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Strategic Bushfire Assessment

'Parkwood' (Ginninderry)

Prepared for
The Riverview Group

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Abbreviations

Abbreviation	Description
ACT	Australian Capital Territory
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
BFMC	Bush Fire Management Committee
BoM	Bureau of Meteorology
BRMP	Bushfire Risk Management Plan
DCP	Development Control Plan
DEM	Digital Elevation Model
EFB	Eruptive Fire Behaviour
ELA	Eco Logical Australia
EP&A Act	*Environmental Planning and Assessment Act 1979*
FDI	Fire Danger Index
FFDI	Forest Fire Danger Index
kW/m^2	Kilowatts per square meter
LEP	Local Environment Plan
NSP	Neighbourhood Safer Place
NSW	New South Wales
PBP	Planning for Bushfire Protection
RFS	Rural Fire Service
RF Act	*Rural Fires Act 1997*
SFPP	Special Fire Protection Purpose
t/ha	Tonnes per hectare
VLS	Vorticity-driven lateral spread

Executive summary

A Strategic Bush Fire Study is required as a condition of the revised gateway determination (Department of Planning and Environment 2018) for the proposed Parkwood development. Meetings with the NSW Rural Fire Service (RFS), Yass Valley Council and the Department of Planning and Environment in 2018 have agreed upon a framework for the Study.

This document addresses the minimum components of a Study listed in Table 4.2.1 and bushfire protection measures identified in the Pre-release Planning for Bushfire Protection (PBP 2018) as well as additional matters raised by the NSW RFS (Ref: r18/238, 24.7.18).

The Study examined the bushfire risk, particularly at a landscape scale and the feasibility of providing best practice bushfire protection measures as part of the land use planning. It was found that the proposal has the capacity to exceed the bushfire strategic planning principles and assessment requirements of PBP 2018, and it will achieve this with ongoing advice from the CSIRO and a proactive approach to bushfire design preceding each Stage of the development. Notable elements of the Study supporting this finding are:

- The development footprint is advantageous in a landscape context as it is east of a potential major fire control line (Murrumbidgee River).
- Landscape scale bushfire from the highest risk directions (west and north-west) must first burn downhill and cross the Murrumbidgee River.
- Any landscape fire not controlled on the River will enter the Conservation Corridor where the fuel management will be reliably implemented by the funding arrangements proposed for the Management Trust.
- All PBP 2018 required bushfire protection measures can unquestionably be accommodated within the large development footprint.
- Capacity exists to enhance the bushfire protection measures through the staged implementation of development and long timeframes for the development as research, technology and policy standards improve community resilience to bushfire.
- The large development footprint can ensure the more vulnerable in the community are in the safest bushfire locations.
- The large development footprint enables all major egress roads to be located where there is no risk of impact by bushfire.
- Traffic studies demonstrate evacuation beyond the development is very efficient and capable of meeting the bushfire response needs.
- Radiant heat modelling shows that the vast majority of the future development footprint will be Bushfire Attack Level (BAL) LOW (i.e. not bushfire prone land).
- Neighbourhood Safer Places can be strategically located to ensure 'out of area' evacuation is not required.
- Landscape design controls across the development footprint will further reduce the bushfire attack potential, particularly from burning debris.

The Study addresses all the components, measures and matters requested and show that the proposed development can achieve compliance with the requirements of PBP 2018.

1 Introduction

1.1 Background

The Parkwood Planning Proposal included a report entitled "Parkwood Planning Proposal, Bushfire Management Strategy, Ginninderry Project" (ELA 2017) which included findings from the masterplan bushfire assessment "The West Belconnen Project, Bushfire Management Project" (ELA 2014).

Subsequent to these bushfire assessments a Strategic Bush Fire Study (the Study) was required as a condition of the revised gateway determination (Department of Planning and Environment 2018). Meetings with the NSW Rural Fire Service (RFS), Yass Valley Council and the Department of Planning and Environment in 2018 have agreed upon a framework for the Study.

The minimum components of a Study listed in Table 4.2.1 and bushfire protection measures identified in the Pre-release Planning for Bushfire Protection (PBP 2018) have been provided herein with additional information where necessary to detail the combination of measures proposed for the development. This includes guidance from the CSIRO (Justin Leonard) to enhance and complement the bushfire protection measures within PBP 2018.

The Study also responds to the following matters raised by the NSW RFS (Ref: r18/238, 24.7.18):

- *the impacts of the development within the landscape context e.g. landscape assessment which considers the requirements for bush fire risk management in the landscape and the impact on biodiversity in the implementation if these risk management mechanisms); and*
- *identification of an indicative road network layout, details of access points and integration with the existing traffic network on roads external to the site (note: the management of emergency evacuation and management of traffic in a bush fire emergency should inform the road network); and*
- *the identification of areas of limited and/or no residential development potential.*

The contents of the study provide detail to address all the components, measures and matters requested and show that the proposed development complies with the requirements of PBP 2018.

1.2 Planning process

The Planning Proposal recommend the inclusion of a specific provision into the new Local Environmental Plan (LEP) for urban release land (i.e. all land outside of the conservation corridor). This provision specified that development cannot commence until a Development Control Plan (DCP) and subsequent neighbourhood structure plan have been prepared. The objective of this clause is to ensure that development in Parkwood occurs in a logical manner, in accordance with a staging plan. The clause of the LEP required that the preparation of a DCP will include specific controls that will apply to the form and layout of development across the site, including bushfire requirements to ensure protection and management issues are identified through land use planning to provide a more bushfire resilient community.

1.3 Aims and Objectives

The Study is to provide an assessment of the landscape bushfire risk and the residual risk for development following the provision of bushfire protection measures compliant with PBP 2018 and to provide principles to guide future Bushfire Risk Management Plans (BRMPs). It is to include the strategic assessment considerations in PBP 2018, being as follows:

- ensuring land is suitable for development in the context of bush fire risk;
- ensuring new development on BFPL will comply with PBP 2018;
- minimising reliance on performance-based solutions;
- providing infrastructure associated with emergency evacuation and firefighting operations; and
- facilitating appropriate ongoing land management practices.

1.4 Study Area

The Parkwood planning proposal is in NSW (see **Figure 1**) and forms part of the Ginninderry Project with adjoining land at West Belconnen in the ACT. It will include residential and related uses, roads, streets, retailing and employment, open space, community, school and recreation facilities, wetlands and waterways. The Ginninderry Project includes a contiguous conservation corridor along the Murrumbidgee River and Ginninderra Creek. The notional staging plan for the Ginninderry Project includes 29 Stages with owner occupation to commence in the ACT (Stage 1A) in 2020 and development to continue until 2055.

In NSW approximately 213ha, or 35% of the total 600ha, is proposed for inclusion in the conservation corridor along the Murrumbidgee River and Ginninderra Creek corridors. The balance of land, 387 ha is anticipated to yield up to 5,189 dwellings and forms the Parkwood Planning Proposal.

Of the total area of 889ha in the ACT approximately 371ha or 42% is proposed to be zoned for river corridor or conservation purposes – the proposed "conservation corridor". The balance of the land is anticipated to yield up to 6,053 dwellings.

The Study Area includes analysis of risk data within 10 kms of the site of the development proposal (**Figure 2 - Figure 7**).

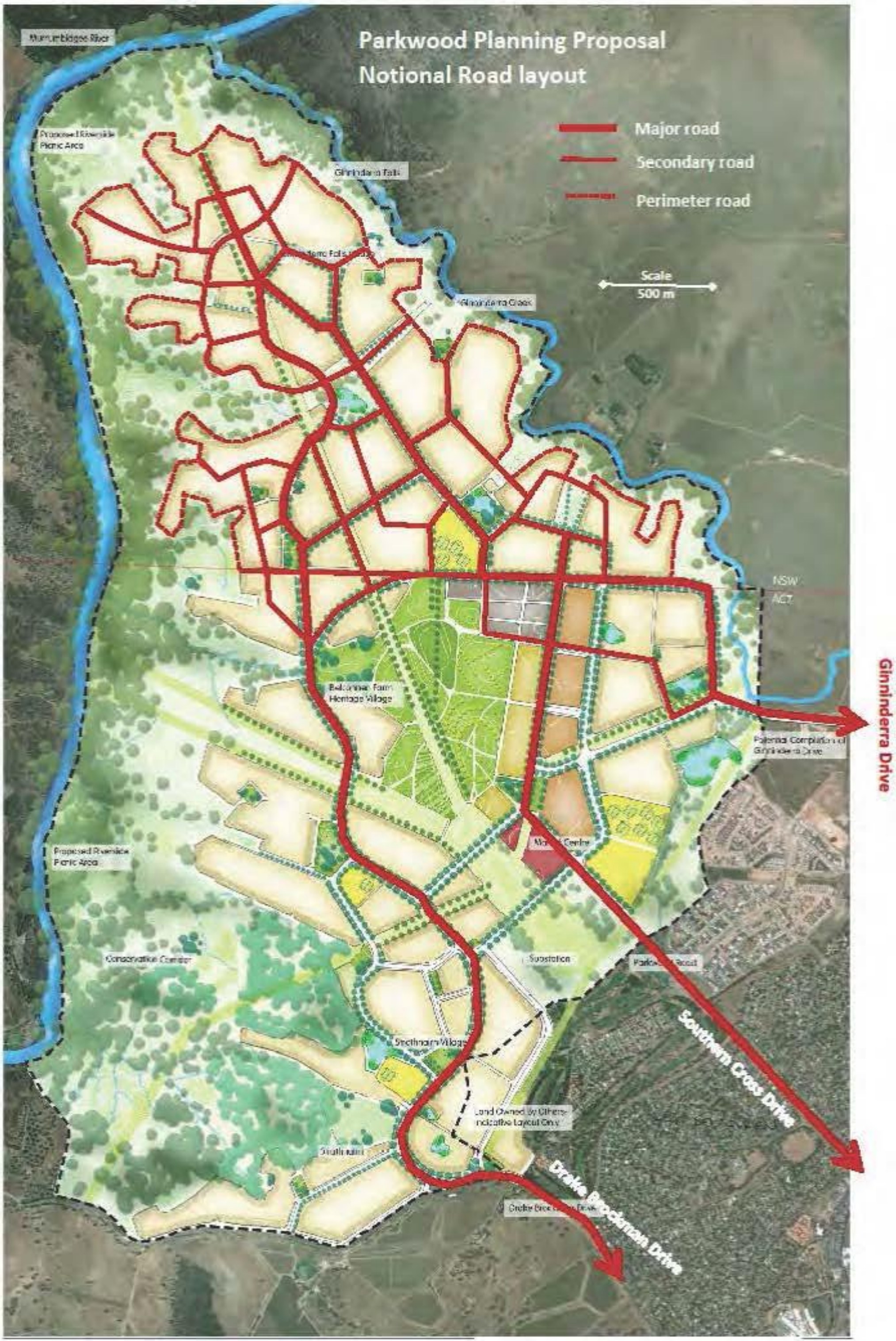

Figure 1: Parkwood Masterplan (Indicative Layout)

2 Bushfire Landscape Risk Assessment

The assessment of landscape bushfire risk includes an analysis in the subsequent sections of bushfire hazard, potential fire behaviour and bushfire history within at least a 10 kilometre radius of the Parkwood Development site. It does not consider the bushfire protection measures or bushfire mitigation activities proposed as part of the development or currently in place (e.g. reduced fire risk from grazing of surrounding lands).

2.1 Bushfire Hazard

Bushfire hazard has been classified using vegetation, slope and weather data for the study area.

The Planning Proposal is within a wider landscape of bushfire prone land (**Figure 7**). The pattern of bushfire hazard is extensive enough and continuous enough to support larger sized bushfires, although fire history for the regions indicated this is of a very low frequency (see **Section 2.3**).

Approximately one third of the Proposal's development perimeter abuts non-bushfire prone land, i.e. to the south and south-east associated with existing urban areas and new urban areas under the Ginninderry Project (see **Figure 7**).

To the north, west and south-west are predominately rural lands dissected by river valleys with expanses of livestock grazing and nature conservation areas. The rural lands are generally undulating with grassland and grassy woodland vegetation predominating whereas the incised valleys contain mostly forest vegetation. An analysis of the landscape patterns of vegetation are provided in Section 2.1.1.

To the north-east are predominately rural lands used predominately for livestock grazing with a scattering of small villages.

2.1.1 Vegetation

The proposal is within a landscape comprised predominantly of grassy woodlands and grasslands, much of which has been altered by grazing. Smaller areas of forest, heathlands and riparian vegetation occur nearer the site of the proposal with larger forested areas 5 kms or more to the west (see **Figure 2** and **Figure 3**). The spatial extent and continuity of these vegetation patterns is sufficient to carry fires over extended distances (many kilometres) and potentially as part of broad area fires.

Vegetation has been classified into Keith Formations and Keith Class (Keith 2004) and assigned a potential total fuel load (tonnes / hectare) using Table A1.2.8 from PBP (RFS 2018). **Figure 2** and **Table 1** show the vegetation and a line indicative of the extent of proposed development. This line is colour coded according to the vegetation classification used in determining the Asset Protection Zones (APZ) required.

Low hazard vegetation (as classified under AS 3959-2009) is proposed within the various 'internal green areas' (See **Figure 1**) and will be a mix of urban agriculture, greenhouses and parkland.

Table 1: Vegetation formation, class and fuel allocation for the study area

Vegetation formation	Keith Class	Overall fuel including bark and canopy (t/ha)*
Forest (Shrubby and Grassy	Southern Tableland Dry Sclerophyll Forests	36.1
Woodland (grassy and woody)	Southern Tablelands Grassy Woodland	20.2
Short heath	Southern Montane Heath	15.0
Grasslands	Temperate Montane Grasslands	6.0

*Overall fuel load including Bark and Canopy from Table A1.12.8 from PBP (RFS 2018)

2.1.2 Topography and slope

Figure 4 shows that the proposed development is located on higher ground to the east of the Murrumbidgee River valley. Landscape spread of fires may be slowed by downhill spread into the River, and the River may be an effective control line under some circumstances. In other circumstances where the fire crosses the River it has an uphill spread toward the proposed development with potential for an increase in rate of spread and fire intensity.

The uphill fire-run portion of the landscape is predominantly within the conservation corridor and will be managed by the proposed Conservation Corridor Management Trust under a Bushfire Management Plan that will form part of the regions Bushfire Risk Management Plan. A spatial and temporal pattern of burning is proposed within the corridor for conservation of biota and mitigation of wildfires (see **Section 5**).

Slope has been classified from a 10 m grid cell Digital Elevation Model (DEM) into the following slope classes (as per PBP):

- Upslope and flat;
- >0° – 5° downslope;
- >5° – 10° downslope;
- >10° – 15° downslope;
- >15° – 18° downslope;
- >18° downslope.

The landscape-wide slope is shown in **Figure 5** with greater detail shown in **Figure 6** which includes the PBP slope used in determining the APZ shown along an indicative edge of the proposed development.

Whilst steeper slopes occur along the river corridor, the slopes abutting most of the development and within the low hazard 'internal green fingers' are typically gentle. Steeper slopes in the river corridor will contribute to the development of bushfire intensity, particularly with fire approaching from the west and north-west. Management actions to address these areas will for part of the Bushfire Management Plan discussed above.

2.1.3 Bushfire Weather

The bushfire season usually commences on 1 October and runs through until 31 March unless conditions warrant an extension. The ACT and surrounding district has a relatively dry, continental climate with warm to hot summers and cool to cold winters (ACT Government 2015). The average annual rainfall in Canberra is 629 mm with an average of 108 rain days per year, varying considerably with heavier falls occurring in the ranges to the west of the city and less to the east (ACT Government 2015). January is the hottest month, with an average of 10 days above 30ºC and two days exceeding 35ºC (ACT Government 2015). Relative humidity in summer is typically around 37 – 40 %, while there is an average of 25 days of strong winds (predominantly from the north-west) per year (ACT Government 2015). Winds from the north-west have the highest Forest Fire Danger Index (FFDI) at Canberra airport, the closest station to the subject site.

Climate change

Climate change projections by the CSIRO and Bureau of Meteorology (BoM) (2019) for the Murray Basin forecasts late in the century (2090), less rainfall during the cool season with rainfall unchanged in the warm season. For the nearer future natural variability is predicted to dominate any projected changes.

In relation to temperature projections, for the near future (2030), the annually averaged warming across all emission scenarios is projected to be around 0.6 to 1.3 °C above the climate of 1986–2005. By late in the century (2090), the projected range of warming is 1.3 to 2.4 °C for an intermediate emissions scenario and 2.7 to 4.5 °C under a high emissions scenario (CSIRO and BoM, 2019).

The projected changes are likely to result in a harsher fire-weather climate linked to rainfall and seasonal variation. Enhanced summer rainfall in some scenarios could moderate the number of severe fire weather days (CSIRO and BoM, 2019).

