



# **Strategic Bushfire Assessment**

## **Nebraska Estate**

Prepared for  
**Shoalhaven City Council**

April 2023 (update)

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# Abbreviations

Abbreviation	Description
APZ	Asset Protection Zone
BFMC	Bush Fire Management Committee
BFPL	Bush Fire Prone Land
BRMP	Bushfire Risk Management Plan
DCP	Development Control Plan
DEM	Digital Elevation Model
ELA	Eco Logical Australia
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
FFDI	Forest Fire Danger Index
GEV	Generalised Extreme Value
IPA	Inner Protection Area
LGA	Local Government Area
NPWS	National Parks and Wildlife Service
NSP	Neighbourhood Safer Place
NSW	New South Wales
OPA	Outer Protection Area
PBP	Planning for Bushfire Protection
RFS	Rural Fire Service
RF Act	<i>Rural Fires Act 1997</i>
t/ha	Tonnes per hectare

# 1 Introduction

## 1.1 Background

This Strategic Bushfire Study (the Study) has been prepared to inform the preparation of the Nebraska Estate Planning Proposal (PP - LP145.1) and supporting Development Control Plan (DCP) being prepared for public exhibition by Shoalhaven City Council. This updated version of the Study replaces the October 2019 report prepared by Eco Logical Australia and its purpose is to ensure the Nebraska Estate Planning Proposal is consistent with the strategic principles set out in Sections 2.3 and 4 – Strategic Planning of *Planning for Bushfire Protection (PBP) 2019*, and thereby, the current (20-Feb-2020) Ministerial Direction 9.1(2) 4.3 – Planning for Bushfire Protection.

Nebraska Estate is identified as Bushfire Prone Land and therefore Council must address Ministerial Direction 4.3 (Planning for Bushfire Protection) issued under Section 9.1 of the *Environmental Planning and Assessment Act*. An updated Bushfire Assessment Report is essential to support a request to the Department of Planning, Industry & Environment for a new Gateway determination.

The minimum components of a Study are listed in Table 4.2.1 of PBP 2019 (Bush Fire Strategic Study) have been provided herein with additional information where necessary.

## 1.2 Planning process

The Nebraska Estate Planning Proposal seeks to amend the Shoalhaven Local Environmental Plan (LEP) 2014 to rezone the land from RU2 – Rural Landscape to a mix of environmental and residential zones. The planning proposal and supporting DCP will allow bushfire risks to be strategically planned and achieve a better outcome compared to what could potentially occur under the current LEP provisions. The proposed zoning and minimum lot size maps are based on a Conceptual Subdivision and Development Plan for Nebraska (LP 145.1) that includes the addition of a proposed fire trail to Grange Road from the intersection of Nebraska and Waterpark Roads. This trail was not part of the previous conceptual subdivision layout adopted by Council in 2016 (MIN16.230) and assessed in the 2018 Study (ELA 2018).

The planning proposal aims to:

- resolve the land's planning status in recognition of the environmental values and constraints and associated statutory and policy framework;
- rezone parts of the subject land that are less constrained to allow residential development, whilst providing increased protection for the remaining land by rezoning it to 'C2 – Environmental Conservation', in accordance with the environmental and land capability constraints;
- manage bushfire risk in accordance with Planning for Bushfire Protection; and
- protect waterways and sensitive downstream ecosystems from the potential impacts arising from residential development.

ELA was also commissioned to review draft bushfire provisions prepared by Council for inclusion in a site-specific Development Control Plan (DCP) chapter.

### 1.3 Aims and Objectives

The Study provides an assessment of the landscape bushfire risk and the residual risk for development following the provision of bushfire protection measures. It includes the following broad strategic assessment considerations in PBP (p. 34, RFS 2019):

- ensuring land is suitable for development in the context of bush fire risk;
- ensuring new development on Bush Fire Prone Land (BFPL) will comply with PBP 2019;
- 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 Nebraska Estate adjoins the existing residential township of St Georges Basin within the City of Shoalhaven (see Figure 1). The proposal seeks to enable residential development in three (3) sectors of the Estate – North-West (NW) Sector, North-East (NE) Sector and East (E) Sector and includes large rural-residential allotments, roads and associated infrastructure.

In addition to bushfire constraints a large proportion of the subject land is affected by other development constraints including flooding, acid sulfate soils, threatened biodiversity and Aboriginal archaeology. These constraints have determined the extent of the three sectors potentially offering residential development potential. Residential development exists to the west, south and south-east of the study area. Figure 1 – Conceptual Subdivision and Development Plan identifies approved dwelling locations both within and on the fringe of the study area as follows:

- Lots 19 & 20, Section A, DP 9699
- Lot 8, Section F, DP 9699
- Lot 19, Section H, DP 9699
- Lot 1, DP 1120892
- Lot 15 & Lot 16, Section H, DP 9699
- Lot 1, DP 1223665
- Lot 100, DP 1104506

Prior approvals for residential use of an existing building ancillary to a worm farm were issued in relation to Lots 19 & 20, Section D, DP 9699.

The subject land formed part of the 1919 subdivision known as Nebraska Estate and comprises 96 lots as follows:

- Lots 4-6 and 11-20, Section A, DP 9699
- Lots 1-20, Section B, DP 9699
- Lots 1-20, Section C, DP 9699
- Lots 1-13 and 18-20, Section D, DP 9699
- Lots 1-7, & Pt Lot 8 Section F, DP 9699
- Pt Lots 15-16 and Pt Lot 19, Section H, DP 9699
- Lots 2-10, Section J, DP 9699
- Lots 1-3, DP 722549
- Lots 1-3, DP 1090657
- Lot 1, DP 777950
- Lot 100, DP 1104506
- Pt Lot 1 DP 1120892

- Pt Lot 1, DP 1223665

Nine (9) of the lots are owned by Shoalhaven City Council, including six (6) that are proposed to be rezoned to enable residential development (Lots 9-13, Section D, DP 9699 & Lot 13, Section B, DP9699). The remainder are privately owned by approximately 50 owners.

The Study Area includes bushfire risk assessment within 5 km of the subject land (Figure 2 - Figure 6).





Figure 1: Nebraska Estate (Conceptual Subdivision and Development Plan, 2023 update) (annotated by Council)

## 2 Bushfire Landscape Risk Assessment

The landscape bushfire risk includes assessment of bushfire hazard, potential fire behaviour and bushfire history within at least a 5 km radius of the Nebraska Estate, herein called the 'study area'.

### 2.1 Bushfire Hazard

The Nebraska Estate is classified as bush fire prone land and is located within a wider landscape of bush fire prone land (see Figure 6 for current BFPL map). The bushfire hazard is extensive and continuous enough to potentially expose the subject land to larger sized bushfires. Larger potential fire catchments (as occurs to the west of the subject land) increase the risk of exposure to landscape wide bushfires which are typically more difficult to control before they impact a site.

Bushfire hazard has been classified using the PBP methodology through assessment of vegetation and slope.

#### 2.1.1 Vegetation

The subject land is within a landscape comprised predominantly of wet sclerophyll and coastal swamp forest vegetation. Smaller areas of woodland and coastal floodplain wetlands occur nearer to the site with larger wet and dry sclerophyll forest dominating the landscape within 5 km of the site (Figure 2 and Figure 3). The spatial extent and continuity of these vegetation types (forests) has the potential to support higher intensity and difficult to control fires.

Vegetation has been classified into Keith Formations and Keith Class (Keith 2004) and assigned a potential total fuel load (tonnes / hectare) using the RFS Comprehensive Vegetation Fuel Loads (RFS 2019b). Figure 2 and Table 1 show the vegetation.

**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 Lowland Wet Sclerophyll Forests (WSF); Coastal Swamp Forest; Central Gorge Dry Sclerophyll Forest (DSF); Sydney Coastal DSF; South Coast Sands DSF; Blackbutt Tall Forest; North Coast WSF; Sydney Montane DSF	36.1
Woodland (grassy and woody)	Coastal Valley Grassy Woodland	20.2
Forested Wetland	Coastal Floodplain Wetlands	15.1
Freshwater Wetland	Coastal Freshwater Lagoons	4.4
Tall heath	Southern Montane Heath	36.9

\*Overall fuel load including Bark and Canopy from (RFS 2019b)

### 2.1.2 Topography and slope

Figure 4 shows that the subject land is located on low elevations to the south-east of higher elevation areas approximately 2 km from the study area (Turpentine Road). The higher elevations along the Nerriga Road toward Sassafras mean that any long running fires from the north-west may become controllable periodically with downhill spread, however upslope spread to the south-east out of Parma Creek has the potential to cause longer distance spotting and impacts on the subject land.

Slope has been captured from a 10 m grid cell Digital Elevation Model (DEM) classified into the following PBP 2019 slope classes (see Figure 5):

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

Steeper areas where fire control is typically more difficult occur to the west and north-west of the subject land, notably within the Parma Creek catchment.

### 2.1.3 Bushfire Weather

The typical / average climate in the Shoalhaven Bush Fire Management Committee (BFMC) area is generally mild with average temperatures ranging from 15.5°C in June to 26.5°C in January. Rainfall is more pronounced in Summer/Autumn with average annual rainfalls of 1110 mm in Nowra and 1270 mm in Milton. The bush fire danger period generally runs between September and March each year.

Adverse fire weather conditions associated with the bush fire danger period in the Shoalhaven are associated with South-westerly to North-westerly winds accompanied by high daytime temperatures and low relative humidity. Dry lightning storms are common during the bush fire season, as are days with a Fire Danger Rating of severe and above.

