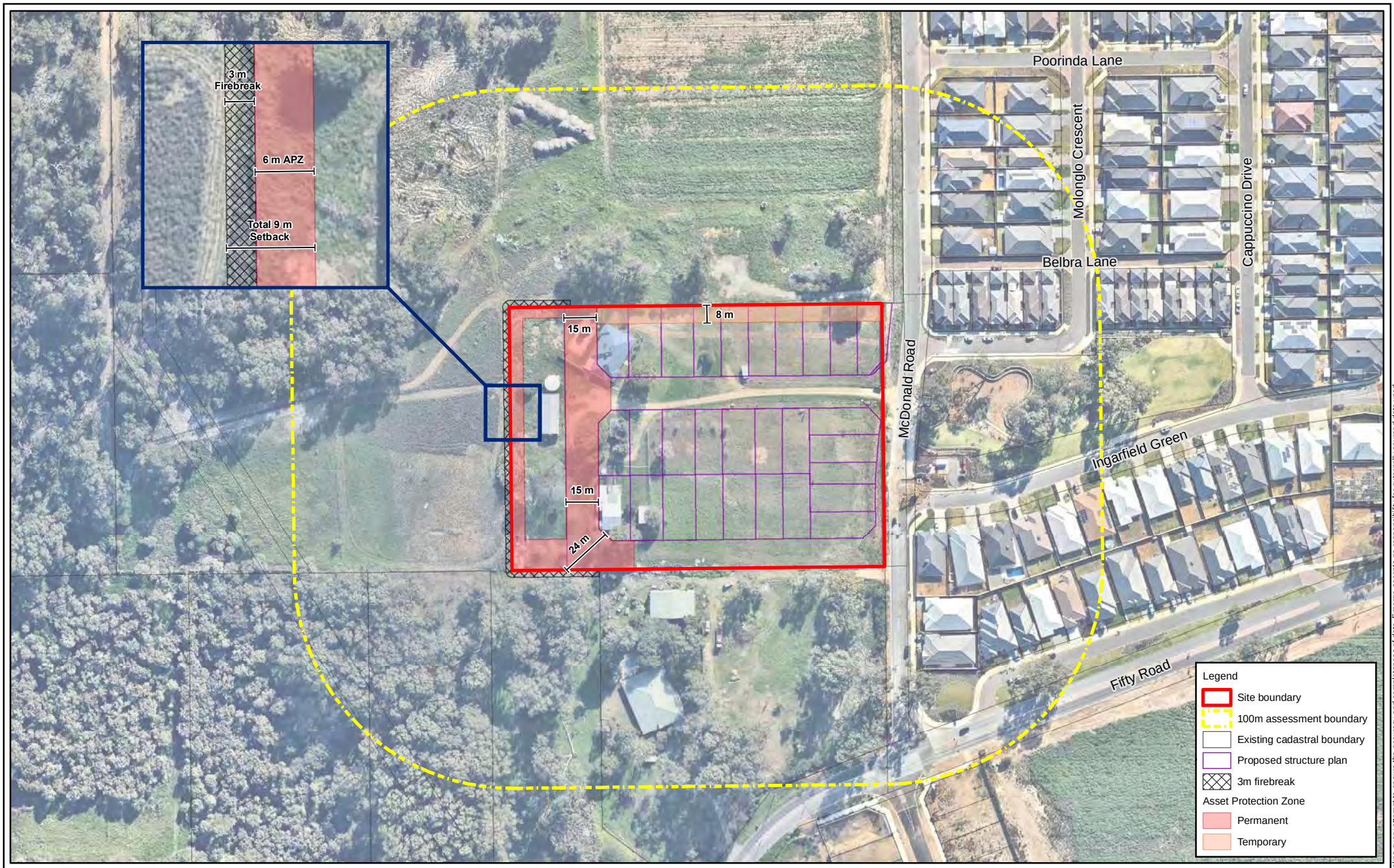

Figure 12: Asset Protection Zone Requirements

Project:	Bushfire Management Plan Portion of Lot 16 McDonald Road, Baldivis
Client:	Defence Housing Australia

Plan Number: EP15-057(03)--F16e			
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Approved:	JDH	Date:	28/11/2016
Checked:	VMK	Scale:	1:2,250@A4