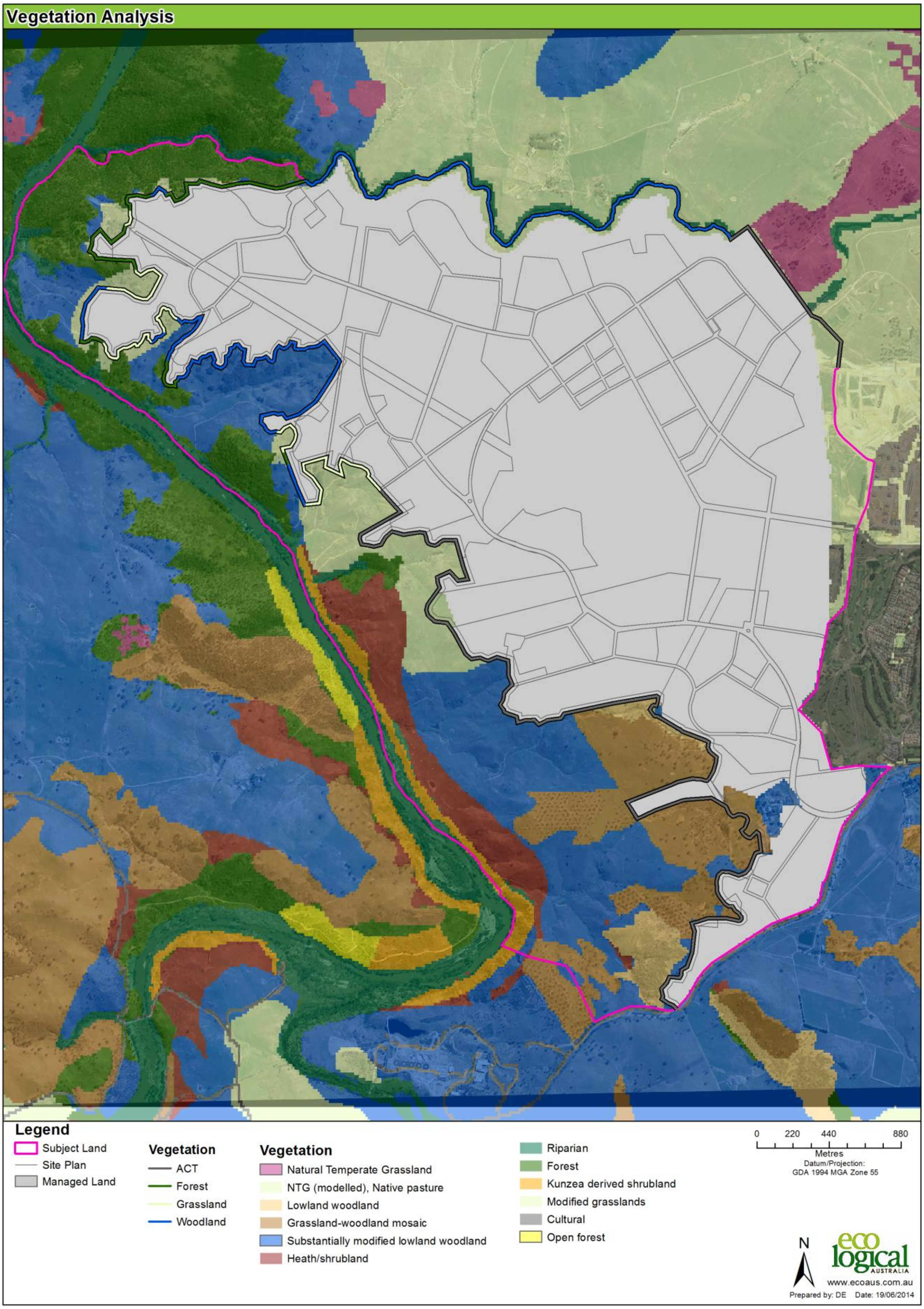

Figure 2: Vegetation Assessment

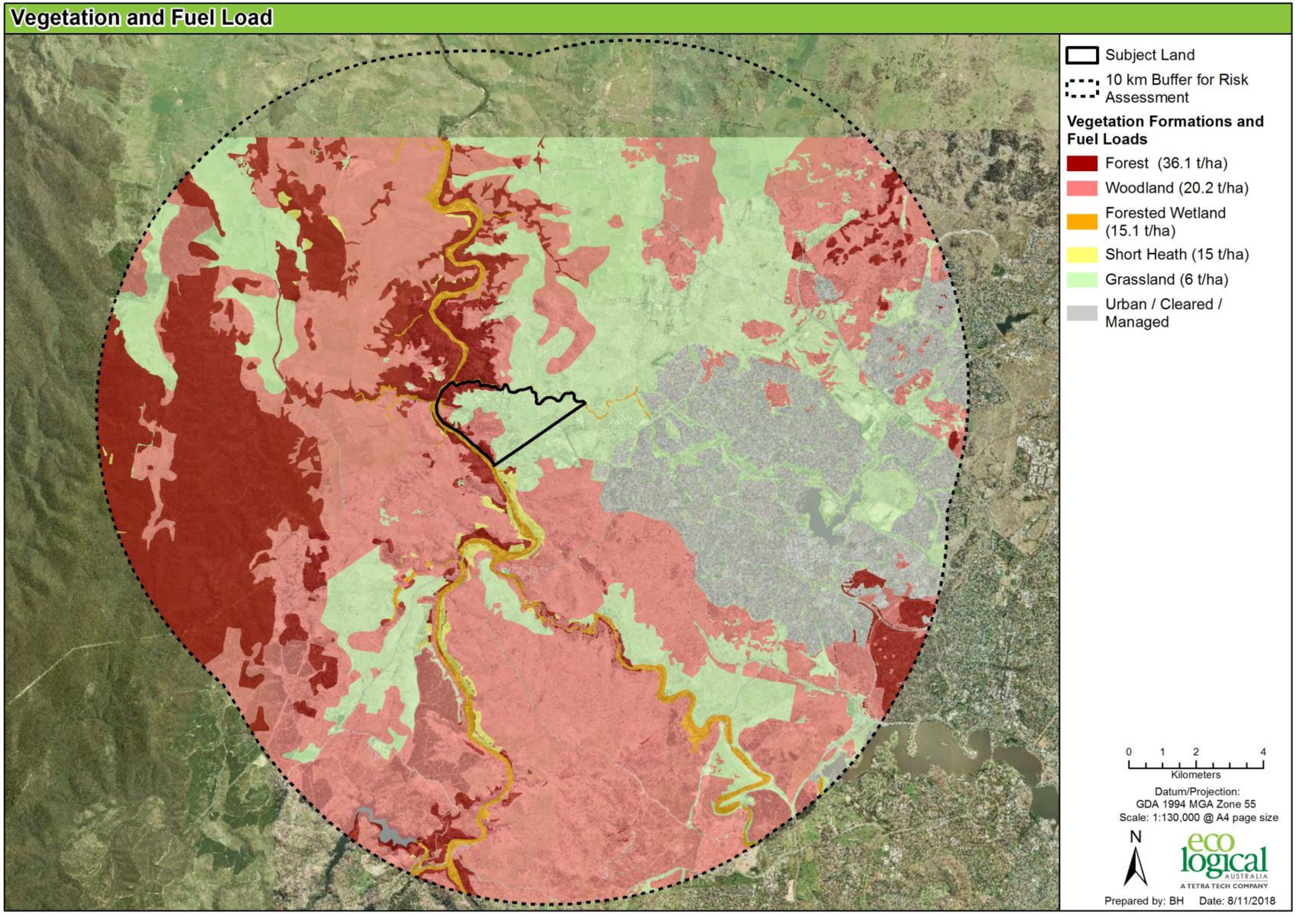

Figure 3: Vegetation formation / fuel classification of Parkwood & surrounding landscape

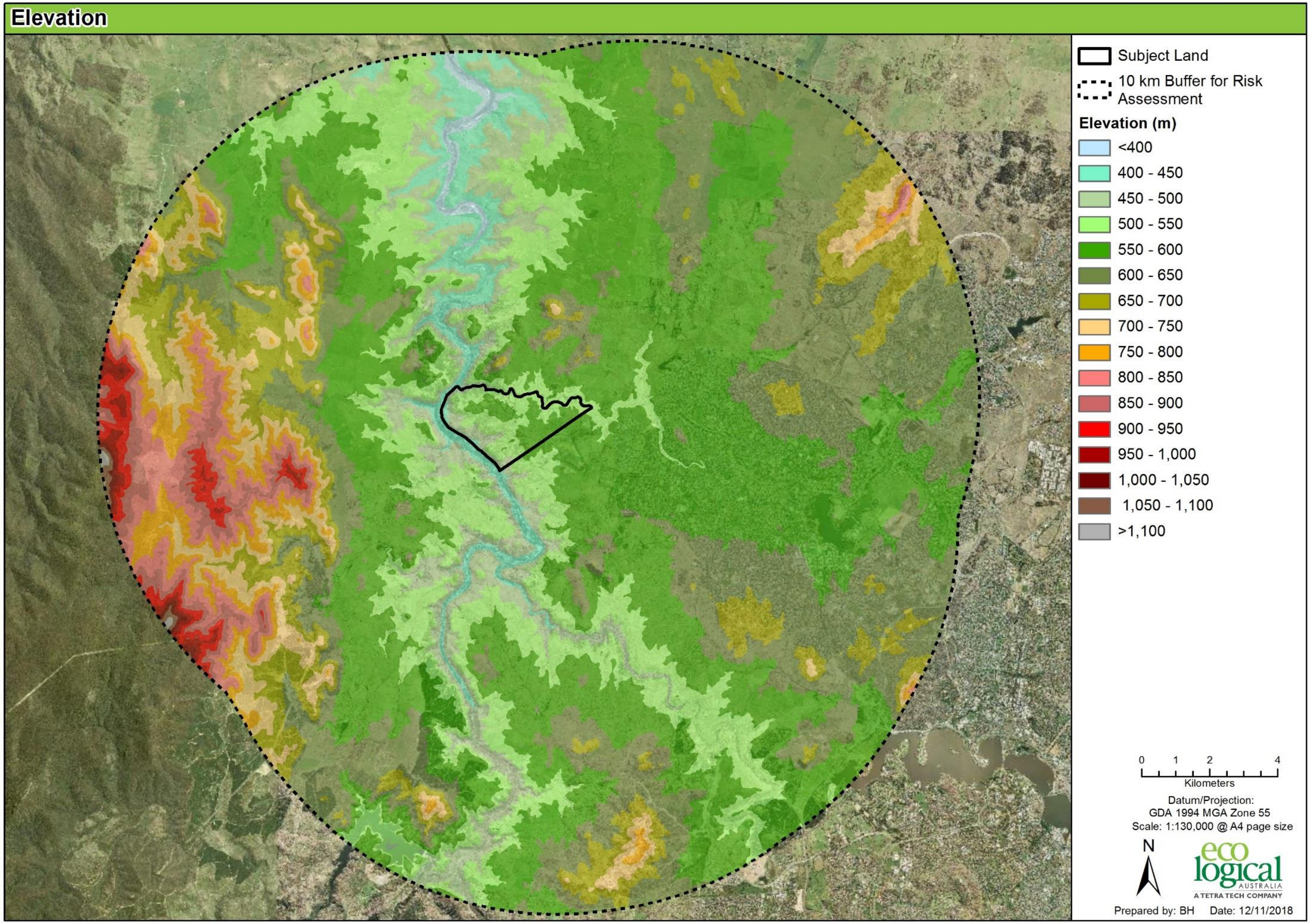

Figure 4: Elevation of Parkwood & surrounding landscape

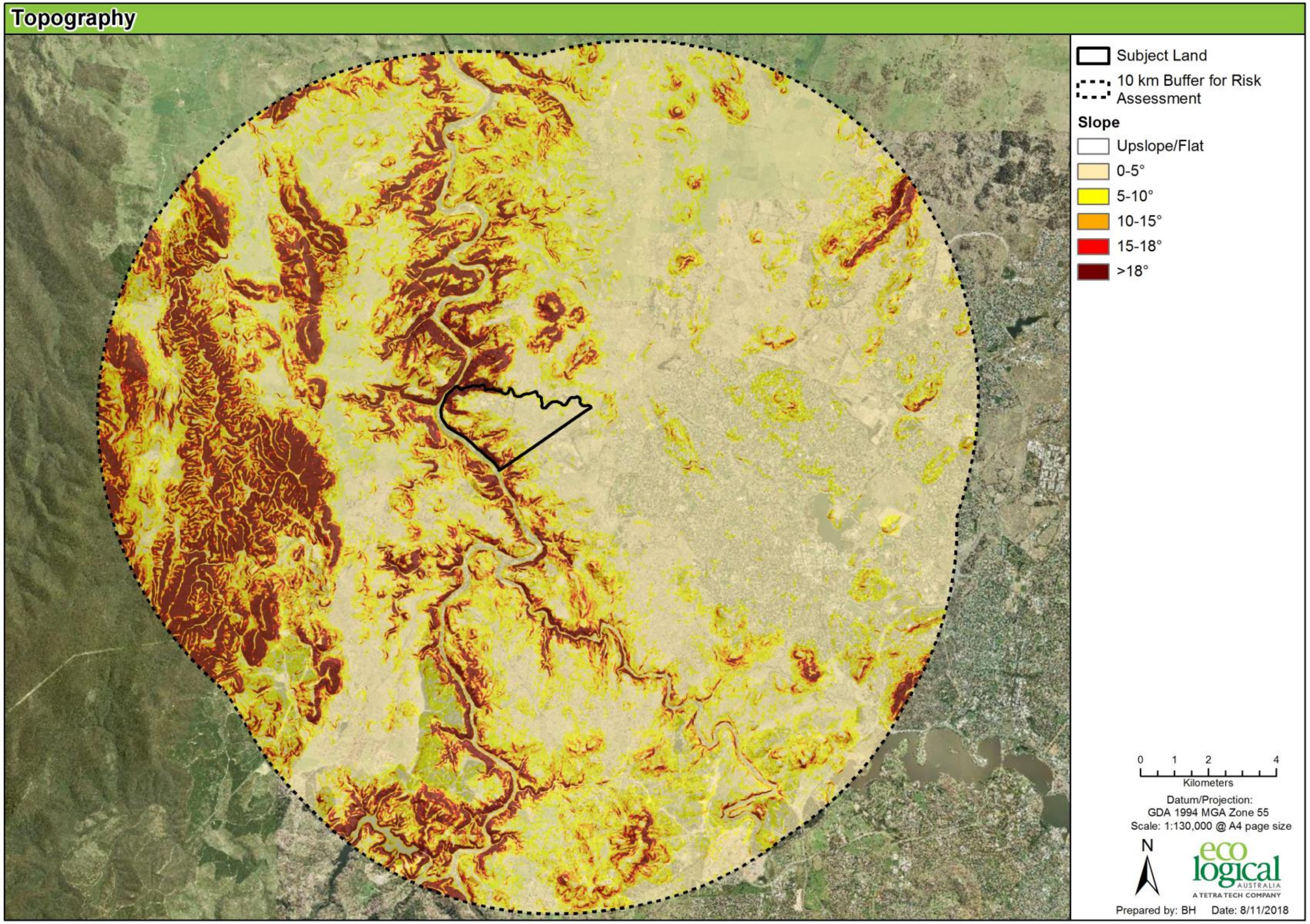

Figure 5: Slope of Parkwood & surrounding landscape

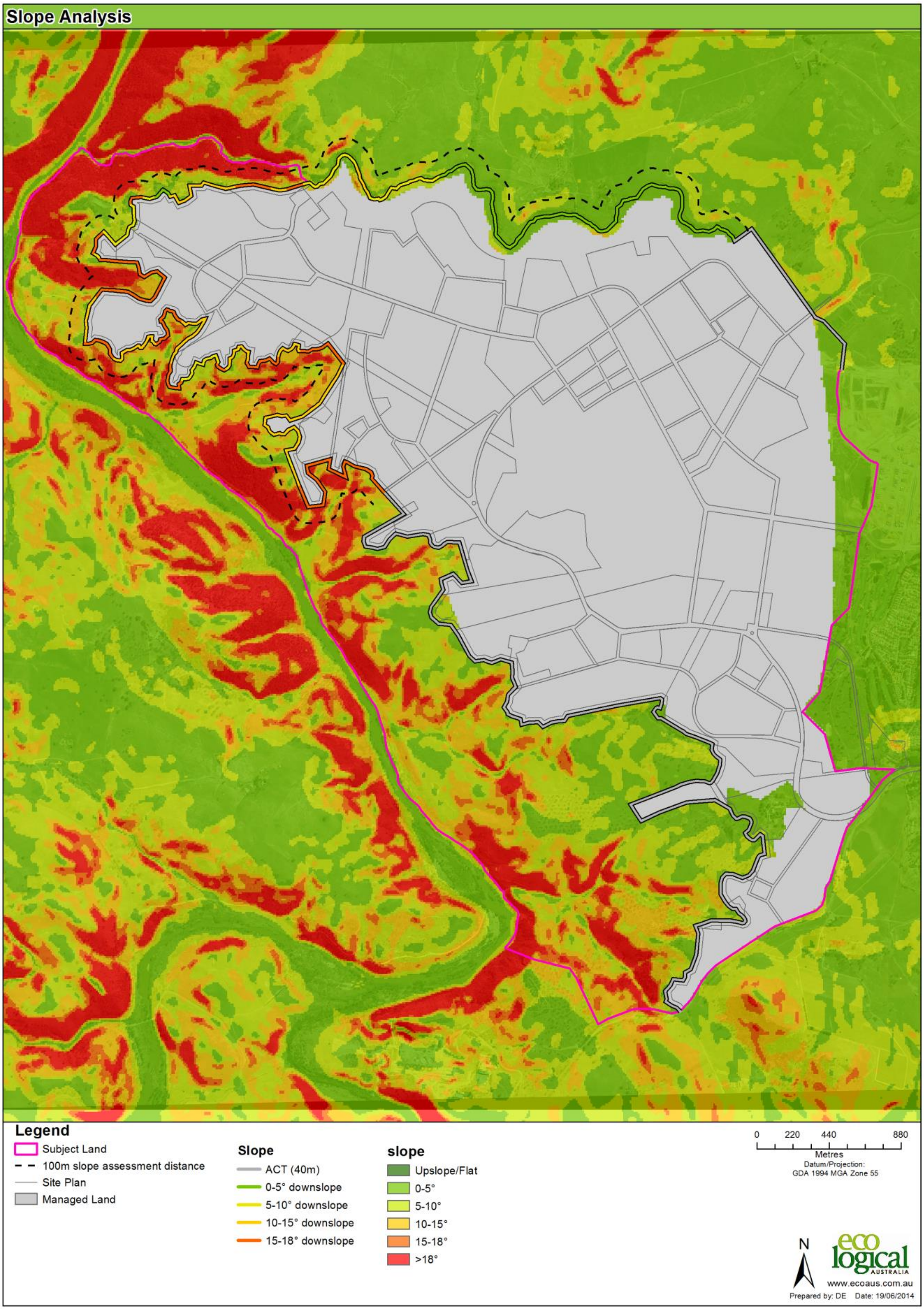

Figure 6: Slope assessment

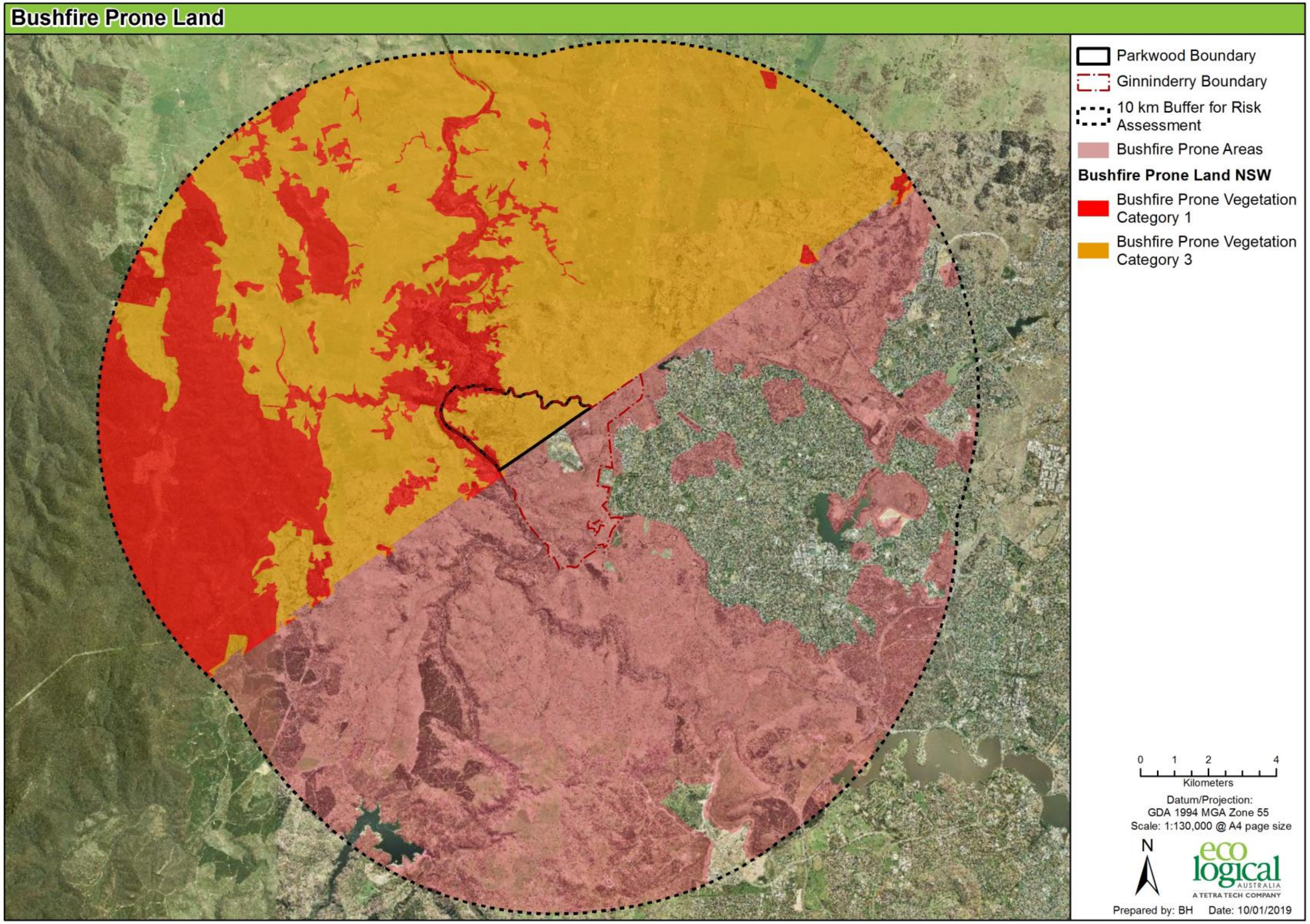

Figure 7: Current Bush Fire Prone Land Map within the Parkwood & surrounding landscape

2.2 Potential Fire Behaviour

Bushfire intensity prediction models have been used to review major bushfire potential from various directions and included the following inputs:

- Fuel (vegetation) - Section 2.1.1;
- Terrain (slope and aspect) - Section 2.1.2;
- Bushfire weather including the Fire Danger Index (FDI) and direction of travel - Section 2.1.3.