If fires were to occur under a Fire Danger Rating (FDR) of Very High or above within the steeper forested areas to the northwest of the subject land they would become uncontrollable within a short period of time and therefore have the potential to impact the subject land. Days of Very High FDR or above occur on average about 7.5 days per year based on data analysed from the National Bushfire Weather Data set - Nowra weather station (station number 068072) (Lucas 2010).

Weather data developed by Lucas (2010) under the National Historical Fire Weather Dataset (1972-2015) incorporates the daily Forest Fire Danger Index (FFDI), where suitable inputs are available from over 70 weather stations across Australia. Data from the Nowra weather station was analysed to determine the maximum FFDI for a 1 in 50-year event, being the accepted recurrence period for land use planning (RFS 2019).

The dataset for each site was split into subsets based on wind directions including:

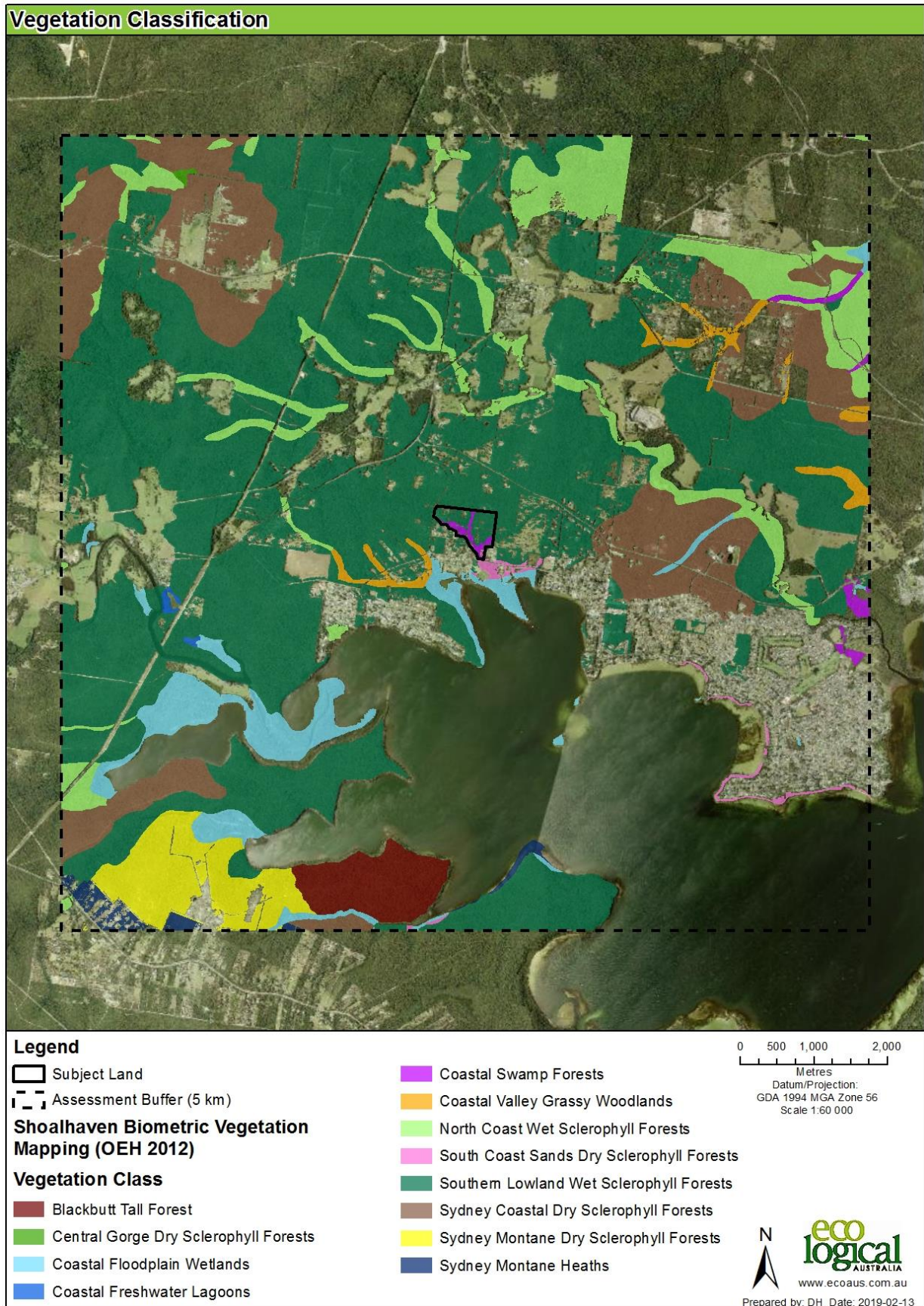
- All directions;
- North to south-east (clockwise);
- South-east to South-west (clockwise);
- South-west to North (clockwise).

To determine the 1:50 recurrence value, a Generalised Extreme Value (GEV) analysis method was undertaken to calculate the FFDI value within each data subset (Table 2). Although the GEV model has been used in other disciplines for analysing extreme events (i.e. flooding recurrence values), it is only in recent times to have been considered appropriate for bushfire weather analysis (Douglas 2017). The GEV methodology and its use to analyse bushfire weather data is discussed in a number of papers by Douglas et al (2014; 2016). Whilst this data has not been updated to 2023, it is expected that the FFDI relationships will remain similar to that shown in Table 2.

**Table 2: FFDI for a 1 in 50-year event**

Weather Station	Max Recorded FFDI	All directions	N to SE	SE to SW	SW to N
Nowra	120	117	47	64	117





**Figure 2: Vegetation Assessment**



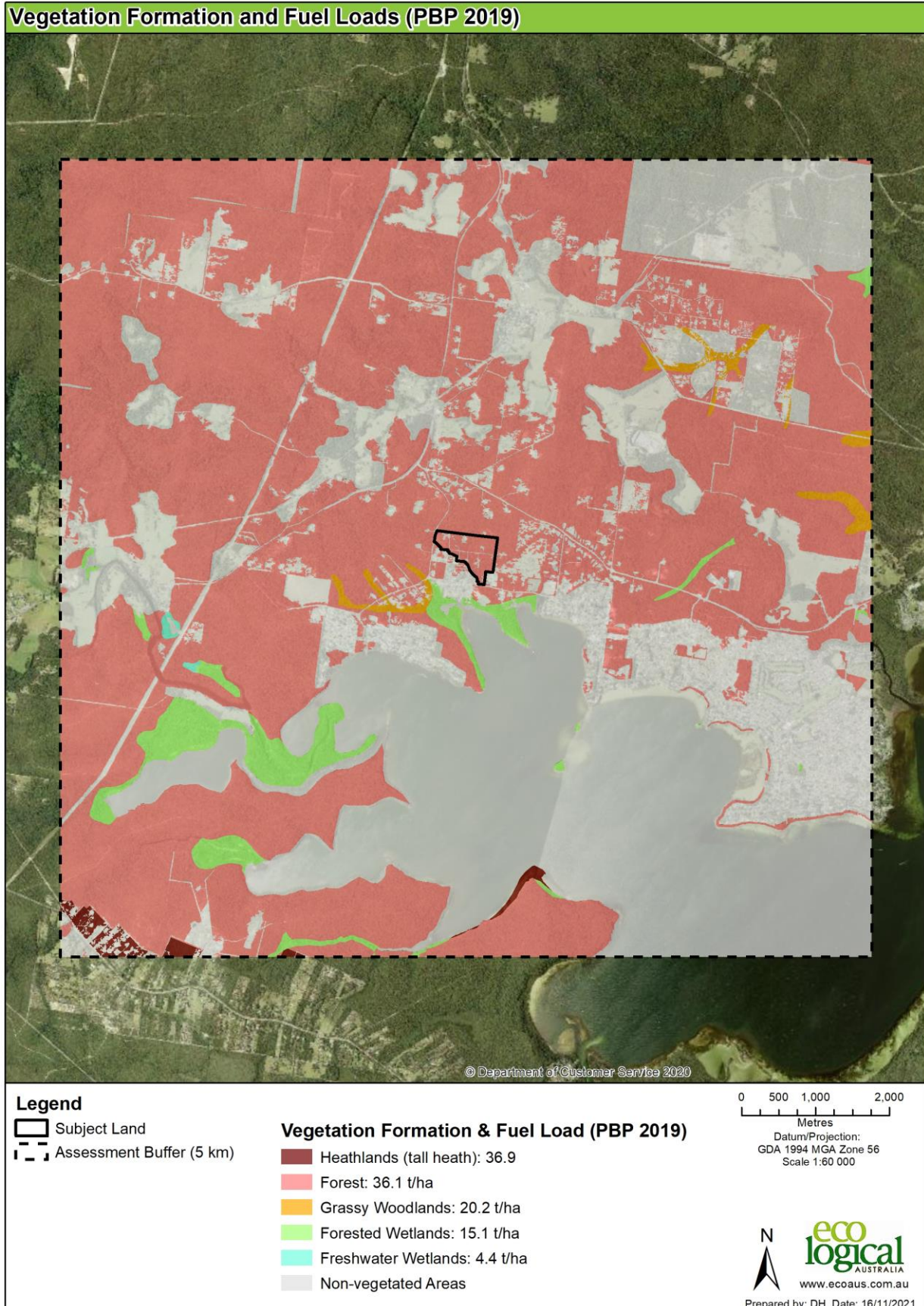


Figure 3: Vegetation formation / fuel classification of Nebraska Estate & surrounding landscape