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APPENDIX A

PORTION OF LOT 16 MCDONALD ROAD, BALDIVIS STRUCTURE PLAN

TPG (2016)

APPENDIX B

COMPLIANCE CHECKLIST

Appendix B: Compliance Checklist

ELEMENT/QUESTION	RESPONSE
1: Location	
Does the proposal comply with the performance criteria by applying acceptable solution A1.1?	Yes.
2: Siting and design of the Development	
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?	No. However the performance criteria P2 is achieved through the provision of a compliant APZ, and the application of increased construction standards in accordance with AS 3959.
3: Vehicular access	
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?	Yes.
Does the proposal comply with the performance criteria by applying acceptable solution A3.3?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A3.4?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A3.6?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A3.7?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A3.8?	Not applicable.
4: Water	
Does the proposal comply with the performance criteria by applying acceptable solution A4.1?	Yes.
Does the proposal comply with the performance criteria by applying acceptable solution A4.2?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A4.3?	Not applicable.

Applicant Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Signature:

Name: Rohan Carboon

Date: 8 September 2016

APPENDIX C

CITY OF ROCKINGHAM FIRE CONTROL NOTICE

Fire Control Notice

NOTICE TO OWNERS AND/OR OCCUPIERS OF LAND IN THE CITY OF ROCKINGHAM

As a landowner or occupier you have a legal requirement under Section 33 of the Bush Fires Act 1954 to carry out fire prevention works on your property in accordance with the provisions of this Fire Control Notice.

You are required on or before 30 November 2015, to remove all flammable material or to install three (3) metre wide mineral earth firebreaks (mineral earth in definition being land totally clear of all vegetation living or dead) and any overhanging trees or other vegetation to a clearance height of four (4) metres. These fire prevention works must be maintained up to and including 31 May 2016.

Inspection of properties will be carried out in all areas for compliance with this Notice after 30 November 2015. Persons who fail to comply with the requirements of this Notice will be issued with an infringement notice ($250).

It is the property owner's responsibility to ensure the standard of prevention work is undertaken and maintained as per this Notice

Correct Rural Firebreak

Urban Slashed Property

Rural Land

On or before 30 November 2015 and thereafter up to and including 31 May 2016:

Have **FIREBREAKS** not less than three (3) metres wide immediately inside and along all boundaries, with all overhanging tree branches, tree limbs etc. to be trimmed back clear of the firebreak to a clearance height of four (4) metres.

Maintained and living lawns are acceptable in conjunction with or in lieu of mineral earth firebreaks, provided that the same minimum width and height requirements for a firebreak are maintained.

Buildings/Sheds and Haystacks

Have FIREBREAKS not less than five (5) metres wide so far as to surround all buildings, sheds and haystacks, with all overhanging branches, trees, limbs etc. to be trimmed back clear of the firebreak to a clearance height of four (4) metres.

Fire Management Plans

All properties within subdivisions/developments within the City of Rockingham shall comply with the Fire Management Plans for their estate to the satisfaction of Council or its duly Authorised Officer.

Building Protection Zones

For properties in a bush fire risk area, install a 20m building protection zone. For more information visit the DFES website and search Building Protection Zones.

Urban Areas (Vacant Land)

On or before 30 November 2015 and thereafter up to and including 31 May 2016:

Land less than 2000 m²

Have the entire vacant land clear of all flammable material by slashing, mowing or other means to a height no greater than 50mm.

Land more than 2000 m²

Have FIREBREAKS not less than three (3) metres wide immediately inside and along all boundaries of the vacant land with all overhanging tree branches, trees, limbs etc. to be trimmed back clear of the firebreak area to a clearance height of four (4) metres.

Or

Maintained and living lawns are acceptable in conjunction with or in lieu of mineral earth firebreaks, provided that the same minimum width and height requirements for a firebreak are maintained.

Alternative Situations

Variation applications must be lodged in writing to the City of Rockingham by 16 October 2015. An application to Vary Location and Type of Firebreaks can be downloaded from the City's website or is available from the Emergency Services Administration Officer on 9527 0732.

Fire Control Enquiries

8.30am – 4.30pm Monday to Friday **Phone:** 9527 0732 **Email:** firecontrol@rockingham.wa.gov.au