The potential head fire intensity was modelled using fire intensity formulae of Cheney et al 2012 (for Forest and Woodland), Anderson et al 2015 (for Heath and Shrubland), and Cheney et al 1998 (for Grassland). **Figure 8** shows the modelled fire intensity under a bushfire attack from the north to south-west direction at FDI 100, the direction from which fire history and weather data suggests is the greatest risk.

The highest intensities are predicted on the forested western facing slopes; and these occur in nearby conservation areas to the north and west and within steeper, forested portions of the river valley. Areas to the north-east to south-east may carry serious fires but these are likely to be less often and at relatively lower intensities. Although grasslands within the study area typically do not carry fires with the intensity of forests they may provide a higher risk of ignition and rate of spread.

Figure 8 and the models used to produce it do not consider ignition risk or identify the rate of spread of a bushfire. The intensity modelling also does not identify the potential for extreme fire behaviour such as spotting/fire storm, fire tornado/whirls, lateral vortices, junction zones (Jump fires), eruptive fires; conflagrations, downbursts or pyro-convective events. Notwithstanding these limitations **Figure 8** helps identify potential fire pathways and where fire intensities are likely to be lower (e.g. <4,000 kW/m, which is generally considered the limit of fire control).

2.2.1 Dynamic fire propagation

There is increasing evidence that fire propagation can be significantly affected by dynamic feedback processes that result in the continual escalation of fire spread rates and intensities even when environmental conditions are consistent (e.g. eruptive fire behaviour (EFB) and vorticity-driven lateral spread (VLS) (Duff et al 2016). Dynamic fire propagation arises from complex interactions between the terrain, the atmosphere and the fire.

While several advances have been made in understanding bushfire development under extreme conditions, these have not been quantified in a manner that is suitable for inclusion in a fire behaviour modelling framework (Duff et al 2016). Therefore, a precautionary approach has been taken in considering dynamic fire propagation in term of the subject site, including identifying areas that may have the required environmental conditions for VLS and EFB based on published works and discussions with Associate Professor Jason Sharples.

2.2.1.1 Vorticity-driven lateral spread

Several environmental conditions need to be satisfied for VLS to occur, including slope, aspect, wind speeds and fuel loads. Sharples et al. (2013) demonstrated the existence of a threshold in the background wind speed for VLS of greater than 20 km/hour. Sharples et al. (2012) found that there were thresholds in the terrain slope and wind direction relative to the terrain aspect for VLS events in the 2003 Canberra bushfires. While further research is needed to explore the sensitivity of VLS to additional aspects of the fire environment, research to date indicates the fuel type and load required for VLS is heavy (forest) fuels

15 – 20 t/ha, the terrain slope is greater than 20 – 25 degrees, and aspect of the lee slope in relation to wind direction is within 30 – 40 degrees of the wind. An improved understanding of these environmental thresholds will facilitate improved operational predictability of VLS (Simpson et al 2014).

Based on the environmental conditions identified above, an analysis of the area surrounding the proposed development to identify areas prone to VLS was undertaken using the following parameters and shown in **Figure 9**:

- Slopes >= 20°
- Aspect >= 95 & <= 175 (based on prevailing wind direction)
- Fuel >= 15 t/ha

The analysis shows that the nearest occurrence of a VLS prone site is approximately 205 m from the proposed APZ commencing at the public reserve boundary which further separates buildings from such potential fire behaviour. Development of the Stage closest to the potential VLS prone site (Stage 25) is indicatively in 2044.

2.2.1.2 Eruptive fire behaviour

EFB is described as a sudden intensification and acceleration of burning with high energy release. These phenomena create their own wind patterns that can be strong enough to uproot trees and loft embers (Blanchi et al 2011). Viegas and Simeoni (2011) identified that EFB is more likely to occur on steep slopes and especially in canyons, and that the mechanisms that could explain EFB are linked to external conditions (change in wind intensity and direction, development of thermal belt and instability above the fire) and the individual characteristics of the fire (convective feedback from the fire, a flow attachment, gas accumulation or spotting).

Based on research and discussions with Associate Professor Jason Sharples, an analysis of the area surrounding the subject land to identify sites prone to EFB was undertaken using the following parameters and shown in **Figure 10**:

- Slopes > 24°
- Aspect >= 275 & <= 355.

The nearest occurrence of an EFB prone site is approximately 68 m from the APZ commencing at the public reserve boundary of the proposed development. Development of the Stage closest to the potential VLS prone site (Stage 25) is indicatively in 2044.

In recognition of the potential EFB and VLS and acknowledgement that burning debris may extend well beyond 100 m the minimum construction standard within the proposed development is to be Bushfire Attack Level (BAL) 12.5 and best practice landscaping design for bushfire prone areas will apply. As the proposed development is likely to occur from 2044 onwards, advances in bushfire protection and research are readily able to be incorporated into more detailed designs and go through its own approval process. At this Planning Proposal stage it is evident that the very large development footprint allows for best practice bushfire protection measures to be included.

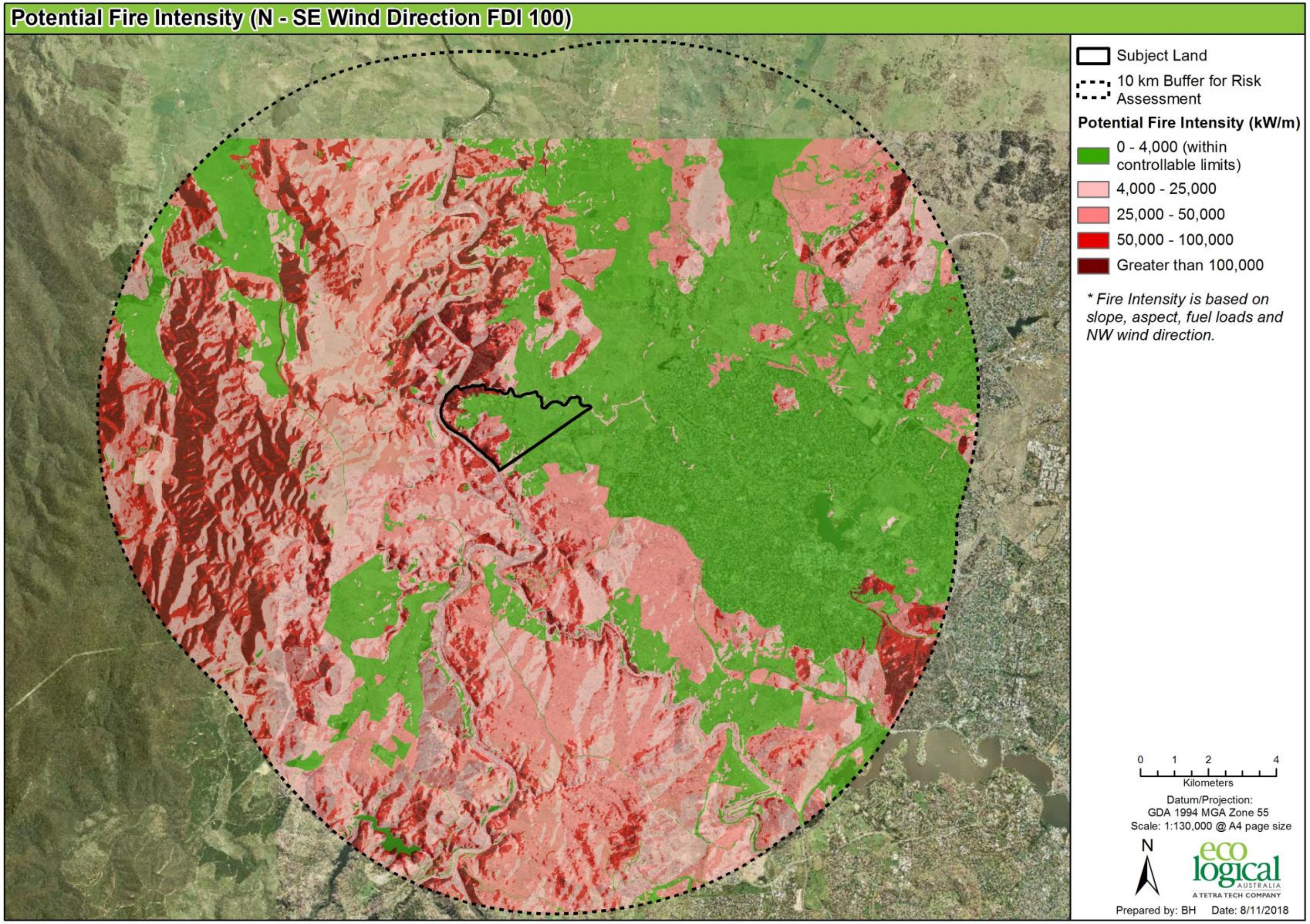

Figure 8: Potential Fire Intensity across the study area (north to south-east wind, FDI 100)

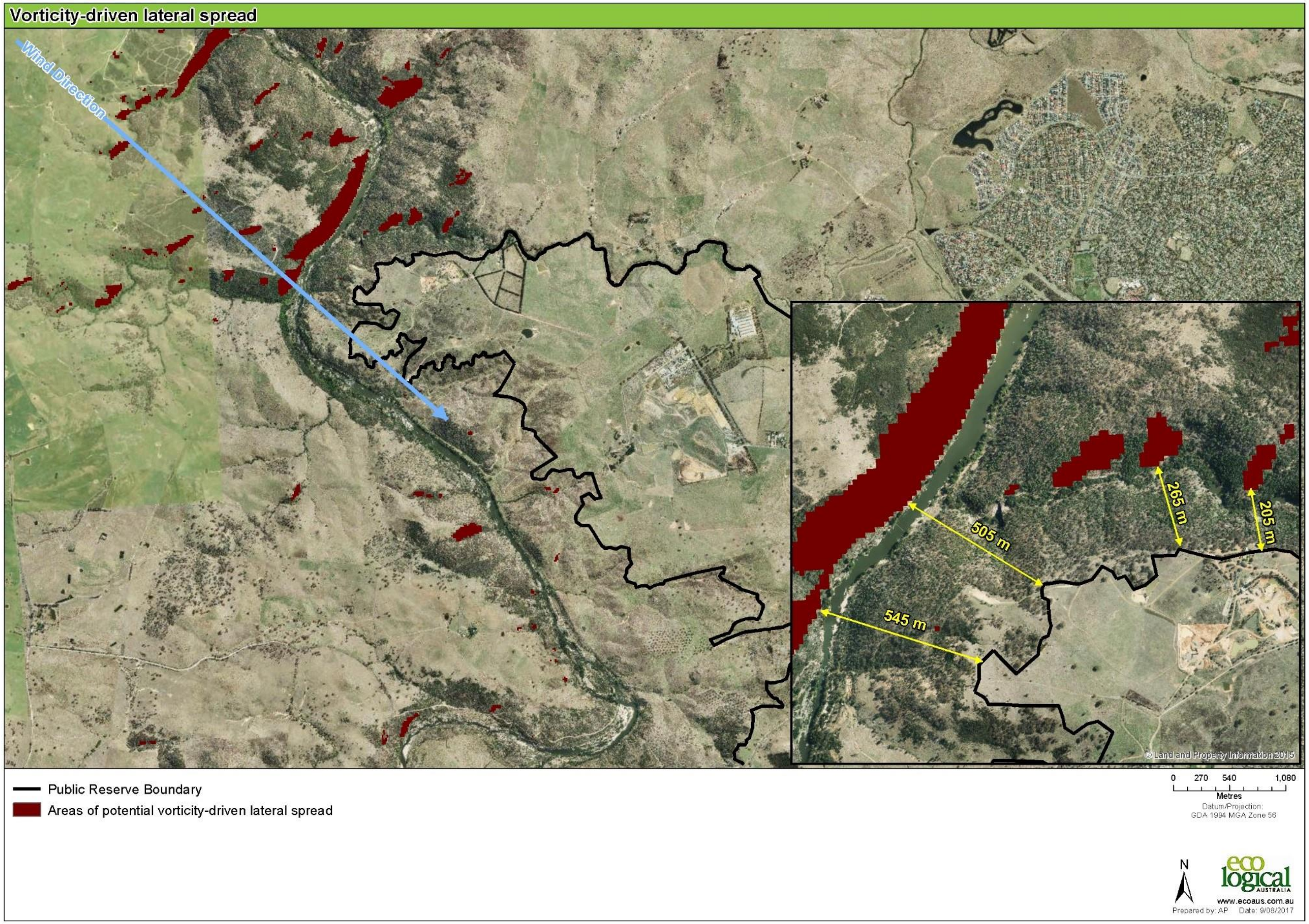

Figure 9: Potential areas of vorticity driven lateral spread

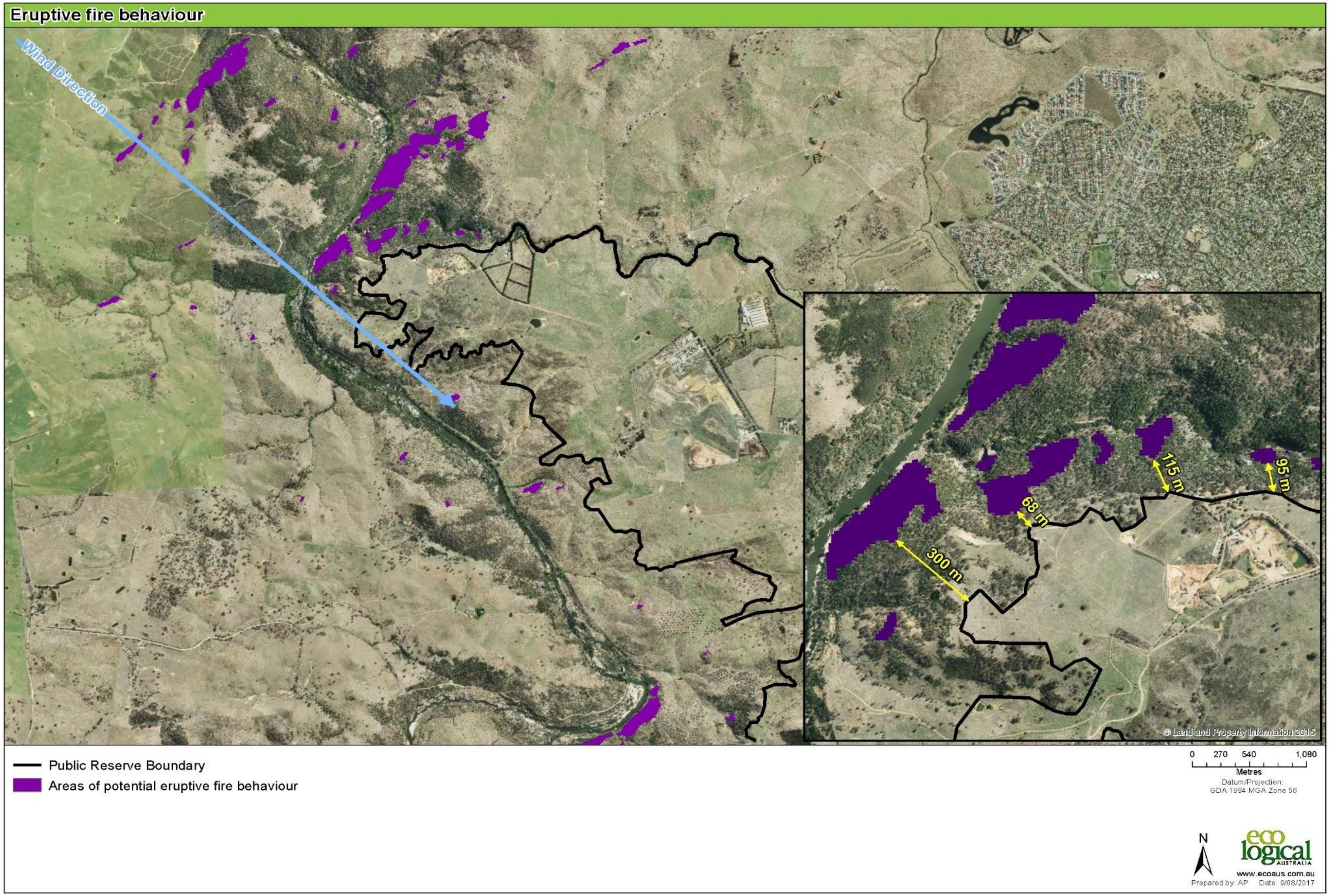

Figure 10: Potential areas of eruptive fire behaviour

2.3 Bushfire History

The Southern Tablelands BRMP (BFMC 2009) identifies the southern tablelands bushfire history as:

- *Major fires occur sporadically with about 3 in a 5 year period…Yass valley has a 2.5 year cycle of major fires.*
- *The main sources of ignition in the Southern Tablelands Zone BFMC area are:*
    - *Lightning strikes associated with late spring and summer thunderstorm activity*
    - *Ignition caused by human error (farm machinery, mowers, welding, cigarette butts on major highways)*
    - *Arson has not tended to be a major concern in many parts of the Zone although it is of concern in urban areas and around rubbish tips*

The ACT Government (2015) identified large bushfires as occurring in the Parkwood region in 1925 -26; 1938-39; 1978 -79 and 2002-03. These fires were associated with larger fire events across the region at those times. The total number of unplanned fires in the ACT between 2004 – 05 and 2013 – 14 was 2629. The average fires occurring each year was 262.9, with 255.5 of these less than a hectare in size (ACT Government 2015).

Overall the risk of ignition from human activity is low, with ignition from lightning a moderate risk. The network of fire towers in the ACT means that any lightning ignitions are detected quickly.

Summary of fire history findings

It is probable based upon the ACT data that a similar pattern can be expected i.e. <1% of fires >1ha and there is at least a 25-year large fire recurrence period. The likelihood of a major fire attack specifically on the proposed development is very low and infrequent.

2.4 Potential fire spread patterns

Eight design fire simulations (from the four highest risk directions) have been evaluated using the SPARK Wildfire Simulation Toolkit (CSIRO 2018, Miller et al. 2015) to compare potential speed of bushfire attack from various directions. There are many different fire attack scenarios that could be investigated by varying ignition points, weather conditions and fuel loads (e.g. altered by prescribed burning) however for a high level strategic study seeking otherwise unforeseen bushfire risks, those chosen are representative of the bushfire attack potential. The models do not include spot fire spread or dynamic fire propagation as these are not yet available within any modelling software. Fuel modification (e.g. from slashing, grazing, prescribed burning, trittering etc) has not been considered in the simulations thus providing conservative predictions that overstate the fire behaviour.

The rate of spread was modelled using Cheney et al (2012) for forests, Anderson et al (2015) for heath and shrublands and Cheney et al (1998) for grass dominated vegetation types (including grassy woodlands). The use of the rate of spread models was based on the identification of these as best practice models by Cruz et al 2015 in *A guide to rate of spread models for Australian vegetation*.

To facilitate comparison of fire attacks all fires were assumed to start at ignition points 10 kilometres from the proposed development with fire footprints plotted at 30 minute intervals over 4 hours. The data inputs to the models were:

- Weather as per **Table 2**
- Vegetation, as per Table 1 in Section **2.1.1**
- Fuel load, as per Table 1 in Section **2.1.1**
- Fuel hazard score for forest vegetation types

- Terrain, as per Section **2.1.2**
- Ignition Points, as **Table 2**

Table 2: Weather inputs and ignition points for the eight fire simulations

Ignition Point		Wind Direction	Wind variation (degrees)	FFDI	Weather Inputs			
Lat	Long				Temp (degrees)	RH (percent)	Win Speed (km/h)	Drought Factor (DF)
-35.1329	148.871	NW	10	99	37.4	8	48.2	9.7
-35.2083	148.832	W	10	95	36.2	10	51.8	9.5
-35.1124	148.911	NNW	10	69	38.2	9	37.1	8.9
-35.1072	148.96	N	10	34	36.1	9	16.6	7.5
-35.1329	148.871	NW	10	100	37.9	7.1	45	10
-35.2083	148.832	W	10	100	37.9	7.1	45	10
-35.1124	148.911	NNW	10	100	37.9	7.1	45	10
-35.1072	148.96	N	10	100	37.9	7.1	45	10

FFDI <100 are the highest FFDI recorded from Canberra AWS from 1972 to 2018 (Lucas 2010) for the four different wind directions used. The FFDI 100 simulations represent the acceptable solution FFDI in PBP.