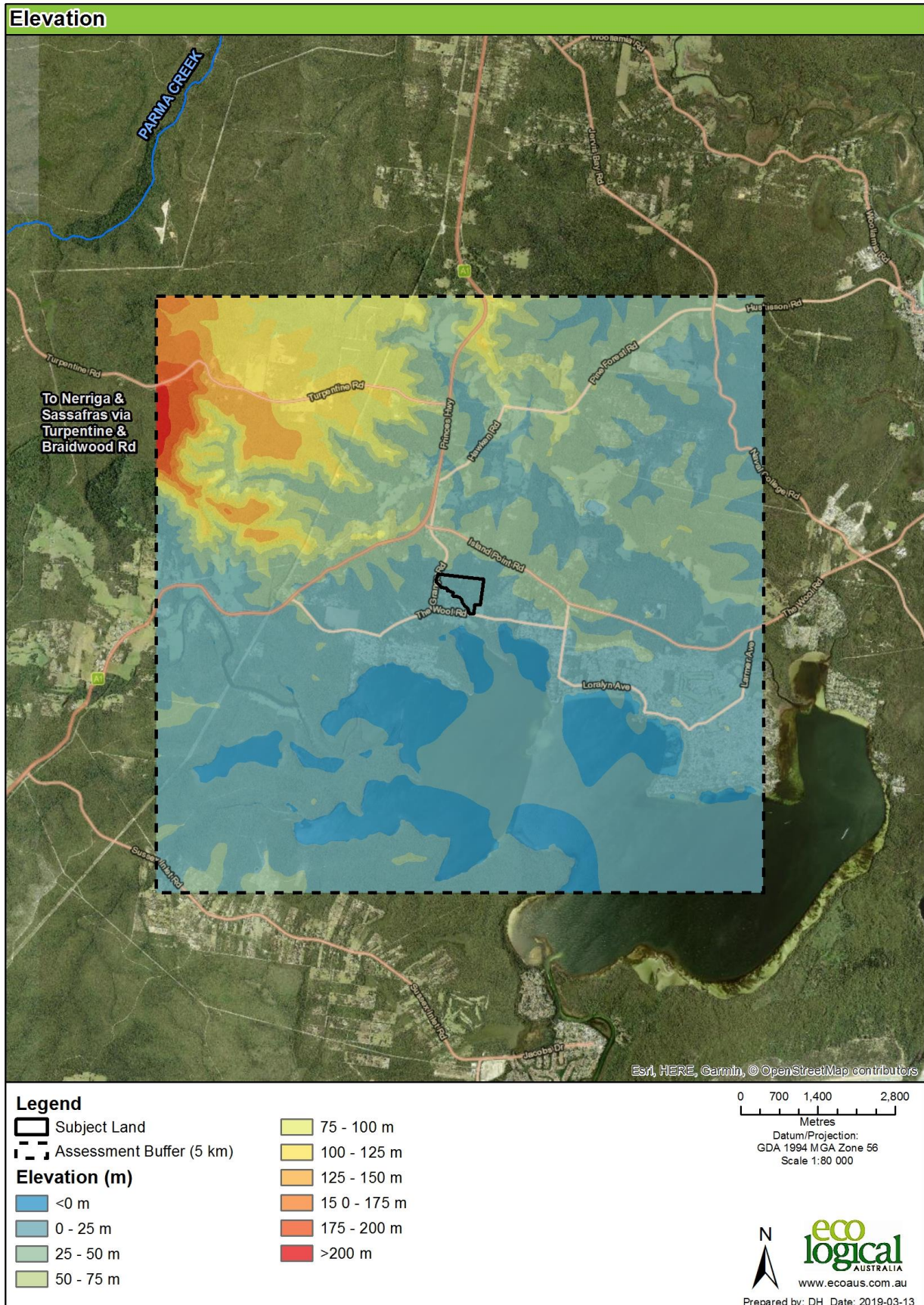


Figure 4: Elevation of Nebraska Estate & surrounding landscape



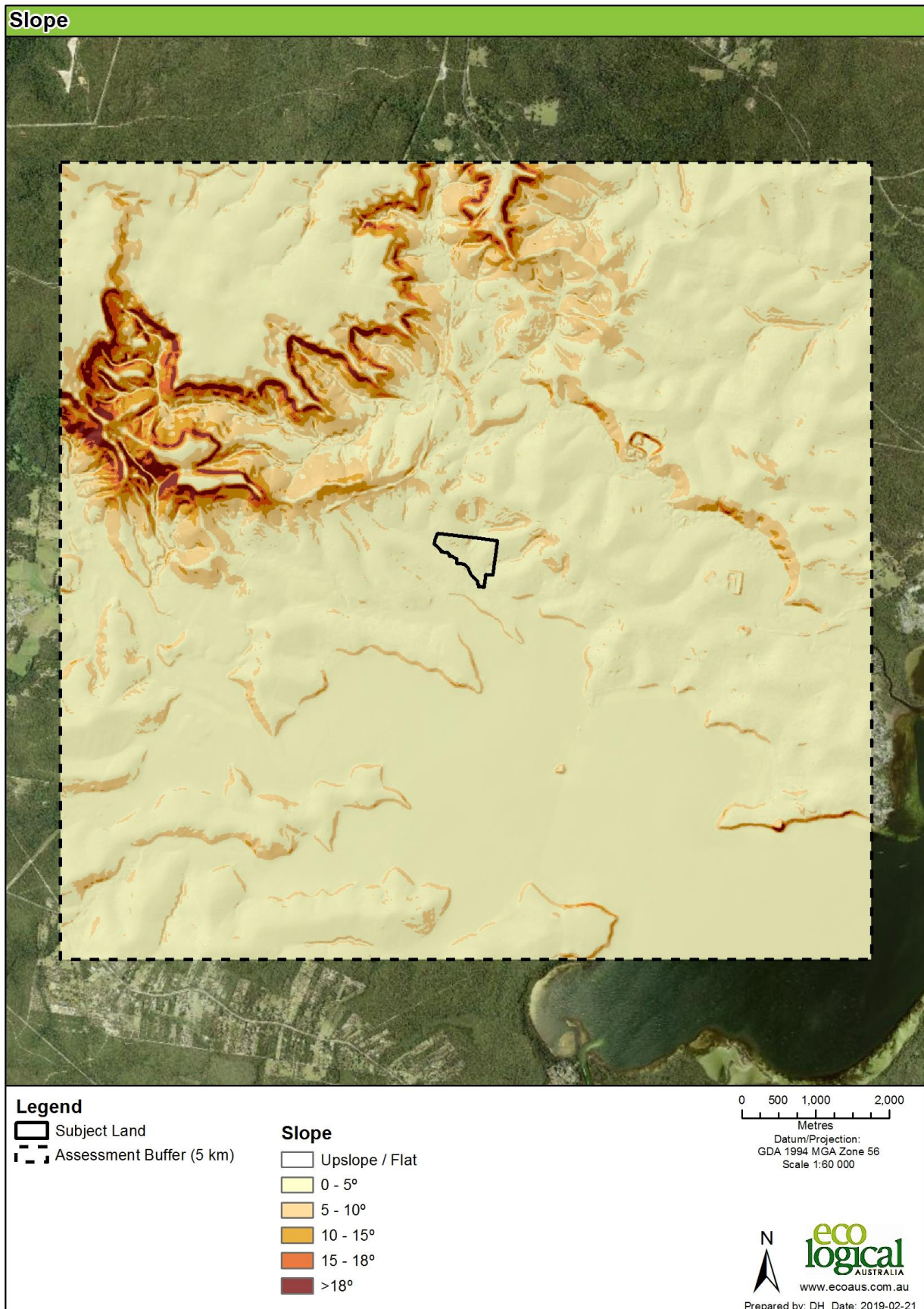


Figure 5: Slope of Nebraska Estate & surrounding landscape



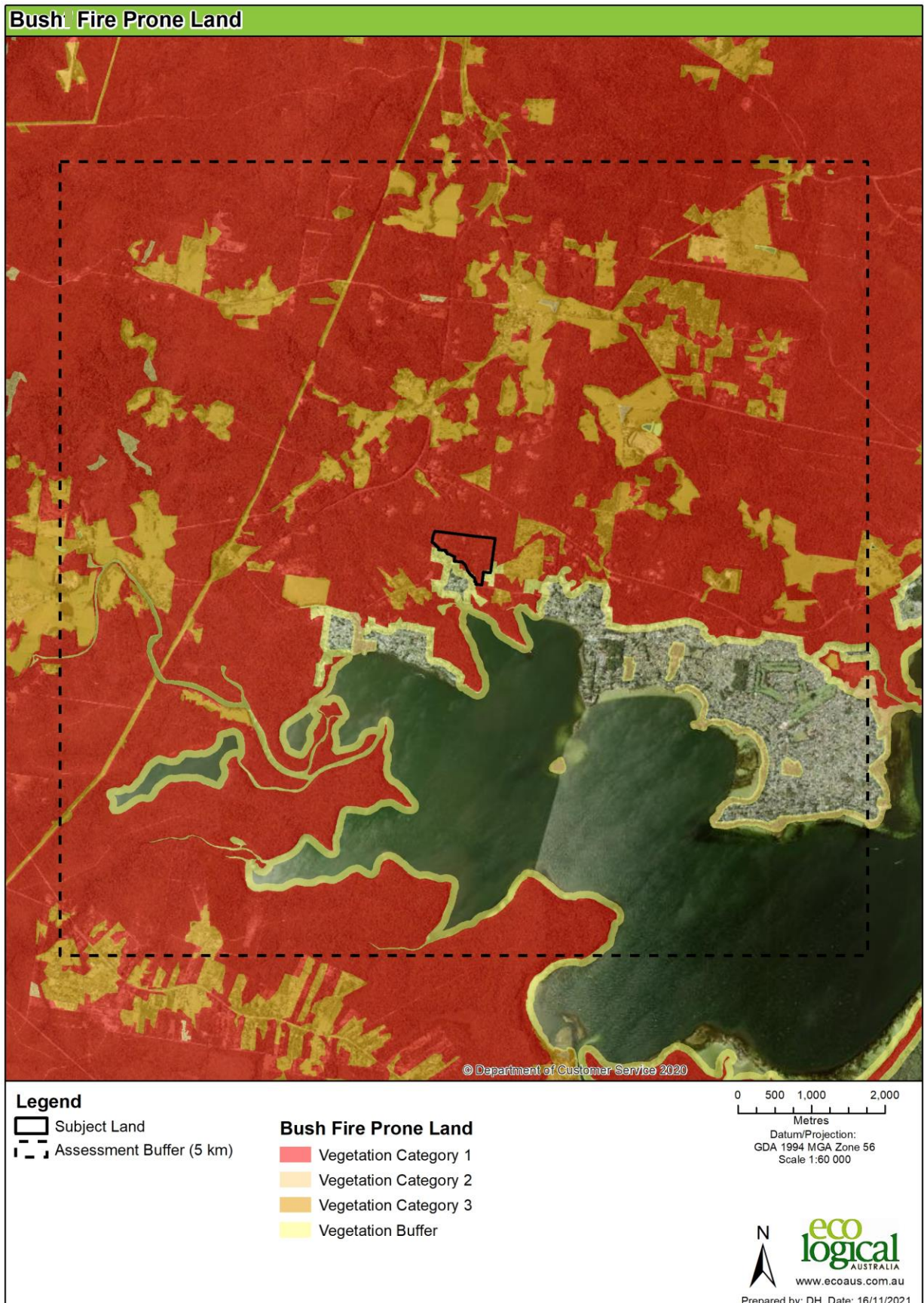


Figure 6: Current Bush Fire Prone Land Map within the Nebraska Estate & surrounding landscape

## 2.2 Potential Fire Behaviour

Bushfire intensity prediction models have been used to review major bushfire potential from various directions with the potential head fire intensity modelled using fire intensity formulae of Cheney et al 2012 (for Forest, Woodland and Wetlands) and Anderson et al 2015 (for Heath). Three models were prepared for the following bushfire attack scenarios:

- Bushfire attack from the north to south-east direction (clockwise) at FFDI 47 (Figure 7);
- Bushfire attack from the south-east to south-west direction (clockwise) at FFDI 64 (Figure 8);
- Bushfire attack from the south-west to north direction (clockwise) at FFDI 117 (Figure 9).