The Regional Climate Modelling (NARCliM) project is a multi-agency research partnership between the NSW and ACT governments and the Climate Change Research Centre at the University of NSW. The NARCliM project has produced a suite of twelve regional climate projections for south-east Australia spanning the range of likely future changes in climate. Summary documents for each of the state planning regions of NSW are also available and provide climate change information specific to each region (NSW Office of Environment and Heritage and ACT Government, 2014). The snapshots provide descriptions of climate change projections for two future 20-year time periods: 2020–2039 and 2060–2079.

The Forest Fire Danger Index (FFDI) is used in NSW as the primary fire weather parameter for sites such as the Study Area. The FFDI combines observations of temperature, humidity and wind speed with an estimate of the fuel state. FFDI values below 12 indicate low to moderate fire weather, 12-25 high, 25-49 very high, 50-74 severe, 75-99 extreme and above 100 catastrophic. Long term FFDI estimates show average daily FFDI is 7 in Canberra. Both Canberra and the adjoining region have on average 1.1 days each year when the FFDI is severe or higher (i.e. FFDI≥50). The NARCLiM project has predicted the likely change in fire weather days with an FFDI≥50 that will occur as a consequence of the changing climate.

The Ginninderry project includes land in the ACT and "Parkwood" in NSW; NARCLiM climate projections are broken down on a regional basis across NSW and the ACT. The Ginninderry project area falls within the ACT and adjoining South East and Tablelands region. The projected additional number of fire weather days with FFDI≥50 are provided in **Table 3**.

Table 3: Projected changes to annual days with FFDI ≥50

Number of additional fire weather days with FFDI≥50		
	Near future (2020 – 2039)	Far future (2060-20790
Parkwood (South East and Tablelands region)	0.1	0.5
Ginninderry (ACT)	0.1	0.3
Ginninderry average	0.1	0.4

From this data it can be calculated that at Ginninderry, for the near future, the average number of severe fire weather days is likely to increase from 1.1 days per year to 1.2 days per year and in the far future to 1.5 days per year. Whilst any increase in the quantum of severe fire weather is a matter for concern these increases are not great and are able to be managed by the measures for fire management and protection that are proposed for Ginninderry.

Figure 11 – Figure 17 show the rate of spread predictions and are arranged with the predictions under the maximum recorded FFDI adjacent the FFDI 100 for each of the four wind directions assessed. A large difference in the fire arrival time between adjacent figures is indicative that the FFDI 100 design fire is unlikely to occur e.g. the design fires from the north have a fourfold difference, largely due to the grassland fuels in this area and the effect of winds on fire spread for grass fuels compared to the forest type fuels in other scenarios (**Figure 11** and **Figure 12**).

The simulations suggest the most rapid attack potential is from the north under FFDI 100, however, a fire burning under this FFDI from this direction is the least likely of all simulations (i.e. maximum recorded FFDI of 34 compared to FFDI of 100) and is considered unrealistic and not useful for risk evaluation. With the northern fire attack FFDI 100 simulation dismissed the most rapid fire-attack on the proposed development is (from highest to lowest) NW, NNW, W and N.

The simulations provide an indicative and relative fire-attack-time risk and may be useful for assessing evacuation routes and the location of neighbourhood safer places. Both the BALs and fire attack times will vary considerably dependent upon weather conditions, where the fire starts (i.e. ignition point) and initial response of emergency services. But unlike BALs, which are all managed to <29kW/m^2 through variations in the width of APZ, fire attack times are not altered by development design.

The fire attack times will also be useful in selecting the spatial and temporal pattern of prescribed burning for ecological purposes within the river corridor i.e. by the Conservation Corridor Management Trust. The aim of such burning is to provide a recent prescribed burn (of an appropriate size) in the path of a fire to reduce its rate of spread, as a result of the reduction of fuel loads for the burn area.

Prescribed burning is not essential for buildings to survive a bushfire attack and there is no evidence in the fire simulation data or the landscape risk analysis that prescribed burning beyond the river corridor needs to be relied upon to lower the fire attack time risk. If evacuations were to occur the fire simulations show that it is feasible for evacuees to move directly away from the on-coming fire and into nearby Neighbourhood Safer Places (NSPs) (see **Section 6.1**).

The design fire simulations show fires stopping at the future development footprint as the current vegetation is replaced by roads, APZ, buildings and other fuel free or fuel reduced areas. Additionally, fuel modification in the Conservation Corridor associated with ecological burning will decrease fire rates of spread and potential intensity, however this fuel modification is not included in the design fire simulations.

Fire history (see Section 2.3) suggests the most likely bushfire attack scenarios for the Parkwood development will be smaller, lower intensity fires starting either within or nearby its boundary. Smaller fires are easier to control and usually do not pose the same threat as landscape wide fires.

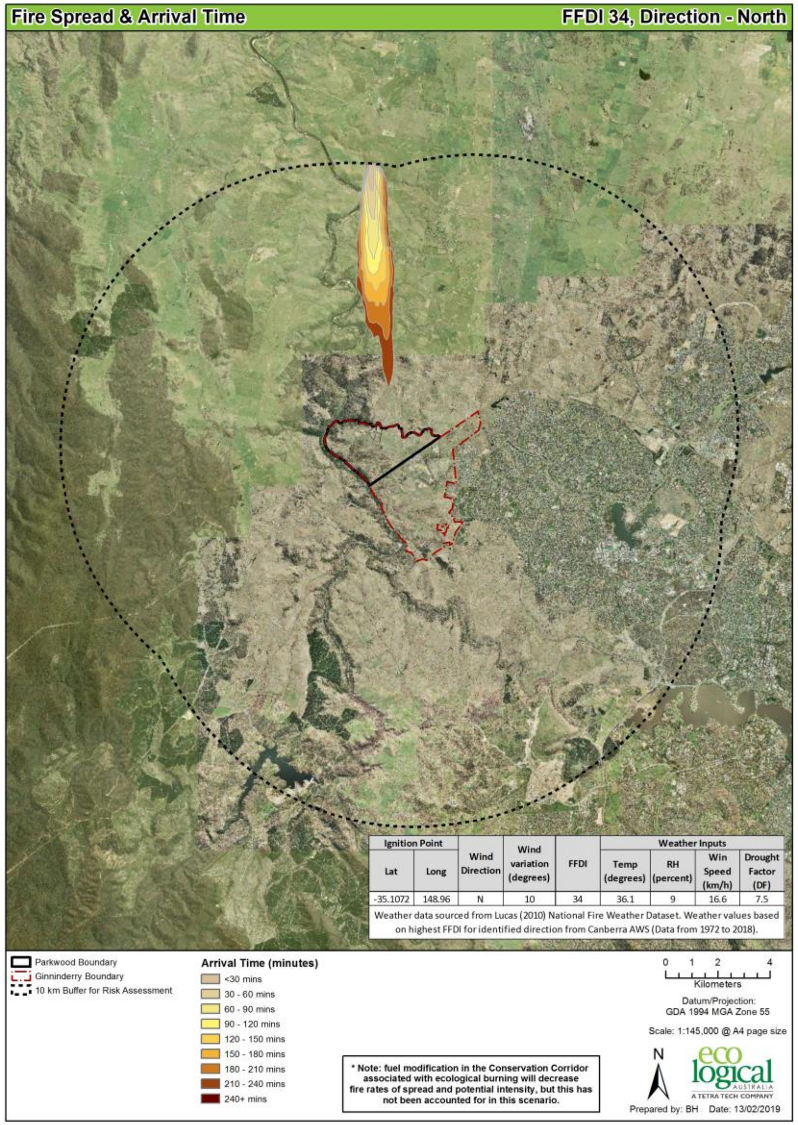

Figure 12: Potential fire spread under FFDI 34 and northerly winds

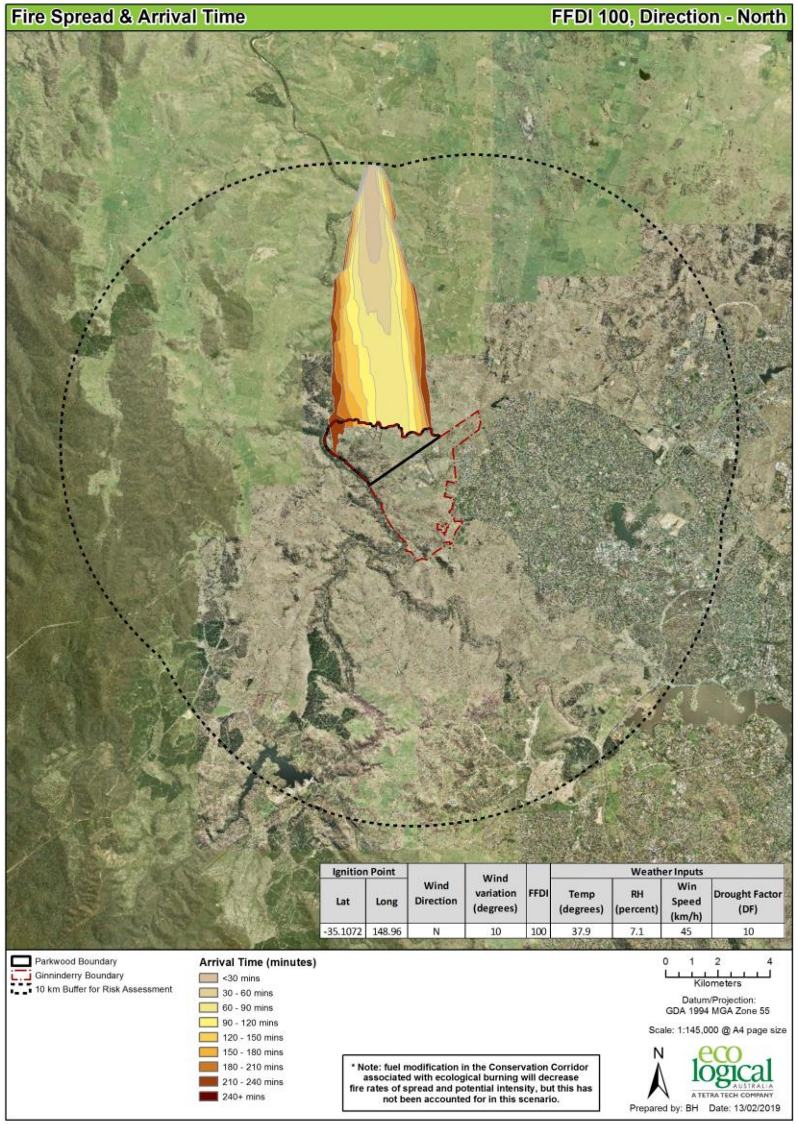

Figure 11: Potential fire spread under FFDI 100 and northerly winds

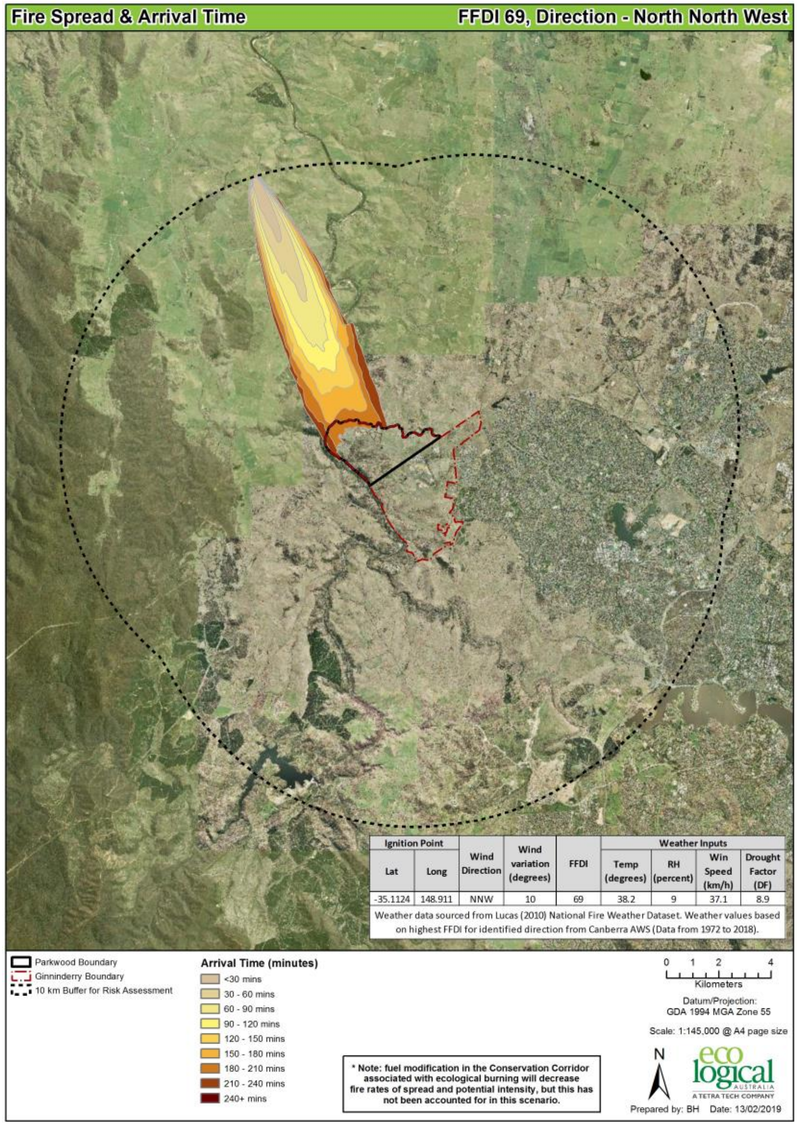

Figure 14: Potential fire spread under FFDI 69 and north north westerly winds

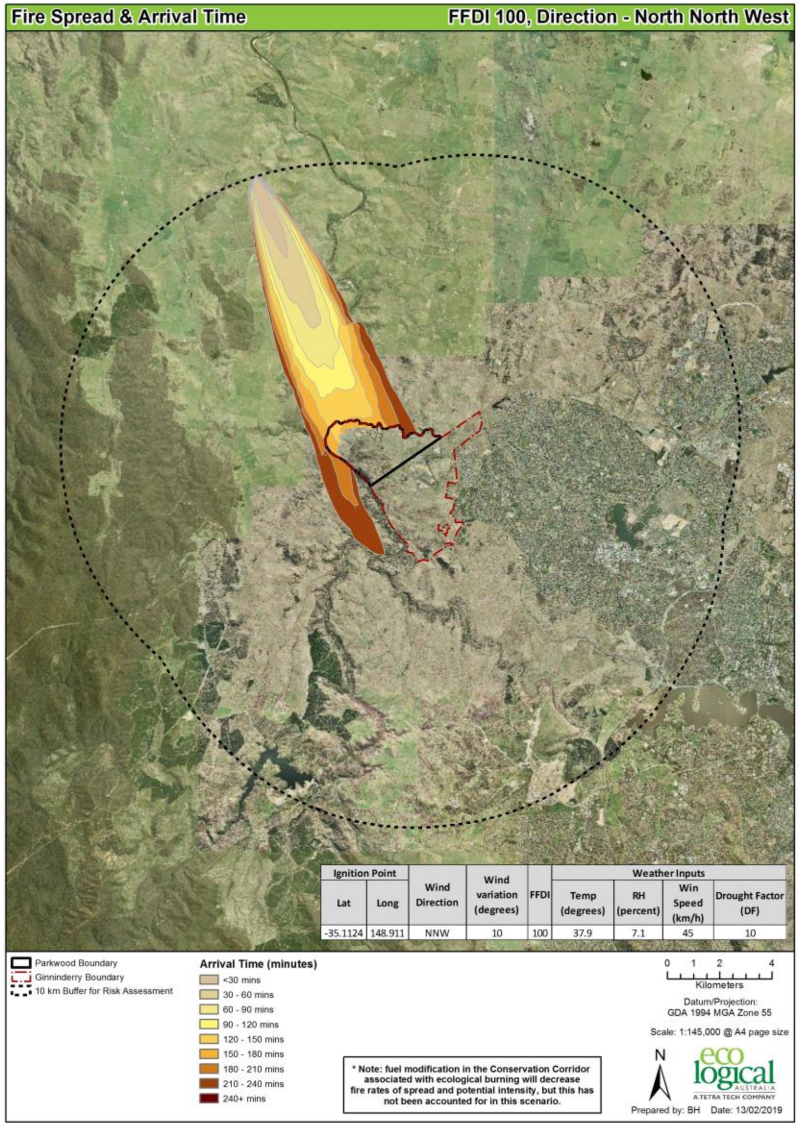

Figure 13: Potential fire spread under FFDI 100 and north north westerly winds

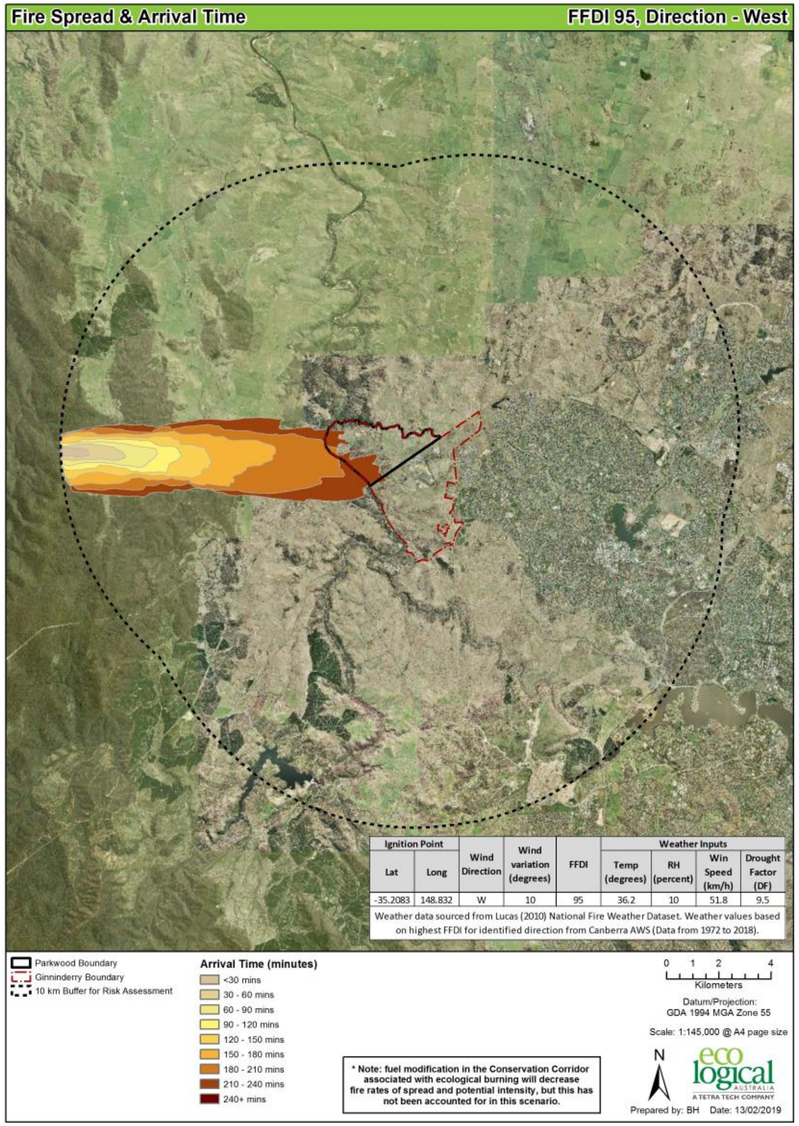

Figure 15: Potential fire spread under FFDI 95 and westerly winds

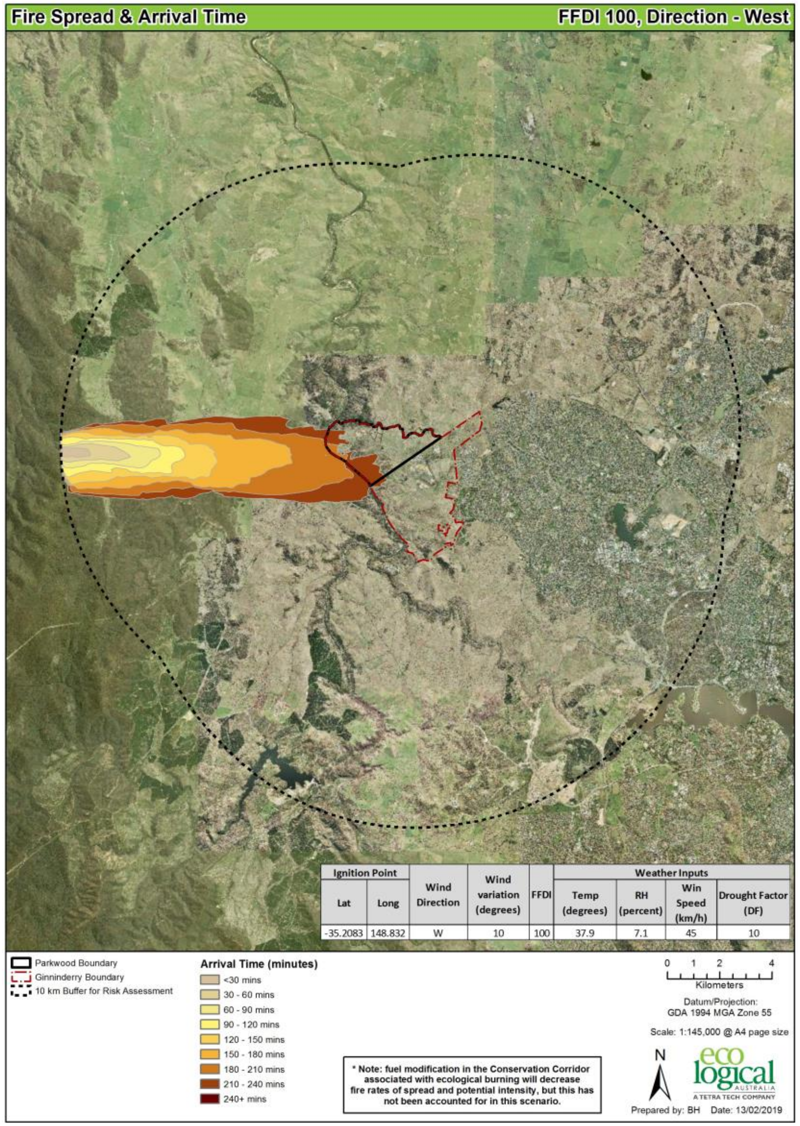

Figure 16: Potential fire spread under FFDI 100 and westerly winds

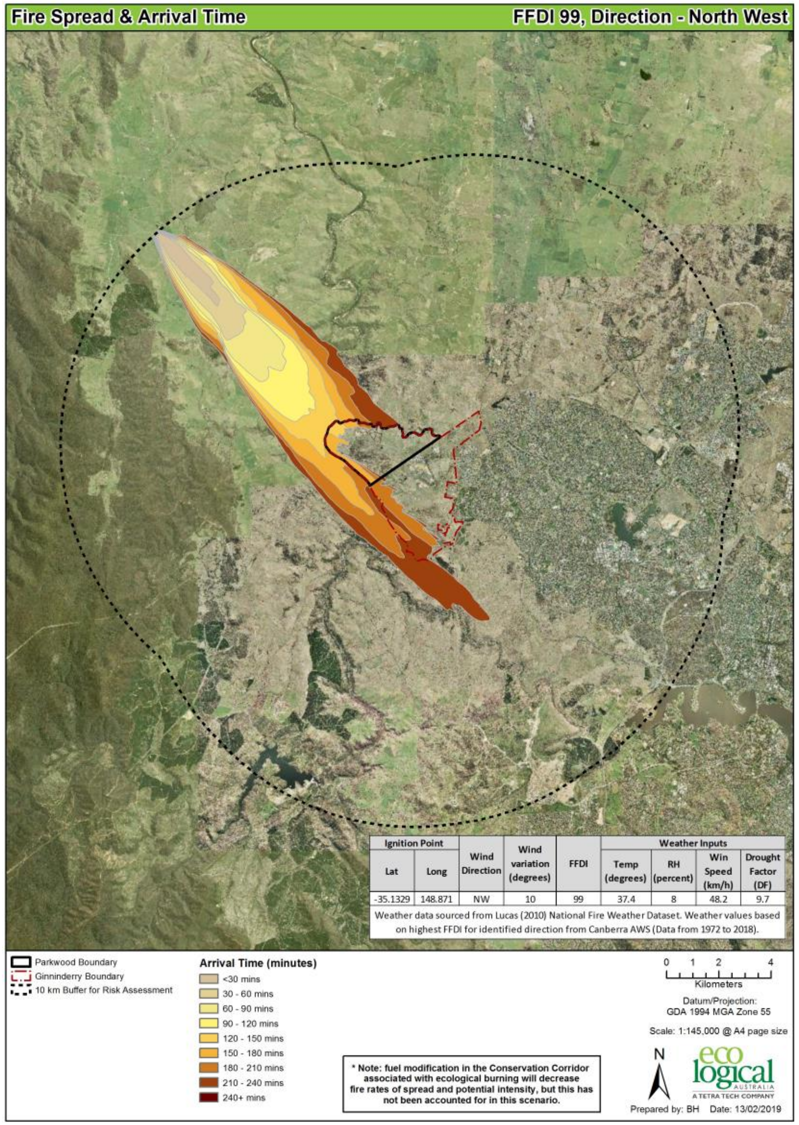

Figure 17: Potential fire spread under FFDI 99 and north westerly winds

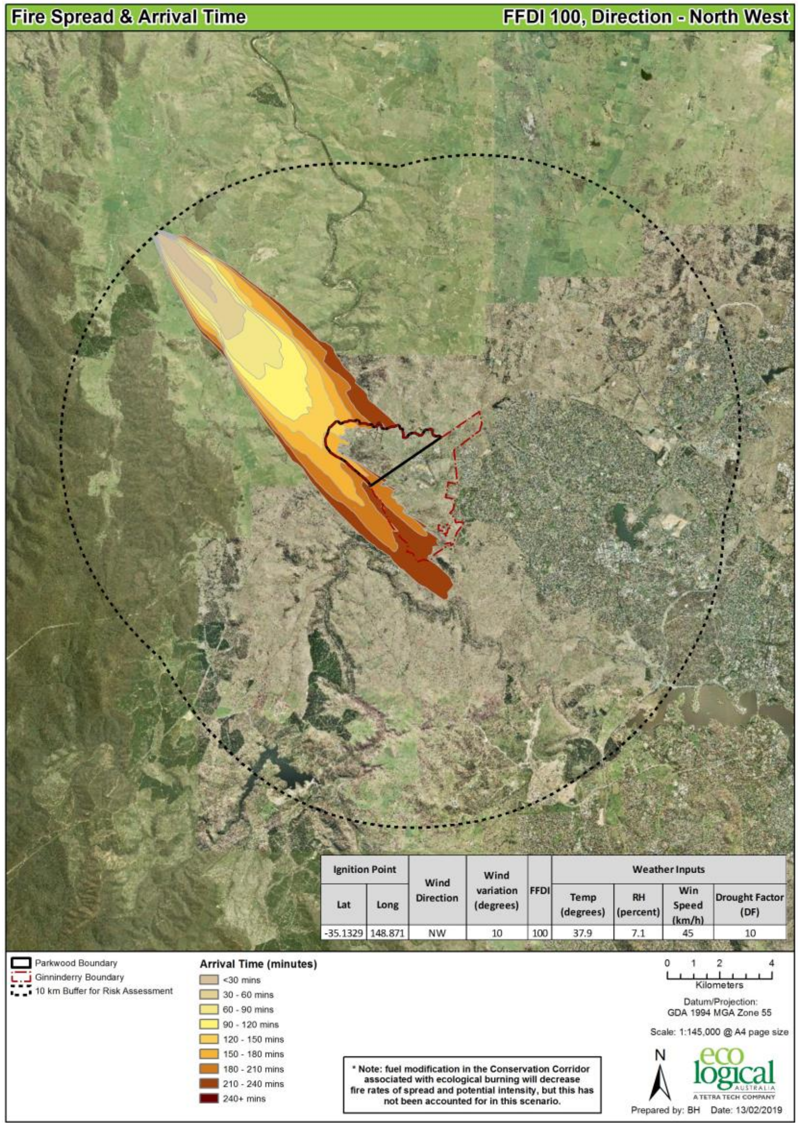

Figure 18: Potential fire spread under FFDI 100 and north westerly winds

2.5 Summary of landscape bushfire risk assessment

The landscape hazard analysis indicates that the potential for attack by larger bushfires exist in most years, if not all, due to weather conditions and fuel continuity. It is also feasible that BAL of the magnitude required to be assessed under AS3959 and PBP 2018 could occur.

However, the likelihood of these fires impacting the proposed development will be determined by:

- the likelihood and location of ignitions within the landscape coinciding with adverse fire weather conditions that move a fire toward the proposed development; and
- factors related to wildfire mitigation and suppression such as timing of fire runs, reduced fuel areas, quality wildfire detection from ACT fire towers, suppression deployment and capability, and the coincidence of these with landscape fire advantages such as the Murrumbidgee River, areas of modified fuels and existing road and trail networks.

Although the probability of a landscape wide fire or major fire attack is low, it remains feasible as it is for any part of the urban/bushland interface, and total elimination of bushfire risk is not necessary or feasible on any bushfire prone land.

The Study shows no evidence the development proposal is in an inappropriate bushfire landscape given the landscape fire advantages identified above and the site capacity to implement appropriate bushfire protection measures. The landscape risk analysis indicates a risk level where it is feasible to design and build resilience into the community that matches or exceeds the risk in this landscape. This is illustrated later in the Study report where the obvious advantages of a very large development site enable the design of a bushfire resilient development fully compliant with PBP 2018.

3 Land use assessment

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Rural Fires Act 1997* (RF Act) are the primary legislative instruments relevant to bushfire planning for the site. PBP is called up by these legislation as the site is mapped as bushfire prone land, and it is a critical guide in assessing the bushfire risk suitability of the proposal.

PBP 2018 outlines broad principles and assessment considerations for strategic planning. It also specifies that bushfire protection measures need to be considered at the strategic planning stage to ensure that the future development can comply with PBP (as specified in Chapters 5-8 of PBP 2018).

The aim and objectives of PBP 2018 below provide additional guidance for land use assessment within a Strategic Bushfire Study:

> *The aim of PBP is to provide for the protection of human life and minimise impacts on property from the threat of bush fire, while having due regard to development potential, site characteristics and protection of the environment.*
>
> *The objectives are to:*
>
> *i. afford buildings and their occupants protection from exposure to a bush fire*
>
> *ii. provide for a defendable space to be located around buildings*
>
> *iii. provide appropriate separation between a hazard and buildings which, in combination with other measures, minimises material ignition*

iv. ensure that appropriate operational access and egress for emergency service personnel and residents is available

v. provide for ongoing management and maintenance of bush fire protection measures

vi. ensure that utility services are adequate to meet the needs of firefighters.

3.1 Risk profile

The feasibility of the proposal to comply with the bushfire protection measures within PBP 2018 is fundamental to the Study. Whilst Bushfire Protection Measures and their performance requirements are a benchmark for approval of a development, a strategic level study needs also to evaluate these measures within the landscape risk context. This Study has therefore considered the:

- Footprint within the bushfire landscape and the need for adjustment of the protection measures given the landscape risks;
- Pattern and potential bushfire resilience of the development bushland interface;
- Potential cumulative risk associated with the protection measures;
- Risk profile of different areas and their appropriate landuse; and
- Potential for application of innovative or emerging bushfire protection measures.

The following landuse risk profile has been identified in the Study:

- The development site (in NSW alone) is very large; approximately 3.5 km wide by 2 km long, providing an area of 206 ha within which bushfire resilience can be incorporated.
- Over 95% of future development will be located within BAL LOW i.e. large internal areas no longer classified as bushfire prone land. This provides the potential for a high bushfire resilience.
- Over 75% of the development perimeter has a negligible to low bushfire risk (see Figure 8)
- The *perimeter to area ratio* of the development is low compared to most development proposed on bushfire prone land in NSW as a direct result of the large scale of the development. A low perimeter to area ratio reduces bushfire risk and helps increase community resilience.
- Locating a development east of the Murrumbidgee River (a potential major control line) and above a reliably fuel managed conservation corridor (i.e. under the Trust management) means there are no unacceptable landscape siting risks.
- There is ample area to locate APZ and other bushfire protection measures to meet the acceptable solutions within PBP 2018;
- There is ample area to locate Special Fire Protection Purpose (SFPP) Development well away from the hazard (see minimum SFPP APZ footprint in **Figure 20** and the large area suitable for NSP located beyond 2kW/m^2 in **Figure 21**);
- Development within the relatively small 'perimeter pockets' in the north-west (precinct 26) requires specific measures to minimise risks, including possibly a site specific DCP and provision of a Community Fire Unit;
- No unusual cumulative risks have been identified. Complementary and consistent risk management through landscape and building design, land management practices and community programs are proposed and will increase bushfire resilience.

3.2 Risk Response – Bushfire Protection Measures

In response to the strategic level risks identified in Section 2 the following bushfire protection measures have successfully passed a proponent feasibility review and are proposed by the development:

- Resilient bushland interface development (PBP 2018 compliant APZ + AS3959 compliant buildings + PBP 2018 compliant perimeter access);

- Complementary fuel and ignition risk management under the Trust-managed Bushfire Management Plan within the conservation corridor which will enhance the landscape fire risk advantages provided by the Murrumbidgee River (See **Section 5**);
- Landscaping controls across the development to minimise burning debris attack risk, house to house fire spread and the potential for weak spots in the community resilience;
- Best practice community awareness and response program to establish 'safer living with bushfire', includes ongoing CSIRO input; and
- Community fire units to augment emergency response and provide ongoing engagement of the community in fire protection and education.

4 Feasibility of Asset Protection Zones

Table 4 provides a comparison of APZ dimensions for PBP 2006 (current version); PBP 2018, AS3959-2009 and those currently identified for the proposed development (ELA 2018). The proposed APZ from ELA 2018 are generally consistent with those required under PBP 2018 and any areas of additional APZ are easily accommodated within the land available. APZ are typically refined during subdivision stages with the Structure Plan ensuring the APZ required are achieved (see **Section 1.2**).

Figure 19 shows the proposed APZ for the subject land using PBP 2018 APZ for residential subdivisions, while **Figure 20** shows the required APZ for SFPP developments. **Table 4** identifies the slope and vegetation type used to determine the APZ in NSW. These data and the associated figures demonstrate that APZ compliant with PBP 2018 acceptable solutions are easily accommodated on the site and no performance solutions are required.

Areas of potential exposure to EFB and VLS (see **Figure 9** and **Figure 10**) can be provided with enlarged APZ if required. SFPP and NSP can also be easily excluded from within an appropriate distance from these areas as a precautionary measure. The Study indicated the nearest site of potential EFB to the public reserve boundary is 68 m. The size of the proposed development footprint as well as the timeframe for the staging of the development enables the APZ in perimeter locations to be adjusted if required to any new bushfire protection standard or relevant research.

Currently, however, there is insufficient information to more specifically identify the need for, or extent of, an expanded APZ for the risk associated with EFB or VLS. Furthermore, Stages 25 and 26, located in closest proximity to areas of potential exposure to EFB and VLS (see **Figure 9** and **Figure 10**) are not scheduled for development until 2044 and 2045, allowing significant time for consideration of any relevant research.

Table 4: Indicative PBP APZs relevant to the Parkwood Masterplan

Effective slope	Predominant vegetation	PBP required BAL 29 APZ (PBP 2006)[1]	PBP required BAL 29 APZ (PBP 2018)[2]	BAL-29 required APZ (AS 3959-2009)[3]	Proposed APZ (Planning Proposal, ELA 2018)[4]	PBP required SFPP APZ (PBP 2018)[5]
Upslope/ flat	Grassland	10	10	9	10	36
	Grassy woodland	10	12	16	10	42
	Forest	20	24	25	20	67
>0 – 5	Grassland	10	12	10	15	40
	Grassy woodland	15	16	21	15	50
	Forest	25	29	32	25	79
>5 – 10	Grassland	10	13	11	12	45
	Grassy woodland	20	20	26	20	60
	Forest	35	37	39	35	93
>10 - 15	Grassland	10	15	13	15	50
	Grassy woodland	25	25	33	25	72
	Forest	50	45	49	50	100
>15 - 20	Grassland	10	17	15	15	55
	Grassy woodland	30	32	41	30	85
	Forest	60	57	61	60	100

*As per PBP (RFS 2018) APZs for effective downslopes >20° will require detailed performance assessment.