A model has also been compiled to identify the highest intensity from each of the three directions at FFDI 100 (Figure 10). The models show that the greatest intensities occur in forest vegetation which are prevalent in the surrounding areas to the west and south. The areas to the east are generally have lower predicted levels of bushfire intensity.

It is noted that each bushfire event is different, responding to changes in fuel, weather conditions and FFDI. Thus, the model predictions are indicative of what could be experienced under a bushfire likely to be experienced by the expected weather and fire spread through nearby fuels and terrain.

It is important to note that the models of potential fire intensity do not provide ignition risk or the rate of spread of a bushfire; and these are important considerations in likelihood and evacuation risk (respectively). They also do not consider extreme fire behaviour / weather including such phenomena as:

- Spotting/Fire storm;
- Fire tornado/whirls;
- Lateral vortices;
- Junction zones (Jump fires);
- Eruptive fires;
- Conflagrations;
- Downbursts;
- Pyro-convective events.



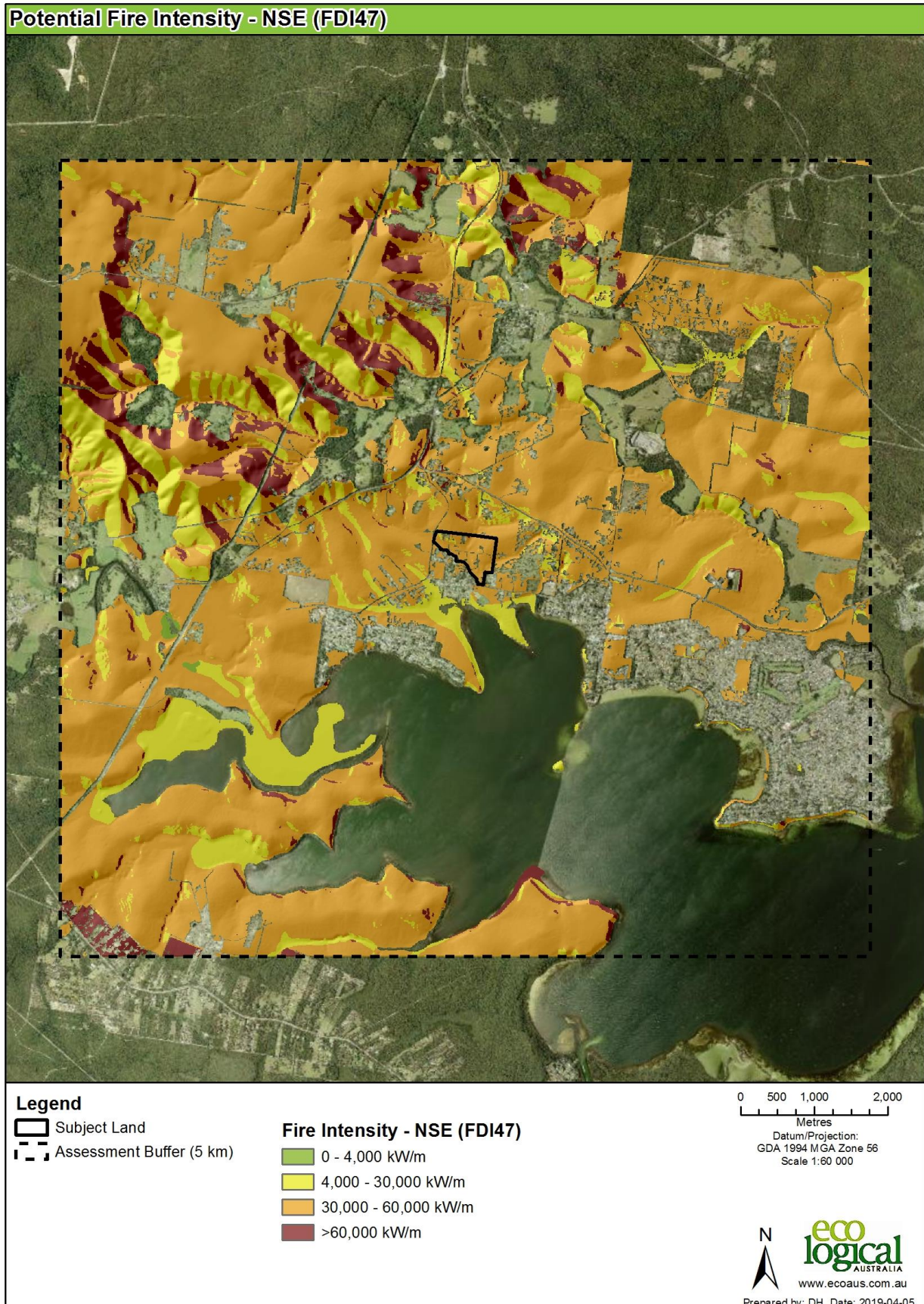


Figure 7: Potential Fire Intensity across the study area (north to south-east wind, FFDI 47)



Potential Fire Intensity - SESW (FDI64)

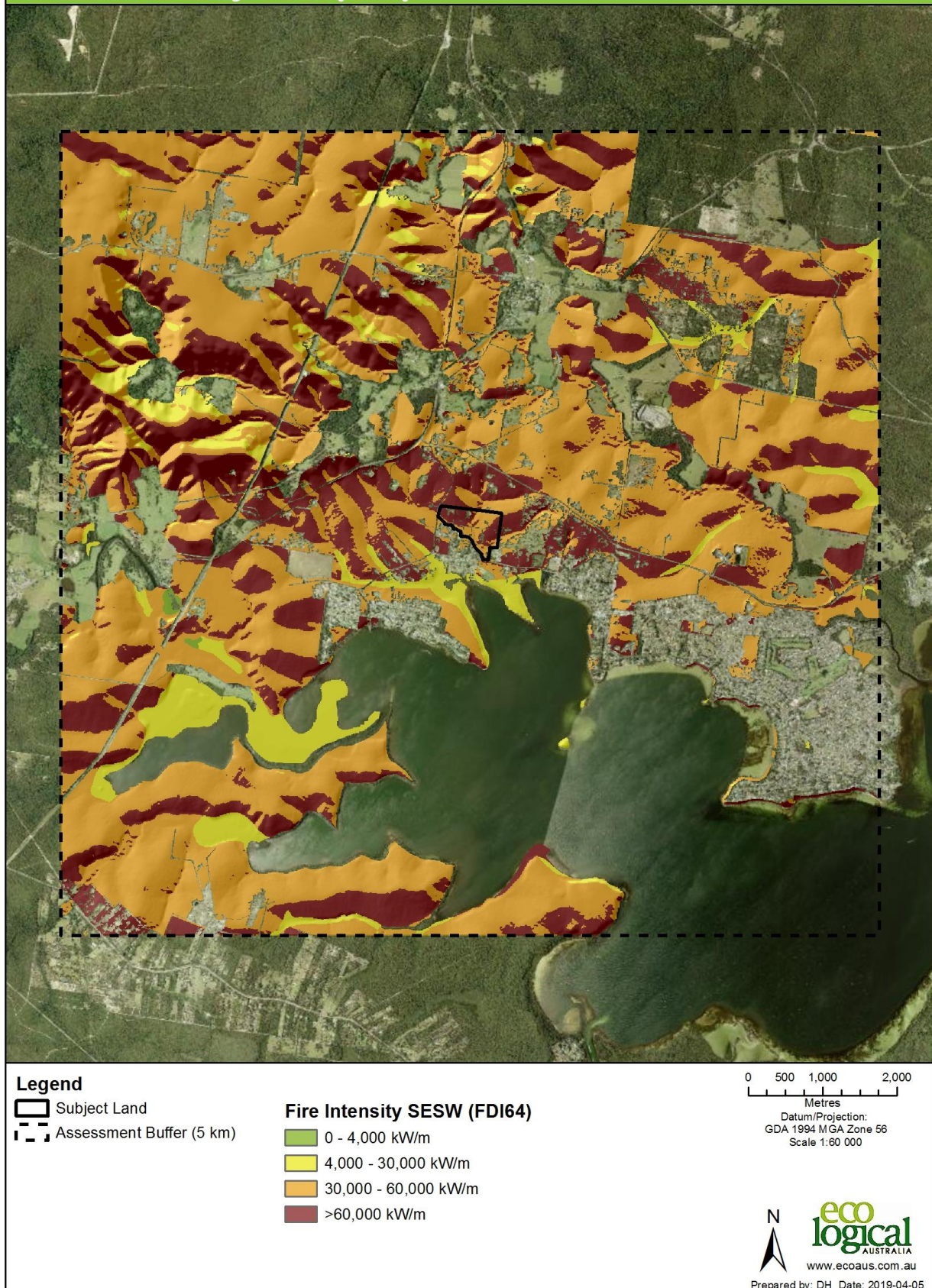


Figure 8: Potential Fire Intensity across the study area (south-east to south-west wind, FDI 64)



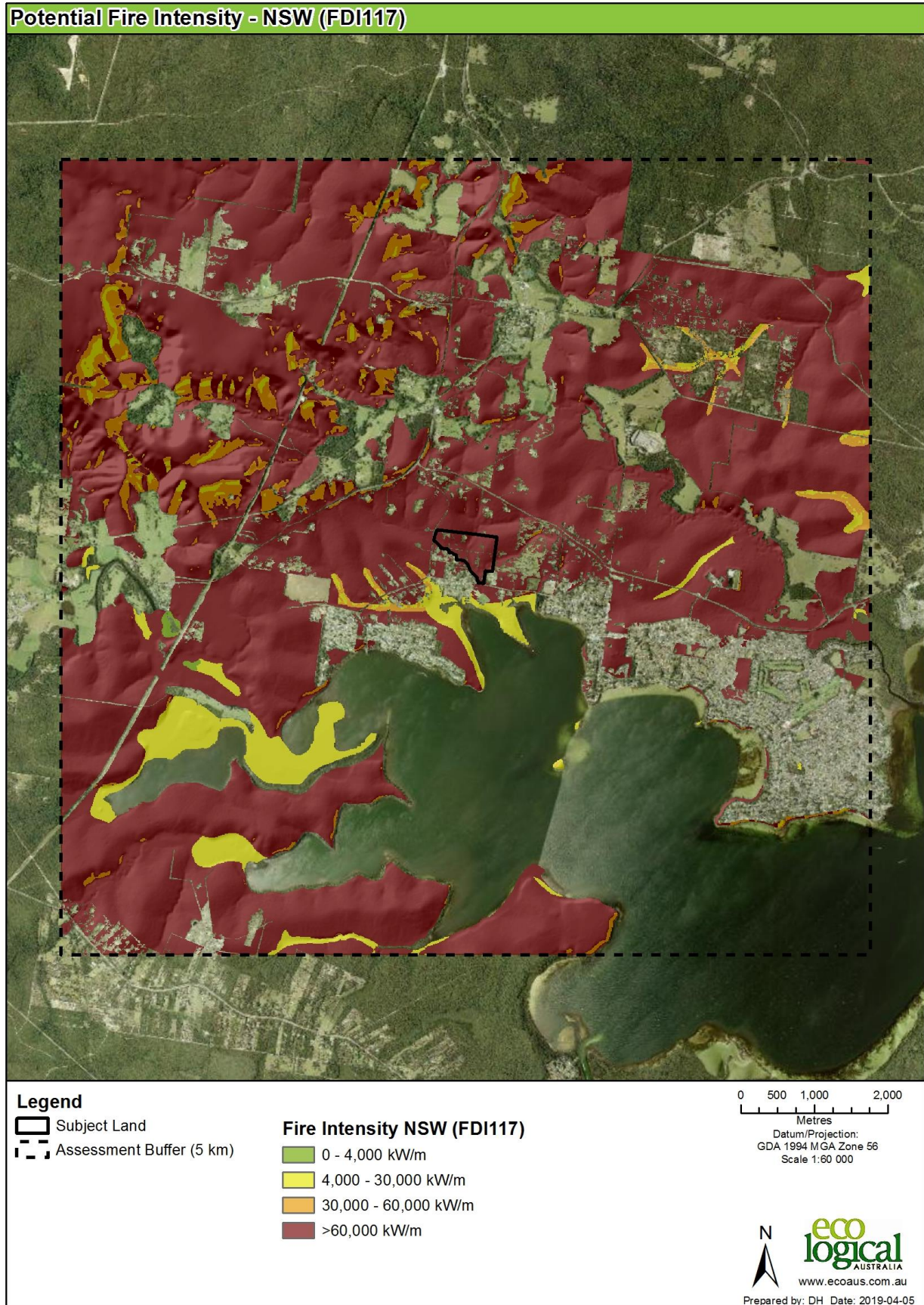


Figure 9: Potential Fire Intensity across the study area (south-west to north wind, FFDI 117)



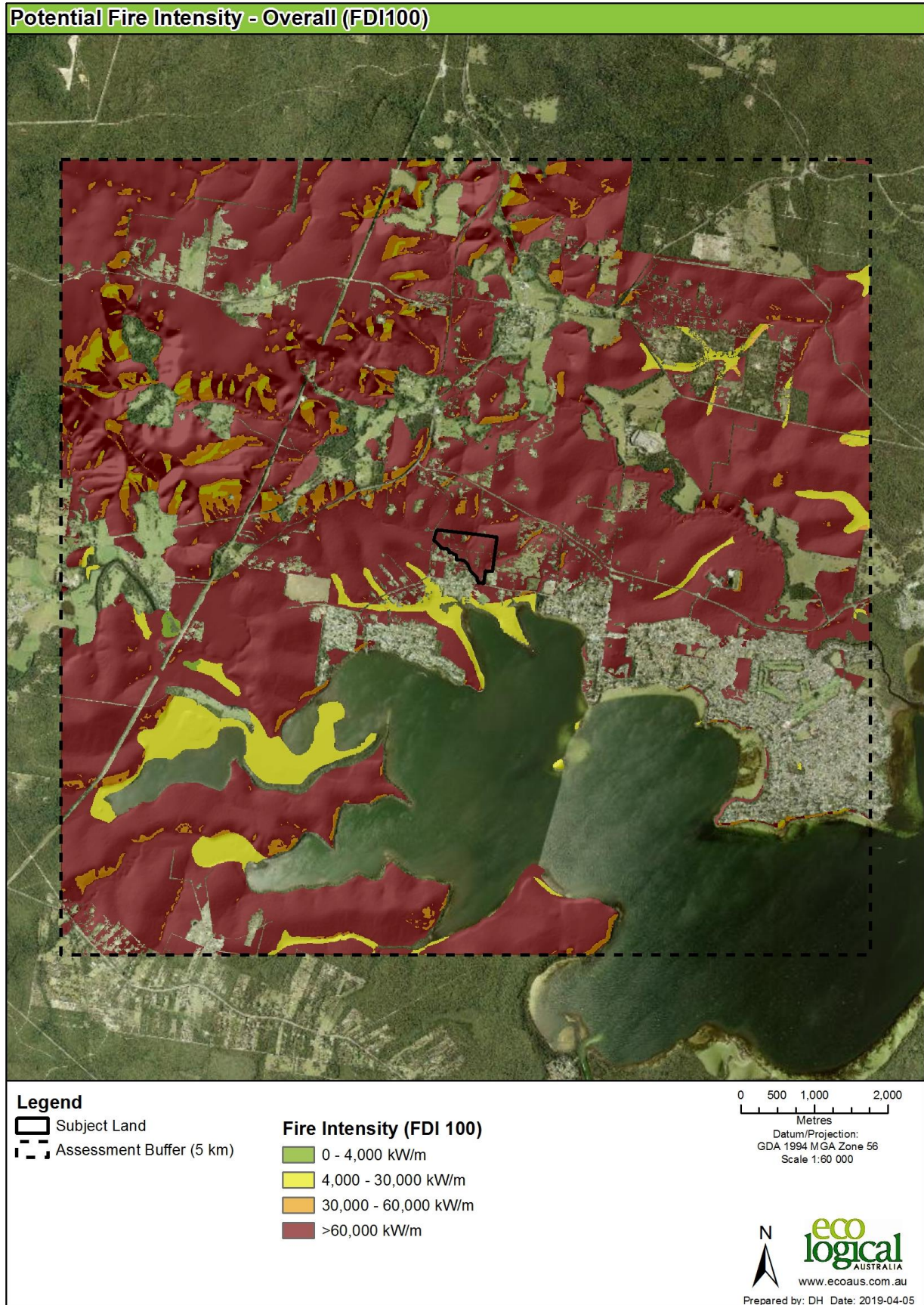


Figure 10: Potential Fire Intensity across the study area (south-west to north wind, FFDI 100)