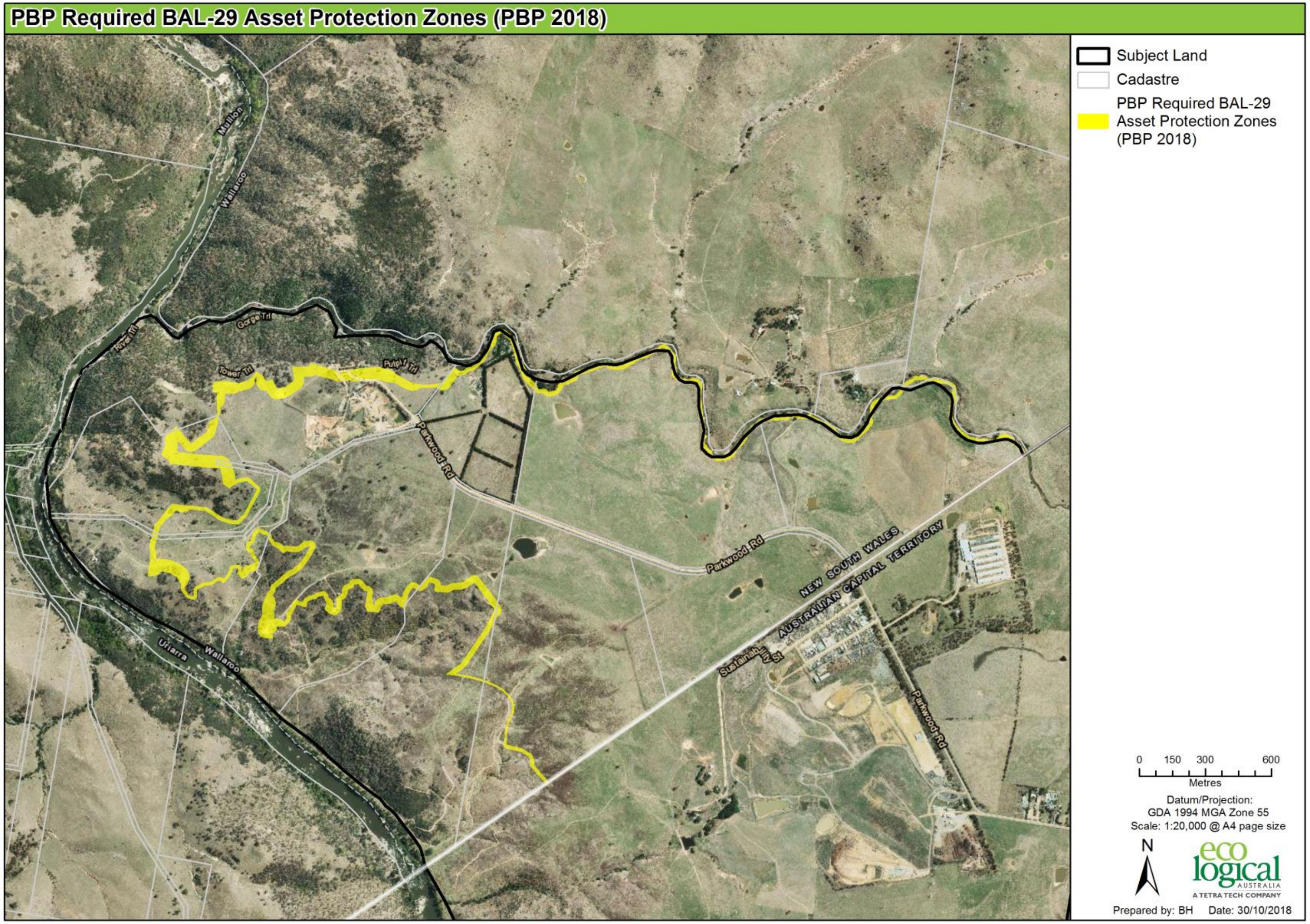

Figure 19: Asset Protection Zones for residential subdivision (PBP 2018)

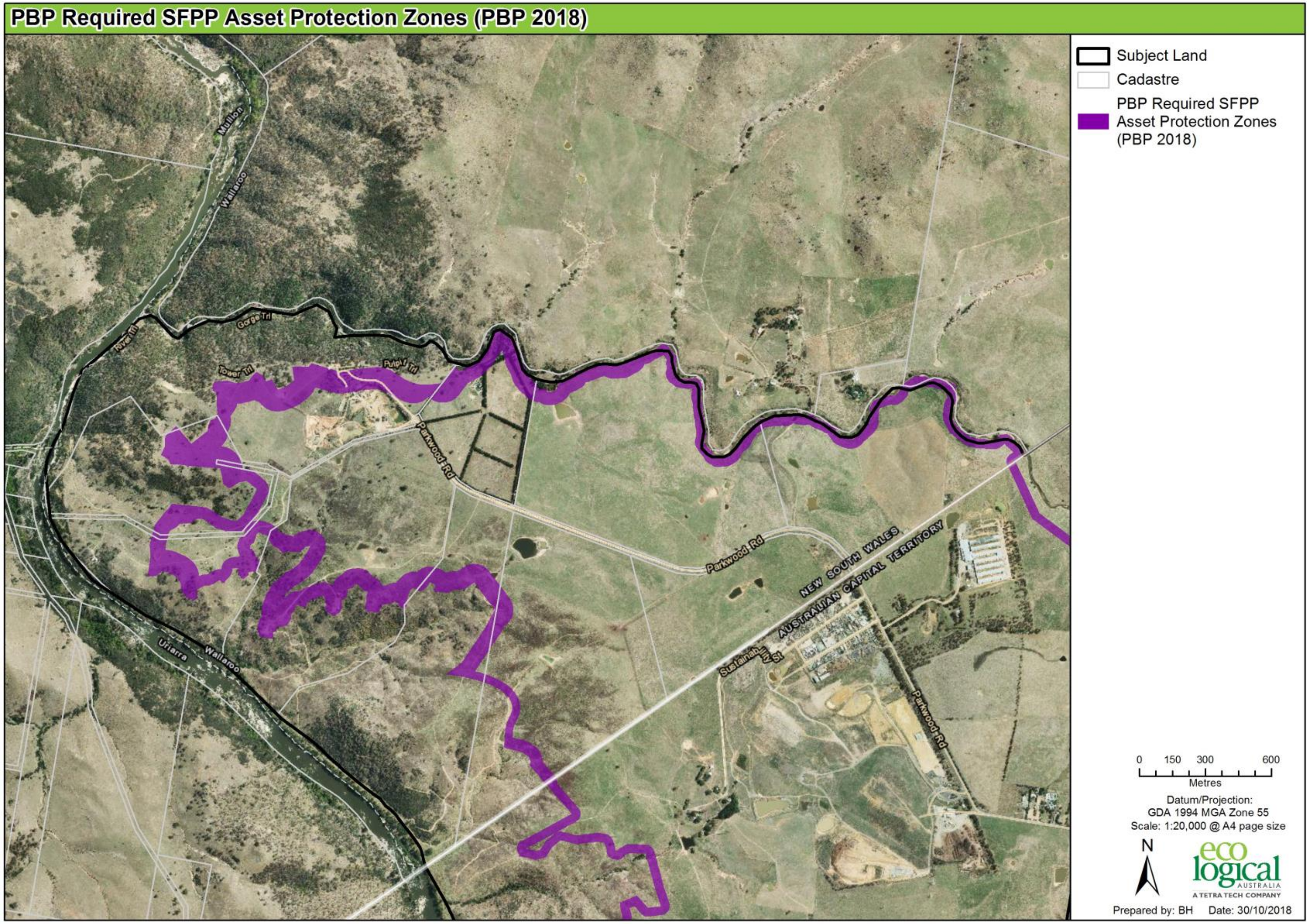

Figure 20: Asset Protection Zones for Special Fire Protection Purpose developments (PBP 2018)

5 Conservation corridor

The bushfire risk associated with proposal will be reliably reduced by the intended fuel management (primarily prescribed burning) practices of the conservation corridor which abuts the primary direction of potential bushfire attack (i.e. north-west and west). Whilst the corridors primary management objective will be cultural and recreational use and conservation of biodiversity it's bushfire management for conservation purposes can add further to the bushfire resilience of the Parkwood community. The Bushfire Management Plan will form part of the broader BRMP for the Southern Tablelands and be developed in consultation with stakeholders including the NSW RFS.

The draft Corridor Conservation Management Plan includes fire management as part of the reserve-wide strategies and the proposed E2 – Environmental Management Zone objectives expressly identify the intent "*to provide for applicable bushfire management consistent with the ecological values of the land*".

The Conservation Management Land is held in Trust with a reliable management regime, secure funding and adaptive management capacity and will enable best practice conservation and bushfire management. The funding model proposed for the corridor management will provide bushfire management more reliably and effectively than any government and most private land management organisations in NSW.

The recommended funding model includes three primary revenue streams (as detailed in Appendix 28 of the Planning Proposal – "*An Environmental Trust for West Belconnen*" Elton Consulting 2014):

- Contribution by the JV parties equivalent to 1% of the revenue from all land sales;
- A $100 per annum levy on all NSW ratepayers; and
- An annual contribution from the ACT Government equivalent to $100 per ratepayer.

Collectively this will provide annual funding in perpetuity of approximately $2m in 2018 dollars.

6 Access and egress

The Concept Masterplan (**Figure 1**) broadly indicates the proposed development, including connection to existing major roads in Ginninderra Drive, Southern Cross Drive and Drake Brockman Drive. The connection roads lead away from the primary directions of a possible bushfire attack (N- NW-W) to the south (Drake Brockman Drive), South-east (Southern Cross Drive) and east (Ginninderra Drive). The connections provide redundancy in the event of one major egress being restricted during a bushfire attack, and with the proposed secondary and perimeter roads the options for evacuation routes are expected to be adequate for any foreseeable bushfire attack contingency.

As all major roads (**Figure 1**) and most of the secondary roads are located within BAL LOW and beyond the 2kW/m^2 radiant heat exposure level (**Figure 21**) no part of the development is at risk of being isolated by a bushfire event. Lower intensity fire may enter green spaces, but the design of these spaces can minimise fire spread and any potential restriction of localised traffic movement. Urban edge roads link at short intervals to the secondary and major road network providing rapid egress to BAL LOW areas and potential NSPs – see Section **8.1** below.

Future more detailed planning (see **Section 1.2**) can readily incorporate all access requirements of PBP 2018 (see Appendix A) and achieve:

- a road design that facilitates the safe access and egress for residents and emergency service personnel, including multiple access/egress options for each area;
- access that meets the acceptable solutions detailed in PBP (where relevant), especially the provision of perimeter roads (of sufficient width and capacity) separating developed land from bushfire prone vegetation and the provision of alternative access;
- a road design with adequate capacity to facilitate satisfactory emergency evacuation;
- provision of fire trail/s (if required) to support operational activities in strategic locations.

6.1 Road capacity for off-site evacuation

The capability of the proposed road network under various bushfire evacuation scenarios was assessed by Ontoit (2018) with their report provided as Appendix B. The potential impacts of emergency evacuation under the scenarios was assessed from the length of time estimated for residents to clear from the development site assuming a future egress road capacity of 4,200 vehicles per hour.

Assuming residents within a NSP <2 kW/m^2 footprint do not need to evacuate (see **Figure 21** and **Section 7**) the maximum estimated number of dwellings potentially required to evacuate would be 2,000 for the high yield scenario and 1,700 for the low yield scenario. Ontoit (2018) found that under a likely and realistic bushfire attack scenario from the north-west, the estimated maximum 2,000 dwellings could be evacuated within 45 minutes or less. Highly unlikely and improbable scenarios were also tested with evacuation of all dwellings within Parkwood development (maximum of 5,189 dwellings) and the entire Ginninderry development (maximum of 11,242 dwellings) with the estimated times being 1 hour 51 minutes and 4 hours or less (respectively). This includes all dwellings within the identified NSP suitable footprint and well away from bushfire risk and is therefore not considered an appropriate evacuation evaluation input.

With early evacuation required to avoid unsafe exposure to a fire (advocated in Bush fire survival plans by both ACT and NSW RFS) the estimated evacuation times suggest an efficient and effective off-site evacuation is feasible but unnecessary. Even under rapid on-set bushfire attack such as those identified in **Section 2.4** the analysis shows that it will be feasible to evacuate the most exposed of the dwellings (dependant on the location of the fire and time to impact).

7 Emergency Services

In relation to the objectives and strategic planning principles of PBP 2018 relating to emergency management, the following is recommended for strategic land use planning:

- Mechanisms are established, and early consultation with emergency service organisations is undertaken, to ensure for the provision of adequate emergency management resources (e.g. fire stations) can be afforded to future development;
- Strategic emergency management planning is undertaken in collaboration with emergency service organisations within the strategic land use planning process, to establish preferred future outcomes (i.e. emergency evacuation) that have implications for land use planning, including:
    a. Emergency evacuation planning;
    b. Evacuation adequacy assessment.

These principles are considered further in the sections below.

7.1 Emergency response agency engagement

Extensive discussion has occurred with emergency response agencies, including:

- Emergency Management and Disaster Recovery Working Group – July 2015
- Cross Border Agency Forum – March 2016
- Forum Emergency Services and Police Workshop (28 July 2015)
- Services and Infrastructure Report – June 2017

All discussions to date confirm that existing and future arrangements are appropriate and can be achieved.

The proponent has been, and will continue, to work with the Office of Emergency Management, in partnership with the Emergency Response Agencies (in both NSW and ACT), including the RFS, to build bushfire resilience and response capacity in communities.

7.2 Emergency Services resourcing

Bushfire and other related emergency services for the development will likely be provided from the ACT, as establishing a NSW RFS brigade for the NSW portion of the development is not considered viable. An ACT based bushfire response could be augmented by provision of basic fire equipment at key locations for residents (i.e. Community Fire Units), as well as for the Conservation Corridor land management team.

Given the importance of rapid first attack on bushfires the travel times for the nearest ACT Fire and Rescue Service and ACT RFS units is important. The West Belconnen station at Charnwood is the nearest ACT Fire and Rescue station and the Molonglo RFS station is the nearest RFS brigade located at Holt. These stations will provide good response times on completion of roads for the subject development.

8 Evacuation

Initial assessment of emergency evacuation has occurred and includes the following:

- A collaborative approach between emergency service organisations and subject matter experts (i.e. bushfire evacuation planners and traffic modellers);
- An analysis of the most relevant bushfire attack scenarios, identifying potential time/s to impact from ignition (**Section 2.4**);
- Identification of evacuation and refuge locations, both onsite and offsite (**Section 6** and **8.1**);
- Traffic modelling (**Section 6** and Appendix B); and
- An evaluation of evacuation adequacy and identify option for any shortcomings identified.

8.1 Assessment of Neighbourhood Safer Places (NSPs)

Off-site evacuation is time consuming, causes a range of significant community disruptions and are resource demanding for emergency services. This Study has found that localised evacuation to NSP is both feasible and highly desirable.

The potential for NSPs was assessed in accordance with the criteria and principles documented in RFS 2017 (See Appendix C for additional details) and shown in **Table 7** and **Table 8**. The radiant heat level of 2kW/m^2 (i.e. for open areas without shelter) and not the 10kW/m^2 was modelled to provide additional safety and best practice in assessing the potential for NSP (see **Figure 21**).

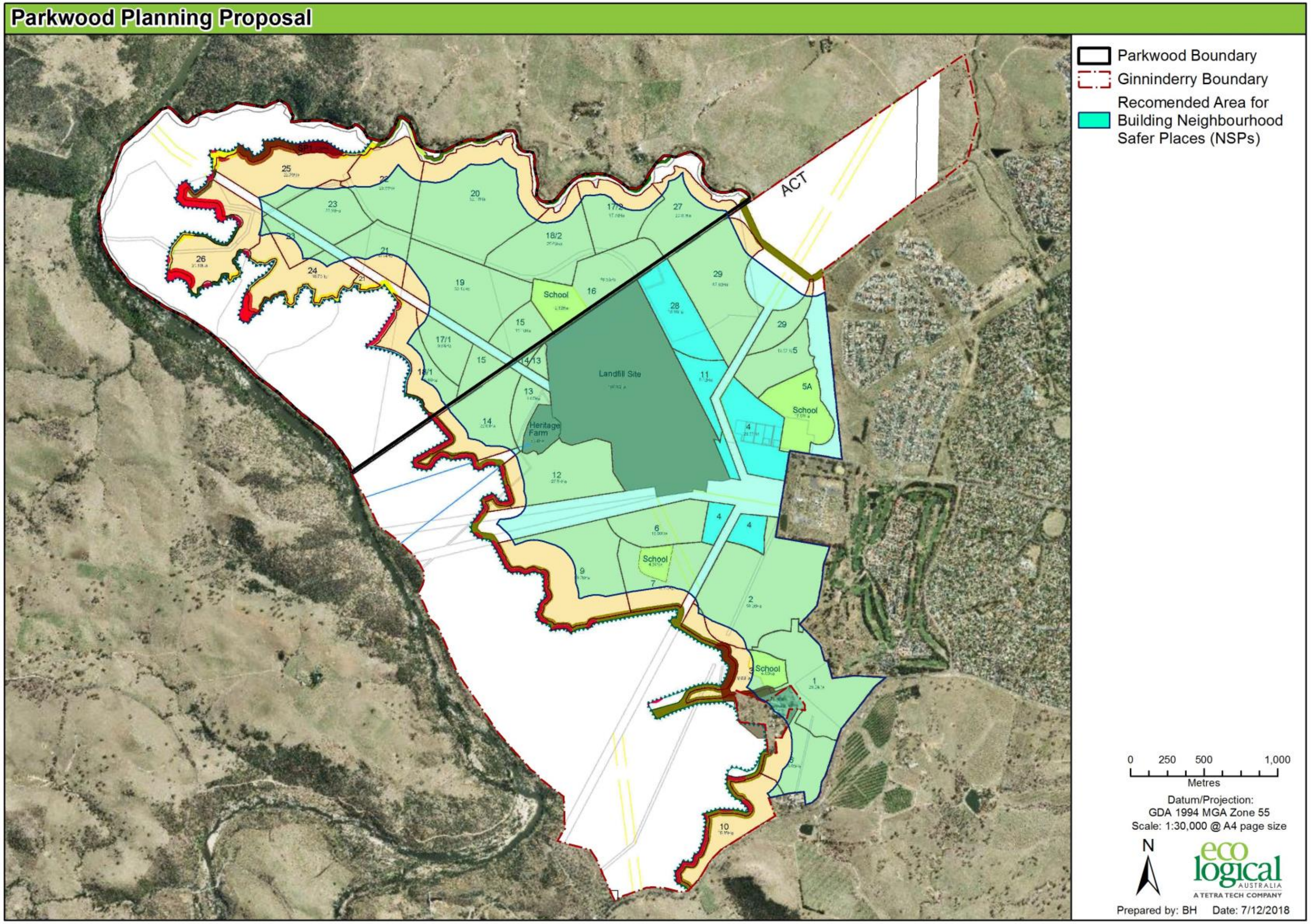

Figure 21: Potential areas for Neighbourhood Safer Places

9 Infrastructure

Future land use planning phases within Parkwood can incorporate the requirements of PBP 2018 for water and utility supply, to ensure appropriate bushfire resilience in the supply of water, gas (if any – see **Section 9.2**) and electricity.

9.1 Reticulated water

Initial investigations by ACTEW and a report by Brown Consulting (2014) indicate that the supply of potable water to the entire development is feasible, and preliminary modelling has indicated that the bulk water supply system has adequate capacity to meet estimated demand. Options are being developed to provide water to higher elevation areas along Stockdill Road, which include ensuring the supply can meet the requirements for supply of water in a major bushfire event. Consultation with ACTEW will continue to identify any capacity issues and future design needs.

The future reticulated water supply will be able to meet PBP 2018 requirements (**Appendix D**).

9.2 Electricity and Gas

An existing network of powerlines is located across the Parkwood development area and is managed by TransGrid. The future power network will continue to be managed in accordance with the *Guide for the Management of Vegetation in the Vicinity of Electricity Supply Infrastructure* (ISSC3 2016).

A number of the existing feeder lines will become part of the development footprint within managed open spaces. These open spaces will be of a design that will potentially lower the existing low ignition risk and will pose no risk bushfire impact to the power supply.

Lower voltage power supply within the development will be underground and Ginninderry is currently proposed as a "no-gas" estate as a greenhouse gas reduction measure. This concept is being trialled with the first 1100 dwellings and if successful will apply across the whole estate. Where gas infrastructure is to be installed, its design will meet the bushfire standards of the time.

10 Adjoining land

Future development will not be reliant on any off-site bushfire mitigation measures. All buildings and use will be designed to be resilient to bushfire attack in circumstances where no additional fuel management is required outside of APZ. As stages of the development are released bushfire protection measures are likely to be included that exceed the bushfire protection standards of the time through the proposed regular input from the CSIRO bushfire research team.

The development funded Conservation Corridor Management Trust will undertake prescribed burning within the conservation corridor. This burning will target conservation objectives and, in the process, lower the bushfire attack potential prior to it reaching the APZ buffering the full bushland perimeter of the proposed development (see **Section 5**). Fuel management further afield (e.g. west of Murrumbidgee River) is not a cost effective or useful bushfire mitigation measure for the proposed development. The most effective bushfire protection measures are prescribed under PBP 2018, and the Conservation Corridor fuel reduction is complementary and beneficial though not an essential bushfire protection measure.

Local Bushfire Management Committees will be updated annually on the bushfire protection measures in-built and proposed for the development and the Conservation Corridor prescribed burning program, for inclusion in the BFRMP.

11 Conclusions

This Study has strategically assessed the potential bushfire risk associated with the Parkwood planning proposal. It is concluded that the Parkwood Masterplan meets the bushfire strategic planning principles and assessment requirements of PBP 2018. Notable elements of the Study supporting this conclusion are:

- The development footprint is advantageous in a landscape context as it is east of a potential major fire control line (Murrumbidgee River).
- Landscape scale bushfire from the highest risk directions (west and north-west) must first burn downhill and cross the Murrumbidgee River.
- Any landscape fire not controlled on the River will enter the Conservation Corridor where the spatial and temporal pattern of ecological burns will mitigate its spread toward the development and this fuel management will be reliably implemented by the funding arrangements proposed for the Management Trust.
- All PBP 2018 required bushfire protection measures can unquestionably be accommodated within the large development footprint.
- Capacity exists to enhance the bushfire protection measures through the staged implementation of development and long timeframes for the development as research, technology and policy standards improve community resilience to bushfire. A program of CSIRO input to design improvements is also in place.
- The large development footprint can ensure the more vulnerable in the community are in the safest bushfire locations.
- The large development footprint enables all major egress roads to be located where there is no risk of impact by bushfire. Most secondary roads are also located on future non-bushfire prone land.
- Traffic studies demonstrate evacuation beyond the development is very efficient and capable of meeting the bushfire response needs.
- Radiant heat modelling shows that the vast majority of the future development footprint will be BAL LOW (i.e. not bushfire prone land). The models also show that NSPs can be strategically located to ensure 'out of area' evacuation is not required enabling substantial improvements to community resilience.
- Landscape design controls across the development footprint will further reduce the bushfire attack potential, particularly from burning debris.

The Study identified measures to improve bushfire risk and community resilience and these are summarised in **Table 5.** The measures may also help guide future DCPs and BFRMPs and will be revised as the staged development progresses to include new bushfire protection standards and the latest research.

Table 5: Guiding information for Development Control Plans and Bush Fire Risk Management Plans

Guideline	PBP 2018	Relevant Section of study
Development Control Plan(s) for the site will be developed in consultation with the RFS, and may be specific for certain stages (e.g. Stages 25 and 26 in NW)	Section 4.5	1.2; 3.1
Road design and layout will facilitate the safe access and egress for residents and emergency service personnel, including multiple access/egress options for each stage	Section 3.4 and applicable tables for development types (i.e. residential or SFPP)	6
Bushfire Management Plan for Conservation Corridor will be developed to be able to be easily incorporated into BFRMP	Section 2.6.1	5
Bushfire protection measures for each stage of development will be in accord with any new bushfire protection standard or relevant research.	Chapters 5-8	4
Minimum construction standard within the proposed development is to be Bushfire Attack Level (BAL) 12.5	Section 3.3	2
Best practice landscaping design for bushfire prone areas will apply	Section 4.5; 5.3	2, 3.2
Ongoing best practice community awareness and response program to establish 'safer living with bushfire'	Section 2.6.3	3.2

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Appendix A: Access Specifications

The following access specifications are reproduced from PBP (RFS 2018).

Intent of measures: To provide safe operational access to structures and water supply for emergency services while residents are evacuating an area.

Table 6: Performance criteria for access for residential and rural residential subdivisions

Performance Criteria	Acceptable Solutions
The intent may be achieved where:	
• firefighting vehicles are provided with safe, all-weather access to structures and hazard vegetation	• property access roads are two-wheel drive, all-weather roads, and • perimeter roads are provided for residential subdivisions of three or more allotments; and • subdivisions of three or more allotments have more than one access in and out of the development; and • traffic management devices are constructed to not prohibit access by emergency services vehicles; and • maximum grades for sealed roads do not exceed 15 degrees and an average grade of not more than 10 degrees or other gradient specified by road design standards, whichever is the lesser gradient; and • all roads are through roads. Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200 metres in length, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end; and • where kerb and guttering is provided on perimeter roads, roll top kerbing should be used to the hazard side of the road; and • where access/egress can only be achieved through forest, woodland or heath vegetation, secondary access shall be provided to an alternate point on the existing public road system.
• the capacity of access roads is adequate for firefighting vehicles	• the capacity of perimeter and non-perimeter road surfaces and any bridges/causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges/causeways are to clearly indicate load rating.
• there is appropriate access to water supply	• hydrants are located outside of parking reserves and road carriageways to ensure accessibility to reticulated water for fire suppression; • hydrants are provided in accordance with AS 2419.1:2005; • there is suitable access for a Category 1 fire appliance to within 4m of the static water supply where no reticulated supply is available.
• access roads are designed to allow safe access and egress for medium rigid firefighting vehicles while residents are evacuating as well as providing a safe operational environment for emergency service personnel during firefighting and emergency	• perimeter roads are two-way sealed roads; and • 8m carriageway width kerb to kerb; and • parking is provided outside of the carriageway width; and • hydrants are located clear of parking areas; and • there are through roads, and these are linked to the internal road system at an interval of no greater than 500m; and • curves of roads have a minimum inner radius of 6m; and • the maximum grade road is 15° and average grade is 10°; and • the road crossfall does not exceed 3°; and

Performance Criteria	Acceptable Solutions
management on the interface	• a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.
• access roads are designed to allow safe access and egress for medium rigid firefighting vehicles while residents are evacuating	• minimum 5.5m width kerb to kerb; and • parking is provided outside of the carriageway width; and • hydrants are located clear of parking areas; and • roads are through roads, and these are linked to the internal road system at an interval of no greater than 500m; and • curves of roads have a minimum inner radius of 6m; and • the road crossfall does not exceed 3°; and • a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.
• firefighting vehicles can access the dwelling and exit safely	No specific access requirements apply in a urban area where a 70 metre unobstructed path can be demonstrated between the most distant external part of the proposed dwelling and the nearest part of the public access road (where the road speed limit is not greater than 70kph) that supports the operational use of emergency firefighting vehicles (i.e. a hydrant or water supply). In circumstances where this cannot occur, the following requirements apply: • minimum carriageway width of 4m; • in forest, woodland and heath situations, rural property access roads have passing bays every 200m that are 20m long by 2m wide, making a minimum trafficable width of 6m at the passing bay; and • a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches; and • provide a suitable turning area in accordance with Appendix 3; and • curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress; and • the minimum distance between inner and outer curves is 6m; and • the crossfall is not more than 10°; and • maximum grades for sealed roads do not exceed 15° and not more than 10° for unsealed roads; and • a development comprising more than three dwellings has formalised access by dedication of a road and not by right of way. Note: Some short constrictions in the access may be accepted where they are not less than the minimum (3.5m), extend for no more than 30m and where the obstruction cannot be reasonably avoided or removed. the gradients applicable to public roads also apply to community style development property access roads in addition to the above.

Appendix B: Traffic Impact Assessment

ontoit.

9.12.2018 / Memorandum

To:	David Maxwell
CC:	Mick George, Rod Rose
Re:	**Ginninderry Bush Fire Evacuation – Traffic Impact Assessment**

Introduction
This memo has been prepared in response to the NSW Government Department of Planning and Environment Gateway Determination in relation to Planning Proposal PP_2015_YASSV_001_00. The Gateway alteration included further conditions, one of which was the request to prepare a Strategic Bush Fire Study. In preparing the Bush Fire Study, the Gateway Determination specified the consideration of three areas:

- *the impacts of the development within a landscape context that includes a landscape assessment that considers the requirements for bush fire risk management in the landscape and the impact on biodiversity in the implementation of these risk management mechanisms; and*
- *identification of an indicative road network layout, details of access points and integration with the existing traffic network on roads external to the site. The management of emergency evacuation and management of traffic in a bush fire emergency should inform the road network; and*
- *the identification of areas of limited and/or no residential or development potential.*

This memo has been prepared specifically to addresses the second bullet point an will focus on the traffic capacities and access that will be available to residents during a bush fire emergency.

Background
Planning for the Ginninderry development has been occurring for over ten years, a brief history and current status is outlined below:

- Stakeholder engagement related to the project has been occurring for 10 years. Discussions commenced with Yass Valley Council in 2009 and with the NSW Department of Planning and Infrastructure in 2010.
- The planning proposal submitted in 2014 has been revised in response to condition of the original gateway determination (issued in late 2014).
- These original conditions required a cross border agency forum was held and cross border government servicing report prepared. This took place between 2015-2016 and is discussed in further detail below.
- In 2016 a revised planning proposal was resubmitted to Yass Valley Council which sought to:
    - Reduce the footprint of urban development in the R1 General Residential Zone from 394 ha to 387 ha;
    - Apply both an E3 Environmental Management Zone (25 ha) and E2 Environmental Conservation Zone (188 ha) to environmentally sensitive areas;
    - Apply an SP1 Special Activities Zone (1 ha) to the Ginninderra Falls Precinct near Ginninderra Falls (recreation area, tourism, community buildings emergency facilities);
    - Include additional LEP provisions to manage environmentally sensitive areas;
    - Include a cross border 'Services and Infrastructure Report' to address cross-border servicing between NSW and the ACT; and
    - An amended Gateway determination was received by the Department of Planning and Environment on 18 August 2018.
- In late 2015 subsequent to the original Gateway Determination in NSW, the first round of intensive engagement occurred with NSW Government agencies in addition to further work with Yass Valley Council, this was followed by a second round of consultation in 2016 and finally a cross border Cross Agency Forum in March 2016.
- An altered Gateway Determination was issued by the DPE in August 2018. The Gateway Determination specified consultation requirements for the Planning Proposal.
- The NSW/ACT Cross Agency forum is due to be held in early 2019.

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CREATING CERTAINTY.

The Proposed Development

The development master plan is presented in Attachment 1. The estimated yield for the development site ranges from a low estimate of 9,563 dwellings to the highest estimate of 11,242 dwellings. The development is progressive with the first stage having commenced in March 2018 and current projections concluding the development in January 2051, which is an approximate timeline of 43 years. The current plan is to deliver the development in 29 stages as illustrated in ***Figure 1***.

The development is proposed to occur in both the ACT and NSW and Ontoit was advised that the development yield for each state is as follows:

- High Yield Scenario:
  - NSW development is 15A through to 27C a total of 5,189 dwellings; and
  - ACT consist of Stage 1A through to 14B and 28A through to 29F total of 6,053 dwellings.
- Low Yield Scenario:
  - NSW development is 15A through to 27C a total of 4,324 dwellings; and
  - ACT consist of Stage 1A through to 14B and 28A through to 29F total of 5,239 dwellings.

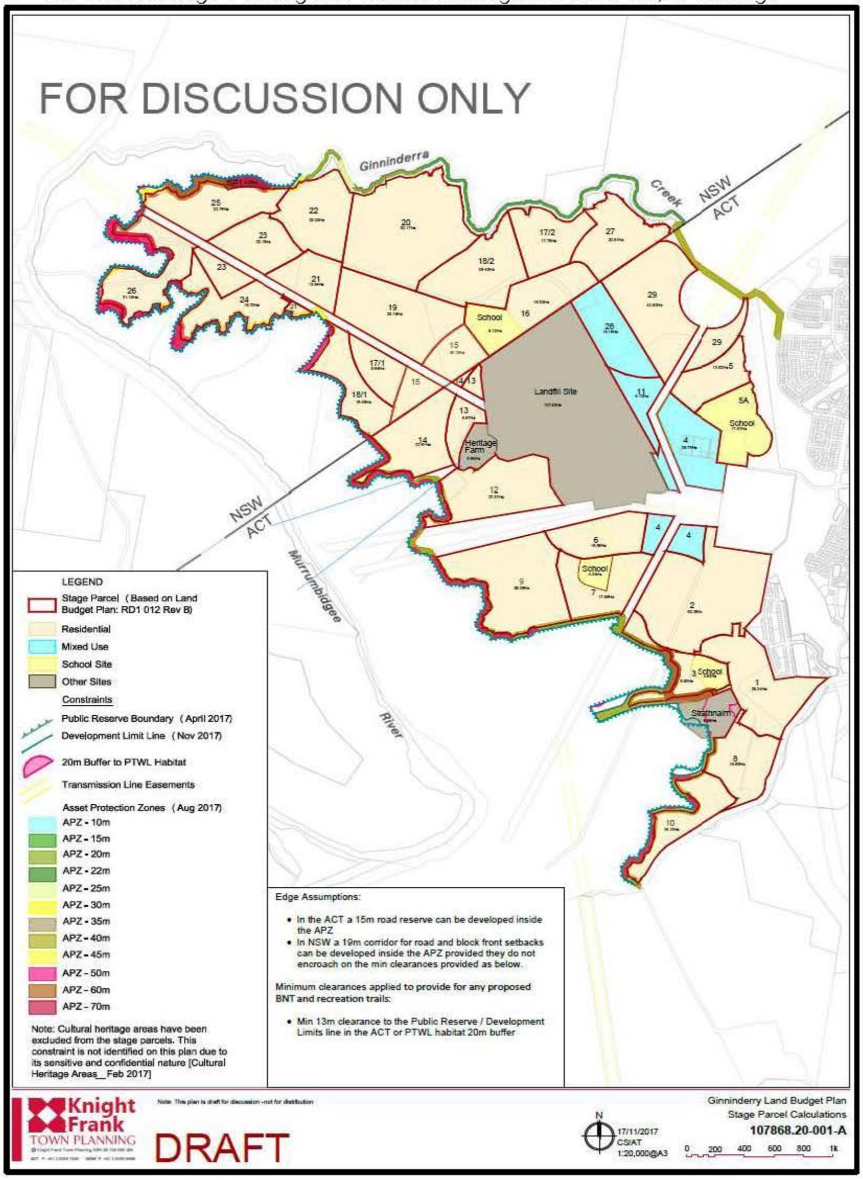

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Figure 1 Proposed development staging

Proposed Development Access

The Ginninderry development will be serviced by three access corridors which will all connect directly to the existing ACT arterial road network. Access to the development will be via:

- Drake Brockman Drive;
- Parkwood Road / Southern Cross Drive; and
- Ginninderra Drive.

Figure 2 illustrates the proposed major road corridors and their connection points to the Ginninderry Development.

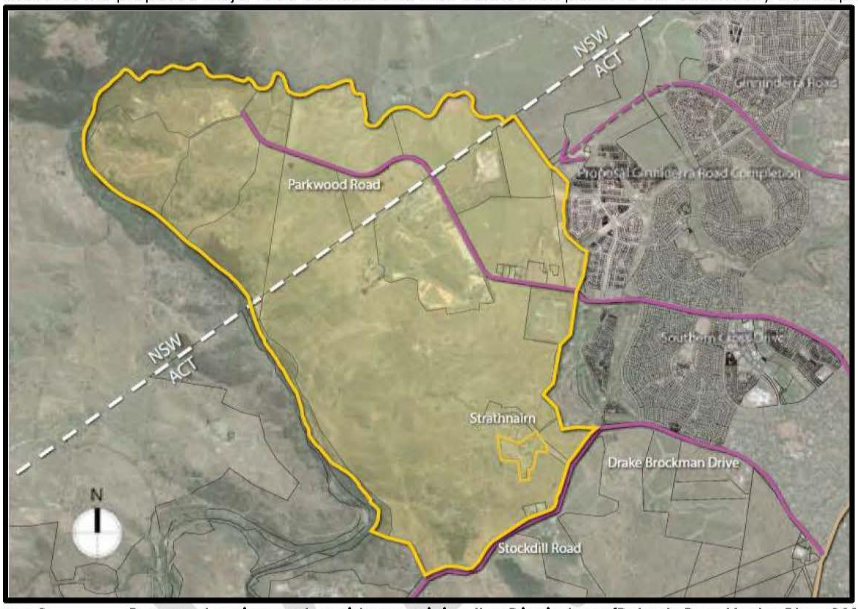

Figure 2 Proposed major road corridors servicing the Ginninderry (Roberts Day Master Plan, 2014)

All three corridors form part of the existing ACT arterial road network and provide direct connections to Belconnen, North Canberra, the City Centre and South Canberra via William Hovell Drive and the Tuggeranong Parkway (see *Figure 3*)

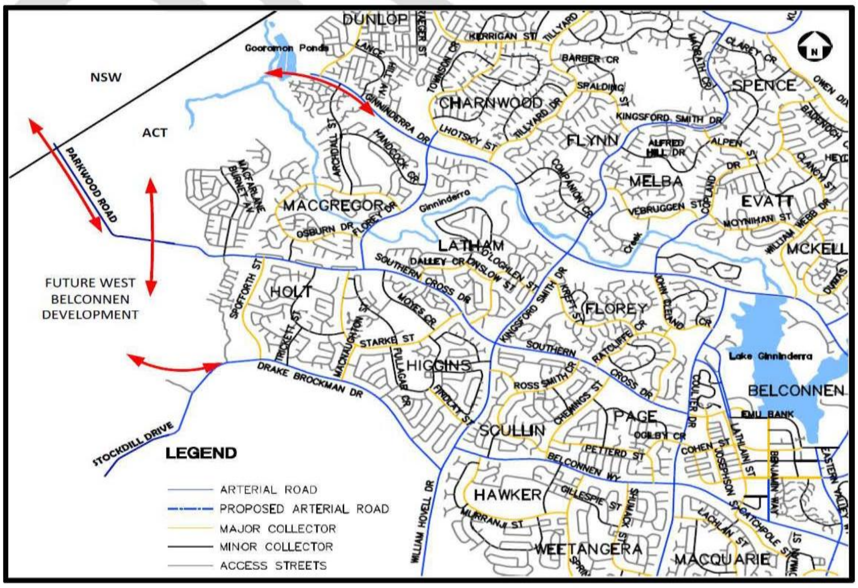

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Figure 3 ***Existing ACT road hierarchy (future Ginninderry road connection illustrated by red arrows) (AECOM, 2014)***

Connecting with external road network will be a Major, Secondary and Perimeter road network as presented ***Figure 4*** and within the development master plan (as presented din Attachment 1). The Avenues (Major Roads) will form the main arterial road network within the development and will generally carry the largest volumes of traffic to / form and within the development. All the road network is likely to have similar characteristics:

- Single traffic lane in each direction;
- Active travel measures on both sides of corridor;
- 40kph on streets other than the main avenues;
- Signalised intersections at major road crossings; and
- Generally, these road corridors should be able to carry 700-900 vehicles an hour.

In addition to the main roads identified below, each suburb will be supported by a network of local road connections which will provide direct linkages to the main roads through the development.

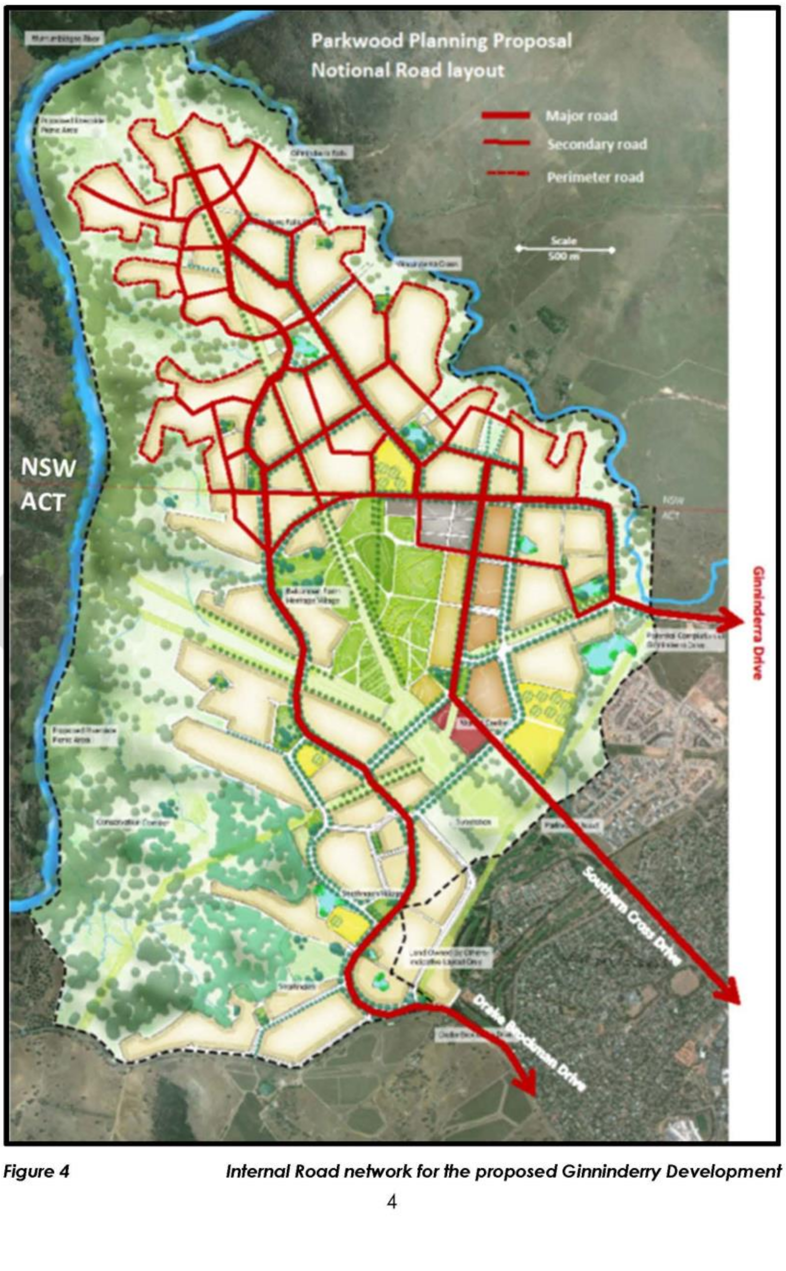

Figure 4 ***Internal Road network for the proposed Ginninderry Development***

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Future Road Connections and Capacity
Each of the major road corridors will have different characteristics in the future and will provide access and egress from the development to different parts of the ACT. The future road capacities will be determined by the ultimate road cross section layout and road corridor characteristics. **Table 1** illustrates the existing and future characteristics and estimated capacities of each road corridor.