### 2.3 Bushfire History

The Shoalhaven Bush Fire Risk Management Plan (BFRMP) (BFMC 2019) identifies that the *main* sources of ignition in the Shoalhaven BFMC area are:

- Arson
- Lightning, and
- Accidental

Figure 11 shows the wildfire history for the study area from 1980 – 2020 from the NPWS fire history mapping data set. No wildfires have occurred on the subject land over this period, however two large fires in 2001/02 and 2019/20 were threatening the area. Although both large fires were contained on major roads, every fire poses a different suite of risks and control options and future fires are expected to occasionally impact the subject land.

In addition to the two major fires there have been others over the past three decades that under different circumstances could have spread to the site (Rod Rose pers. comm. 2019).

A smaller fire in 2006-2007 to the west of the site is the closest recorded fire to the subject land.



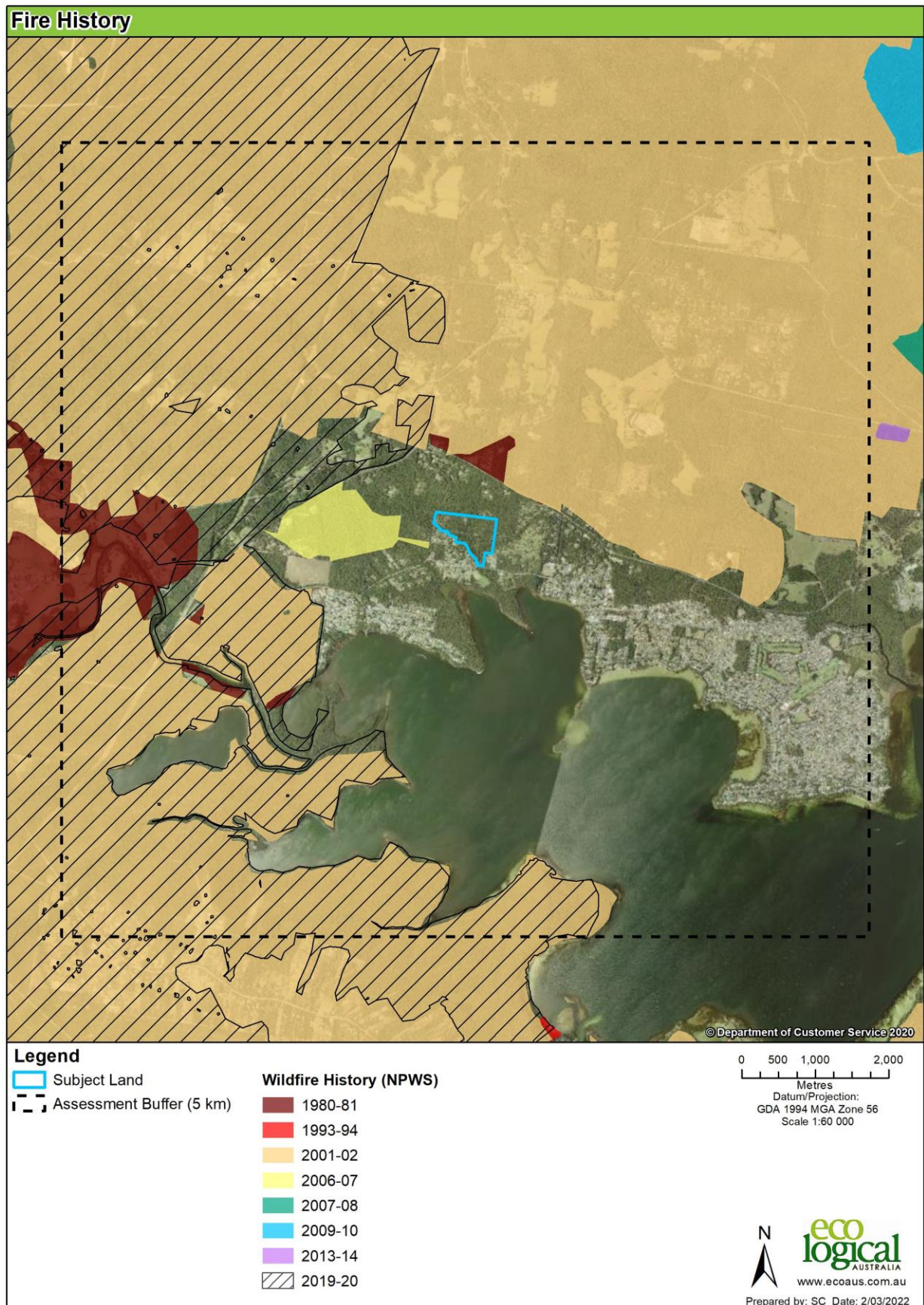


Figure 11: Wildfire history of study area 1980/81 – 2019/20



## 2.4 Summary of landscape bushfire risk assessment

The landscape risk 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 reasonably foreseeable that Bushfire Attack Levels (BAL) under Catastrophic Fire Danger Rated days could occur and therefore assessment of individual allotment risks under the AS 3959-2019 and PBP 2019 benchmarks are appropriate.

BALs are primarily a predictor of the potential consequence of bushfire attack on a building but does not adequately consider likelihood which can be understood from:

- 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 reduced fuel areas, timing of fire runs compared to suppression deployment and capability, and the coincidence of these with landscape fire advantages such as existing roads and infrastructure (i.e. powerline easement) as well as existing areas of development and land management.

Although wildfire history indicates the probability of a landscape-wide fire or major fire attack on the subject land is low, it is feasible and the extent of forests to the west suggest that it is likely, at least over the next 50 years.

Based on the wildfire history, landscape fire advantages and the proposed larger allotment size enabling appropriate bushfire protection measures, the Study does not consider the development proposal as in an unacceptable bushfire landscape risk.

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 bushfire risk in the landscape. The total elimination of bushfire risk is not necessary or feasible; as is the situation for any Bush Fire Prone Land.

### 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. Planning for Bushfire Protection (PBP) is called up by this legislation as the subject land is mapped as bush fire prone land, and it is a critical guide in assessing the bushfire risk suitability of the proposal.

PBP (RFS 2019) 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 2019).

The aim and objectives of PBP (RFS 2019) below provide additional guidance for land use assessment within a Strategic Bush Fire 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 defensible 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 (RFS 2019) is a fundamental consideration of 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:

- There is ample area on each potential allotment to locate APZ and other bushfire protection measures to meet the acceptable solutions within PBP 2019;
- The placement and juxtaposition of building envelopes and their APZ can reduce the risk of bushfire spread through rural residential properties and increase their resilience. Situations

where APZ abut or overlap potentially provide more defensible dwellings and reduce the potential fire pathways through the non-APZ components of a rural residential development. Based on this, consideration should be given to relocate the proposed North-east sector south to adjoin the South sector.

- Where existing buildings do not benefit from combined (enlarged) APZ with adjoining properties their APZ should, where possible, be enlarged to the equivalent of a BAL 12.5 sized APZ;
- No unusual cumulative risks have been identified. Complementary and consistent risk management through landscape and building design, and community programs are also feasible.

## 4 Feasibility of Asset Protection Zones

Figure 12 shows 18 transects used to assess the APZ requirements for the site and the resultant APZs. Table 3 identifies the slope and vegetation type used to determine these APZ. It is concluded that the required APZ under PBP 2019 for residential subdivisions for the three potential development sectors shown in Figure 1 are feasible, subject to the comment provided on Transect 4 in Table 3. It also shows these can be achieved without the need for Performance Solutions.

**Table 3: Indicative APZs for each Sector to achieve BAL 29**

Transect #	Slope <sup>1</sup>	Vegetation <sup>2</sup>	PBP required APZ (residential) (PBP 2019) <sup>3</sup>	Allowable Outer protection area (PBP 2019) <sup>4</sup>	Recommended BAL-29 or BAL-19 APZ <sup>5</sup>	Comments
1	All upslopes and flat land	Forest	24 m	10 m	BAL-29 – 24 m	APZ provided by property access, managed gardens and future Inner Protection Area (IPA) and Outer Protection Area (OPA).
2	All upslopes and flat land	Forest	24 m	10 m	BAL-29 – 24 m	APZ provided by Nebraska Road, managed gardens and should be managed to the standard of an IPA and OPA.
3	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-29 – 29 m	As above
4	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-29 – 29 m	APZ provided by managed gardens and proposed IPA and OPA.
5	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-29 – 29 m	As above.
6	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-29 – 29 m	As above.
7	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-29 – 29 m	APZ provided by property access, managed gardens and future Inner Protection Area (IPA) and Outer Protection Area (OPA).

Transect #	Slope <sup>1</sup>	Vegetation <sup>2</sup>	PBP required APZ (residential) (PBP 2019) <sup>3</sup>	Allowable Outer protection area (PBP 2019) <sup>4</sup>	Recommended BAL-29 or BAL-19 APZ <sup>5</sup>	Comments
8	All upslopes and flat land	Forest	24 m	10 m	BAL-29 – 24 m	APZ provided by managed gardens and proposed IPA and OPA
9	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-29 – 29 m	As above
10	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-19 – 40 m	BAL-19 APZ proposed to address access constraints, with construction to be to BAL-29. APZ for BAL-19 shown on Figure 12
11	All upslopes and flat land	Forest	24 m	10 m	BAL-19 – 33 m	As above
12	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-19 – 40 m	As above
13	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-19 – 40 m	As above
14	All upslopes and flat land	Forest	24 m	10 m	BAL-19 – 33 m	As above
15	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-19 – 40 m	As above

Transect #	Slope <sup>1</sup>	Vegetation <sup>2</sup>	PBP required APZ (residential) (PBP 2019) <sup>3</sup>	Allowable Outer protection area (PBP 2019) <sup>4</sup>	Recommended BAL-29 or BAL-19 APZ <sup>5</sup>	Comments
16	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-19 – 40 m	As above
17	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-19 – 40 m	As above
18	Downslope >0 to 5 degrees	Forest	29 m	10 m	BAL-19 – 40 m	As above

<sup>1</sup> Slope most significantly influencing the fire behaviour of the site having regard to vegetation found as per PBP.

<sup>2</sup> Predominant vegetation is identified, according to PBP.

<sup>3</sup> Assessment according to Table A1.12.2 of PBP 2019.

<sup>4</sup> Assessment according to Table A1.12.3 of PBP 2019.

<sup>5</sup> Assessment according to Table A1.12.5 of PBP 2019.



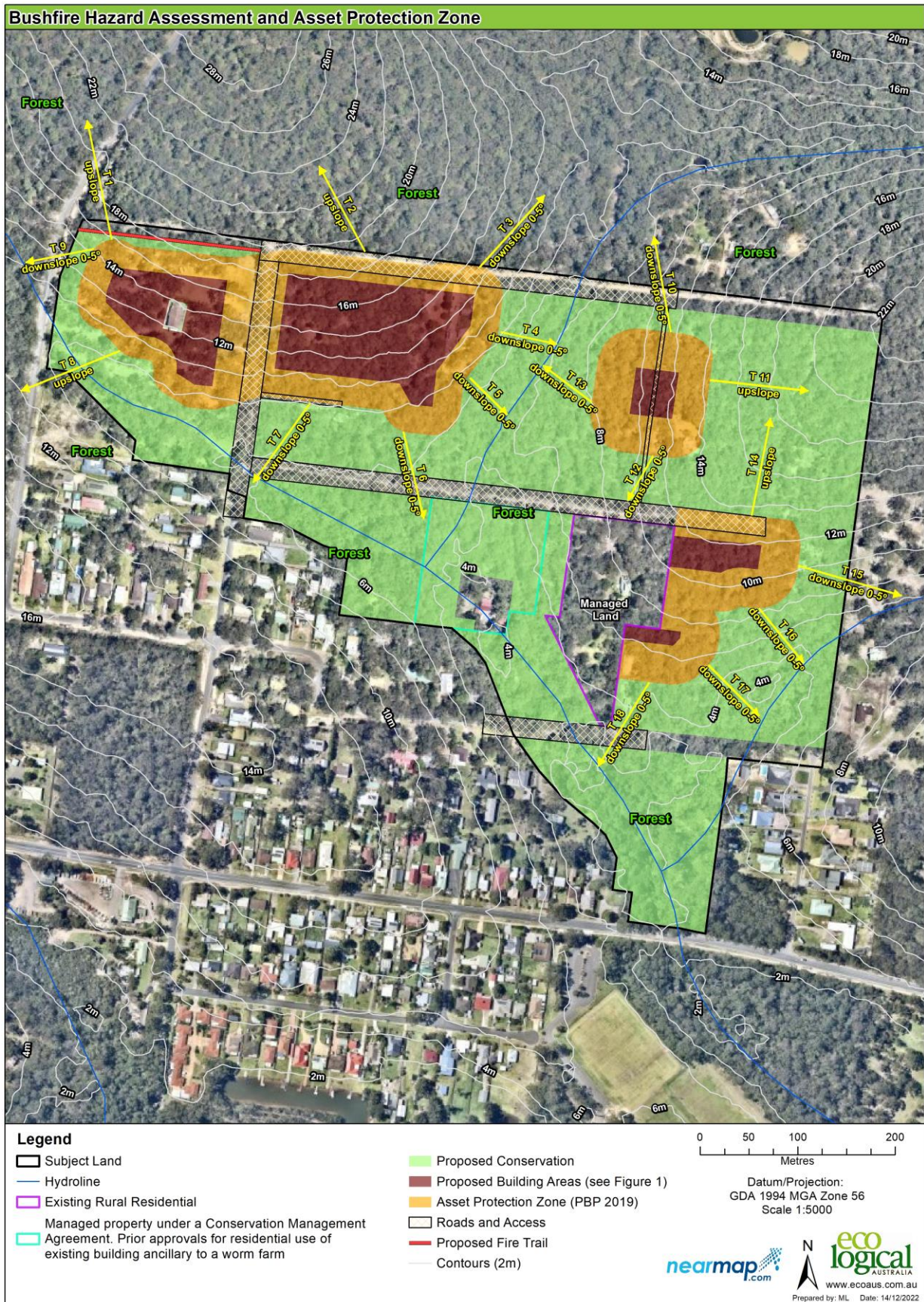


Figure 12: Asset Protection Zones for residential subdivision (PBP 2019)



## 5 Access and egress

Figure 13 shows the existing access for approved dwellings within the subject land. The Conceptual Subdivision and Development Plan (Figure 1) provides the proposed access including off-site alternate egress options via Waterpark Road and Fisherman Road (south-west egress) and a proposed fire trail (with locked gates) for emergency access connecting Nebraska Road to Grange Road (north-west egress). The emergency access only fire trail provides reliable access for RFS brigades (via a master key), however, in the absence of a fail-safe arrangement for opening the fire trail for residents the Study assumes residents can only rely on exiting via Waterpark Road.

While residents have alternative egress options within the majority of the subject land, the 175 m of Waterpark Road between Pelican Road and Clarendon Crescent represents a single road exit for all residents apart from those on proposed dwelling sites 9, 10 and 23. While the southbound egress on Waterpark Road is away from the primary direction of bushfire threat (from the north-west) and the majority of the 175 m single road egress is bounded by residential development (Figure 12), a vegetated riparian corridor (~ 50 m wide) poses a bushfire risk within the portion of single access road at the Pelican Road intersection.

The 50 m wide riparian corridor west of Waterpark Road is about 200 m long and is bordered by rural residential development with well managed paddocks. The narrowness of the vegetated corridor is likely to mitigate the bushfire risk to some extent, however, as the riparian corridor connects to a larger forested area to the west, the egress could be expected to be impacted directly by a westerly approaching bushfire.

The PBP Performance Criteria for access would need to be satisfied in the absence of meeting the Acceptable Solution in PBP. The relevant PBP Performance Criteria addressing alternate egress is *“access roads are designed to allow safe access and egress for firefighting vehicles while residents are evacuating.”*

An important aspect in assessing the Performance Criteria is the likelihood of the 175 m length of ‘single access’ on Waterpark Road becoming unsafe in a bushfire; the following are considerations in that assessment:

- a maximum of 22 residences would need to evacuate over the bridge over the vegetated corridor
- early evacuation typically means evacuees from the 22 lots reliant on the single access will not evacuate simultaneously and may evacuate over many hours
- visibility of a fire approaching from the west is good for some distance past Grange Road
- opening the fire trail as an alternate egress for residents can be done by the RFS (if essential)
- the bushfire intensity from the west is mitigated by the 50 m width of the riparian corridor
- fire impacting the bridge area may be a 1 in 20+ year occurrence (based upon fire history)
- a collision with incoming vehicles is a lower risk as firefighters can move in and out via the proposed fire trail off Grange Road
- Firefighting vehicles have a safe access (via the fire trail) while residents evacuate

Notwithstanding the low likelihood risk of the single egress portion of Waterpark Road being blocked/unsuitable for egressing residents, there is a high consequence risk if evacuees are impacted by a bushfire while in a car, if this occurred adjacent the riparian corridor.

Access to proposed dwelling sites 9 and 10 at the eastern end of Fisherman Road (see Conceptual Subdivision and Development Plan (Figure 1) also does not comply with the PBP Acceptable Solutions.

Although more than half of the single access portion of the egress route for proposed dwellings 9 and 10 is within existing rural residential development, the proposed dwellings are located about 300 m from where alternate egress options are available off Waterpark Road. Given this risk is associated with only two allotments it is considered small and compares favourably with the Acceptable Solution in PBP of *“dead end roads are not recommended, but if unavoidable, 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”*.

The relevant PBP Performance Criteria for assessing the 300 m access road to Lot 9 and 10 is *“firefighting vehicles are provided with safe, all-weather access to structures”*. The Study finds that there is no evidence that firefighting vehicles cannot be provided with safe, all-weather access to Lots 9 and 10.