Table 1 Planned future major road corridor capacities and characteristics

Road Corridor	Existing Characteristics	Existing Estimated Capacity	Future Characteristic	Future Estimated Capacity
Drake Brockman Drive	Single traffic lane corridor in each direction with a posted speed limit of 60kph. All intersections are priority configuration. Residential access directly off-road corridor.	600-900 vehicles per hour	Dual carriageway in its ultimate form with a posted speed limit of 70kph. There will be no residential access directly off the road corridor with the introduction of a service lane to provide access to existing dwellings. All intersections will be signalised and high capacity. Traffic lanes in each direction will be separated with a median.	800-1200 vehicles per hour, per lane
Parkwood Road / Southern Cross Drive	Single traffic lane corridor in each direction with a posted speed limit of 60kph. Intersections are a mixture of signalised and priority configuration. Residential access directly off-road corridor. Southern Cross Drive expands to two traffic lanes east of the Kippax Shopping Centre.	500-700 vehicles per hour / per lane	Road will be upgraded to meet current road specification standards. There will be no residential access directly not the road corridor and intersections will likely be upgraded and signalised to increase capacity. Speed limit is likely to remain 60kph.	600-900 vehicles per hour / per lane
Ginninderra Drive	Does not currently extend into development area. The existing road corridor currently extends to Dunlop and is a single lane carriage way between the Charnwood Shopping Centre and Kerrigan Street. All intersection along this section are priority controlled. East of Charnwood the road expands to two traffic lanes and intersections are generally signalised. The posted speed limit is 80kph. There is no residential access off the road corridor.	700-1000 vehicles per hour per lane	Likely to be dual carriageway in its ultimate form with a posted speed limit of 80kph. There will be no residential access directly off the road corridor. It is likely major intersections will be signalised and high capacity. Traffic lanes in each direction could potentially be separated with a median. Road configuration into the development is likely to reduce to a single lane in both directions.	1000-1400 vehicles per hour per lane

Table 1 illustrates that there is an estimated total capacity of between 4,200 and 6,100 vehicles per hour on the future road network that will connect to and from the development.

Evacuation Scenarios
To assess the potential impacts of an emergency evacuation in the event of a Bush Fire attack on the Ginninderry Development, a number of scenarios were considered to assess the ability of the future proposed road network to support a mass evacuation. The scenarios that were considered are presented in
Table 2.

Table 2 Evacuation scenario descriptions

REF	Scenario Name	Scenario Parameters	Scenario Description
1a	Total evacuation, low development yield, high vehicle trip rate	- All ACT and NSW residents to be evacuated; - Average vehicle trips during evacuation assumed to be 1.5 vehicles per dwelling; and - A total of 14,345 trips during evacuation based on the low development yield.	Evacuate the whole development including residents in both NSW and ACT.
1b	Total evacuation, low development	- All ACT and NSW residents to be evacuated;	Evacuate the whole development including

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	yield, low vehicle trip rate	- Average vehicle trips during evacuation assumed to be 1 vehicle per dwelling; and - A total of 9,563 trips during evacuation based on the low development yield.	residents in both NSW and ACT.
1c	Total evacuation, high development Yield, High Vehicle Trip Rate	- All ACT and NSW residents to be evacuated; - Average vehicle trips during evacuation assumed to be 1.5 vehicles per dwelling; and - A total of 16,863 trips during evacuation based on the low development yield.	Evacuate the whole development including residents in both NSW and ACT.
1d	Total evacuation, high development yield, low vehicle trip rate	- All ACT and NSW residents to be evacuated; - Average vehicle trips during evacuation assumed to be 1 vehicle per dwelling; and - A total of 11,242 trips during evacuation based on the low development yield.	Evacuate the whole development including residents in both NSW and ACT.
2a	NSW residents evacuation, low development yield, high vehicle trip rate	- Evacuate NSW residents only; - Average vehicle trips during evacuation assumed to be 1.5 vehicles per dwelling; and - A total of 6,486 trips during evacuation based on the low development yield.	Evacuate all residents from dwellings located in NSW only.
2b	NSW residents, low development yield, low vehicle trip rate	- Evacuate NSW residents only; - Average vehicle trips during evacuation assumed to be 1 vehicle per dwelling; and - A total of 4,324 trips during evacuation based on the low development yield.	Evacuate all residents from dwellings located in NSW only.
2c	NSW residents, high development yield, high vehicle trip rate	- Evacuate NSW residents only; - Average vehicle trips during evacuation assumed to be 1.5 vehicles per dwelling; and - A total of 7,784 trips during evacuation based on the high development yield.	Evacuate all residents from dwellings located in NSW only.
2d	NSW residents, high development yield, low vehicle trip rate	- Evacuate NSW residents only; - Average vehicle trips during evacuation assumed to be 1 vehicle per dwelling; and - A total of 5,189 trips during evacuation based on the high development yield.	Evacuate all residents from dwellings located in NSW only.
3a	Partial evacuation of NSW and ACT residents, low development yield, high vehicle trip rate	- Partial evacuation of NSW and ACT residents only – dwelling that are outside of the 'safe zone'; - Average vehicle trips during evacuation assumed to be 1.5 vehicles per dwelling; and - A total of 2,550 trips during evacuation based on the low development yield.	Evacuate all residents from dwellings located outside of the 'safe zone' as identified in the bush fire assessment. See **Figure 5**.
3b	Partial evacuation of NSW and ACT residents, low development yield, low vehicle trip rate	- Partial evacuation of NSW and ACT residents only – dwelling that are outside of the 'safe zone'; - Average vehicle trips during evacuation assumed to be 1 vehicle per dwelling; and - A total of 1,700 trips during evacuation based on the low development yield.	Evacuate all residents from dwellings located outside of the 'safe zone' as identified in the bush fire assessment. See **Figure 5**.
3c	Partial evacuation of NSW and ACT residents, high development yield, high vehicle trip rate	- Partial evacuation of NSW and ACT residents only – dwelling that are outside of the 'safe zone'; - Average vehicle trips during evacuation assumed to be 1.5 vehicles per dwelling; and - A total of 3,000 trips during evacuation based on the high development yield.	Evacuate all residents from dwellings located outside of the 'safe zone' as identified in the bush fire assessment. See **Figure 5**.
3d	Partial evacuation of NSW and ACT residents, high development yield, low vehicle trip rate	- Partial evacuation of NSW and ACT residents only – dwelling that are outside of the 'safe zone'; - Average vehicle trips during evacuation assumed to be 1 vehicle per dwelling; and - A total of 2,000 trips during evacuation based on the high development yield.	Evacuate all residents from dwellings located outside of the 'safe zone' as identified in the bush fire assessment. See **Figure 5**.

To determine the number of higher risk dwellings the 'safe zone' area was overlaid on the development staging plan as illustrated in **Figure 5.** From this, we were able to estimate the number of dwellings that would fall outside of the area recommended for building neighborhood safer places:

- For the high yield scenario this was estimated to be 2,000 dwellings; and
- For the low yield scenario this was estimated to be 1,700 dwellings.

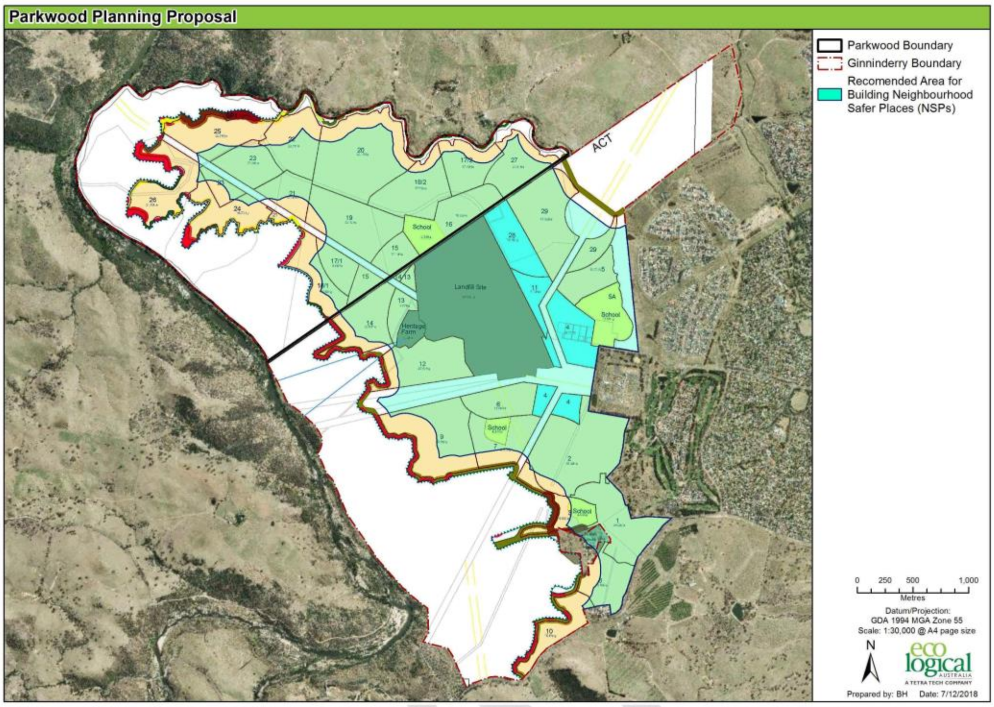

Figure 5 *Development stages overlaid with designated 'safe zone' as determined by the bush fire assessment*

Scenario Testing Results

The potential impacts of an emergency evacuation under all scenarios is measured as the length of time it is estimated to clear the number of residents from the development site. To estimate the time it takes to clear the development under each scenario, the estimated future external road capacity (4,200 vehicles per hour) is divided by the estimated trip generation under each scenario.

Table 3 *Scenario testing results*

REF	Scenario Name	Estimated time to clear development	Commentary
1a	Total evacuation, low development yield, high vehicle trip rate per dwelling: - 14,345 trips	3 hours 25 minutes	Given the extent of the development contained within the 'safe zone', the need for evacuating the whole development is highly unlikely.
1b	Total evacuation, low development yield, low vehicle trip rate per dwelling: - 9563 trips	2 hours 17 minutes	Given the extent of the development contained within the 'safe zone', the need for evacuating the whole development is highly unlikely.
1c	Total evacuation, high development Yield, high vehicle trip rate per dwelling: - 16,863 trips	4 hours 1 minute	Given the extent of the development contained within the 'safe zone', the need for evacuating the whole development is highly unlikely.
1d	Total evacuation, high development yield, low vehicle trip rate per dwelling: - 11,242 trips	2 hours 42 minutes	Given the extent of the development contained within the 'safe zone', the need for evacuating the whole development is highly unlikely.
2a	NSW residents, low development yield, high vehicle trip rate per dwelling - 6,485 trips	1 hour 32 minutes	Large proportions of the development within NSW are contained within the 'safe zone' therefore it is unlikely there will be a need to evacuate all NSW residents.
2b	NSW residents, low development yield, low vehicle trip rate per dwelling:	1 hour 2 minutes	Large proportions of the development within NSW are contained within the

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	- 4,324 trips		'safe zone' therefore it is unlikely there will be a need to evacuate all NSW residents.
2c	NSW residents, high development yield, high vehicle trip rate per dwelling: - 7,784 trips	1 hour 51 minutes	Large proportions of the development within NSW are contained within the 'safe zone' therefore it is unlikely there will be a need to evacuate all NSW residents.
2d	NSW residents, high development yield, low vehicle trip rate per dwelling: - 5,289 trips	1 hour 16 minutes	Large proportions of the development within NSW are contained within the 'safe zone' therefore it is unlikely there will be a need to evacuate all NSW residents.
3a	Partial evacuation of NSW and ACT residents, low development yield, high vehicle trip rate per dwelling: - 2,550 trips	36 minutes	Most likely scenario as the residents identified outside the 'safe zone' may be at most risk during an extreme event and will need to be evacuated to a safer area.
3b	Partial evacuation of NSW and ACT residents, low development yield, low vehicle trip rate per dwelling: - 1,700 trips	24 minutes	Most likely scenario as the residents identified outside the 'safe zone' may be at most risk during an extreme event and will need to be evacuated to a safer area.
3c	Partial evacuation of NSW and ACT residents, high development yield, high vehicle trip rate per dwelling: - 3,000 trips	43 minutes	Most likely scenario as the residents identified outside the 'safe zone' may be at most risk during an extreme event and will need to be evacuated to a safer area.
3d	Partial evacuation of NSW and ACT residents, high development yield, low vehicle trip rate per dwelling: - 2,000 trips	29 minutes	Most likely scenario as the residents identified outside the 'safe zone' may be at most risk during an extreme event and will need to be evacuated to a safer area.

Analysis Assumptions

To undertake the above testing, a number of assumptions were made:

- The external road network is not impacted by the bush fire event and is accessible to all residents in an evacuation situation;
- Driving conditions are assumed to be 'normal' i.e. there are no traffic management or reduce road speeds in place (the lowest range from the estimated future road capacity was utilised as a 'worst case' scenario for the analysis);
- Driving conditions are relatively good i.e. traffic is not impact visually and relatively free flowing; and
- External road capacity was assumed to be 4,200 vehicles per hour which is based on future planned road conditions on the external road network.

Conclusions / Recommendations

This memo presents the results of a first principles assessment of the potential impacts of a bush fire event on residents within the future development of Ginninderry. The memo responds the Gateway Determination in relation to Planning Proposal PP_2015_YASSV_001_00 which specifically requests the '*identification of an indicative road network layout, details of access points and integration with the existing traffic network on roads external to the site. The management of emergency evacuation and management of traffic in a bush fire emergency should inform the road network*'. The key summary points as determined by the analysis within this memo include:

- During the unlikely scenario where a bush fire attack would require the evacuation of the whole development (approx. max of 11,242 dwellings) this could be achieved within 4 hours or less based on the future external road capacity;
- During the unlikely scenario where a bush fire attack would require the evacuation of all dwellings within NSW (approx. max of 5,189 dwellings) this could be achieved within 1 hour 51 minutes or less based on the future external road capacity; and
- During a more likely and realistic scenario, where evacuations of all dwelling within the development that reside outside the designated 'safe zone' (estimated to be approx. 2,000 max), everyone could be evacuated within 45 minutes or less based on the future external road capacity.

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ATTACHMENT 1 – DEVELOPMENT MASTERPLAN

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Appendix C: NSP Specifications

RFS (2017) defines an NSP as follows:

> *An NSP is a building or an open space that may provide for improved protection of human life during the onset and passage of a bush fire. It is a location where people facing an immediate threat to their personal safety can gather and seek shelter from the impact of a bush fire. Their function is to provide a place of last resort for a person to seek shelter at during the passage of the bush fire front.*
>
> *NSPs are not to be confused with Fire Refuges, Recovery Centres, Assembly Areas, Evacuation Centres or Informal Places of Shelter*

Table 7: Assessment Criteria for a Neighbourhood Safer Place (RFS 2017)

Factor	Performance Criteria	Acceptable Solution	Comment
Radiant Heat	Building is located and constructed to enhance the chance for survival for humans in attendance from the radiant heat of a bush fire.	Building is situated to prevent direct flame contact, material ignition and radiant heat level of 10kW/m²; or Provide 139 metres separation distance from a bush fire hazard.	Assessment has been undertaken to identify a radiant heat level of 2kW/m2 and not the 10kW/m2 to provide additional redundancy in the location of any NSP as shown in Figure 21.
	Open Space is located to enhance the chance for survival for humans in attendance from the radiant heat of a bush fire.	Open Space is situated and maintained to prevent direct flame contact, material ignition and radiant heat levels of 2kW/m²; or Provide 310 metres separation distance from a bush fire hazard	Figure 21 indicates the substantial proportion of the development footprint available to provide for a maximum radiant heat level of 2kW/m² to meet these criteria.
Maintenance of the Site and the Land Adjacent	Area between bush fire hazard and the site is maintained to a level that ensures the radiant heat levels at the Building/Open Space meet the Performance Criteria for Radiant Heat.	The site and land adjacent to the site between the Building/Open Space and the bush fire hazard is managed land or maintained in accordance with NSW RFS document *Standards for Asset Protection Zones*	Landscape management practices will be determined at later stages in the development process, however all internal areas will meet the required standards for asset protection zones or be managed land.

Table 8: Principles for Site Identification (RFS 2017)

Consideration	Principles
Site Selection	An NSP should provide a safer place for the community.
	The community should be moving away from the bush fire hazard to access the NSP over short distances where possible.
	NSP locations should reflect community need and bush fire risk.
Moving to a NSP	An NSP should not be isolated from the community.
	The community should not be impeded from reaching the NSP area in a bush fire situation.
Capacity	Additional NSPs should be sought where it is likely current or potential NSPs cannot accommodate those likely to use it.
	Demand for use of an NSP reflect a community's level of bush fire preparedness.

Appendix D: Services Specifications

The following services specifications (provision of water, gas and electricity) are reproduced from PBP (RFS 2018).

Intent of measures: provide adequate services of water for the protection of buildings during and after the passage of a bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building.

Table 9: Performance criteria for services provision for residential and rural residential subdivisions

Performance Criteria	Acceptable Solutions
The intent may be achieved where:	
• a water supply is provided for firefighting purposes	• reticulated water is to be provided to the development, where available; • a static water supply is provided where no reticulated water is available.
• water supplies are located at regular intervals • the water supply is accessible and reliable for firefighting operations	• fire hydrant spacing, design and sizing comply with the Australian Standard AS 2419.1:2005; • hydrants are not located within any road carriageway; • reticulated water supply to urban subdivisions uses a ring main system for areas with perimeter roads.
• flows and pressure are appropriate	• fire hydrant flows and pressures comply with AS 2419.1:2005.
• the integrity of the water supply is maintained	• all above-ground water service pipes external to the building are metal, including and up to any taps.

• location of electricity services limits the possibility of ignition of surrounding bush land or the fabric of buildings	• where practicable, electrical transmission lines are underground;
	• where overhead, electrical transmission lines are proposed as follows:
	  • lines are installed with short pole spacing (30m), unless crossing gullies, gorges or riparian areas;
	  • no part of a tree is closer to a power line than the distance set out in accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.

• location and design of gas services will not lead to ignition of surrounding bushland or the fabric of buildings.	• reticulated or bottled gas is installed and maintained in accordance with AS/NZS 1596:2014 and the requirements of relevant authorities, and metal piping is used; • all fixed gas cylinders are kept clear of all flammable materials to a distance of 10m and shielded on the hazard side; • connections to and from gas cylinders are metal; • polymer-sheathed flexible gas supply lines to gas meters adjacent to buildings are not used; • above-ground gas service pipes are metal, including and up to any outlets.

Table 10: Water supply requirements for non-reticulated developments or where reticulated water supply cannot be guaranteed (Table 5.3d of PBP)

Development Type	Water Requirements
Residential lots (<1000m²)	5000L/lot
Rural-residential lots (1000-10,000m²)	10,000L/lot
Large rural/lifestyle lots (>10,000m²)	20,000L/lot
Multi-dwelling housing (including dual occupancies)	5000L/dwelling

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