Application of PBP Performance Criteria to the two parts of the access system (discussed above) are necessary because of significant environmental and heritage constraints on the subject land. Both access issues are relatively minor and considered capable of compliance with the access Performance Criteria within PBP.

The proposed access road design can comply with PBP 2019 and will be a combination of:

- public roads constructed to perimeter road standard (8 m trafficable width) except where environmental and/or heritage constraints justify a 6 m trafficable width;
- fire trails complying with NSW RFS fire trail standards; and
- property access roads.

Future more detailed planning can readily incorporate access requirements of PBP 2019 (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;
- a road design with adequate capacity to facilitate satisfactory emergency evacuation; and
- provision of fire trail/s to support operational activities in strategic locations.

Widening of the bridge near the Waterpark Road and Pelican Road intersection to two lanes (8 m) should also be investigated.

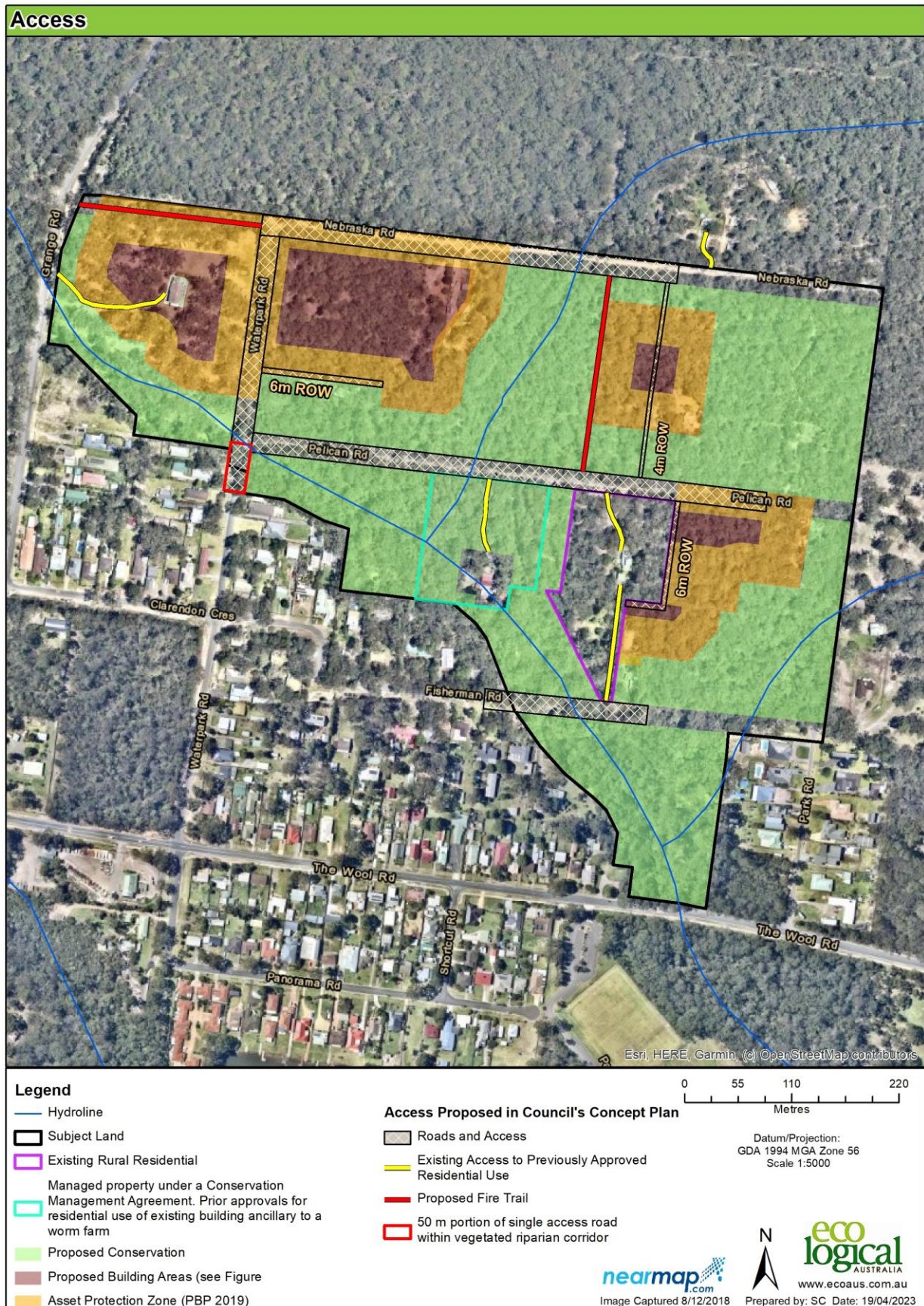


Figure 13: Existing and potential access arrangements

## 6 Emergency Services

The following is recommended for strategic land use planning to achieve the objectives and strategic planning principles of PBP 2019 relating to emergency management. 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.

The proximity of emergency services to the precinct are considered adequate, subject to the completion of all access roads (and fire trail) prior to construction and occupation of new dwellings. There are three RFS brigades within 7 minutes travel time of the subject site:

- Basin View Brigade (2 km, 4 minutes travel time to south-west);
- Tomerong Brigade (4.5 km, 6 minutes travel time to north-west); and
- St George's Basin Brigade (5km, 7 minutes travel time to north-east).

NSW RFS Shoalhaven District Office advised via phone (4 April 2019) that they would expect any future development to be consistent with Shoalhaven BFRMP, including participation by future residents in any future Community Firewise Workshops. Additionally, contact with local brigade(s) as construction occurs and as future residents occupy dwellings to assess access and egress, and discuss Bush Fire Survival Plans was identified as a priority action.



## 7 Evacuation

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

- An analysis of the most relevant bushfire attack scenarios i.e. fire from the west and north-west;
- Identification of evacuation and refuge locations (Section 7); and
- An evaluation of evacuation adequacy and option for the shortcomings identified.

### 7.1 Assessment of Neighbourhood Safer Places (NSPs)

There are a number of existing NSPs in proximity to the subject land, including:

- Basin View Boat Ramp, Basin View Parade Basin View (2.5 km south-west);
- Tomerong Public School, 355 Hawken Road Tomerong (4.5 km north); and
- St George's Basin Country Club, 11 paradise Beach Road, Sanctuary Point (6.5 km east).

### 7.2 Stay and defend options

The Acceptable Solutions within PBP assume early evacuation is feasible. However, modelling of fire rates of spread in forests, and the likely time from ignition to when safe evacuation is complete, always shows that rapid onset bushfire attack is possible and that under such fires early evacuation may not be feasible.

Although this is beyond the Acceptable Solutions considerations within PBP the access options for the Subject Land and the larger lot sizes suggest additional protection measures are desirable. This can be achieved by the building envelope clustering and enlarged APZ and higher building construction standards suggested in Section 4.1. These additional bushfire protection measures significantly improve the stay and defend options of future dwellings.

### 7.3 Bushfire Emergency and Evacuation Plan

A Bushfire Emergency and Evacuation Plan (Evacuation Plan) should be prepared for the site to clearly identify the circumstances under which early evacuation or stay and defend are considered within personal Bushfire Survival Plans. The Evacuation Plan can also identify the circumstances and process under which the fire trail to the west onto Grange Road can be used.

The proposed fire trail provides reliable access for RFS brigades (via a master key) and can achieve the PBP Performance Criteria for emergency access for firefighters. While the fire trail may be suitable for resident evacuation use after it is opened by the RFS, the Evacuation Plan should focus on residents using the egress via Waterpark Road.

## 8 Infrastructure

### 8.1 Water

The proposal is to be serviced by a reticulated water supply, although a number of lots may be located further than 70 m from the nearest hydrant point and will require a static water supply. Appendix B, Table 5 identifies the Acceptable Solution requirements of Section 5.3.4 of PBP, and Appendix B, Table 6 identifies the requirements for lots that may require a static water supply (i.e. if >70 m from hydrant points).

The PBP Acceptable Solution requirements for water is achievable.

### 8.2 Electricity and gas

A decision on whether electricity supply to the subject land will be above ground or below ground has not been made. It is preferable that electrical transmission lines are underground where practical to reduce the risk of ignition or power failure. Details for compliance with PBP 2019 are provided in Table 5.

## 9 Adjoining land

Future development will not be reliant on any off-site bushfire mitigation measures. All buildings and use will be designed to PBP standards and not rely on fuel management on other lands.

The areas to the north and west of the Study Area are identified as a Strategic Fire Advantage Zone (SFAZ) within Map 3 of the 2018 Shoalhaven Bush Fire Risk Management Plan. SFAZ's aim 'to provide strategic areas of fire protection advantage which will reduce the speed and intensity of bush fires and reduce the potential for spot fire development' (Shoalhaven BFRMP, 2018). This management practice is expected to continue, with no additional impacts to the management regime because of the proposed development.

The proposed rezoning will not have a deleterious impact on the ability for bushfire management activities to be undertaken on adjoining land or increase the risk to other development in the locality. It is likely the proposed clustering of APZ and the associated extra clearing and upgraded roads will reduce the potential for bushfire impacts on St Georges Basin and other nearby areas to the south and east of the Subject Land.

Notwithstanding this, low density rural dwellings in a forested landscape complicate fire management to some extent, unlike fully clustered development where bushfire attack is more manageable. As discussed in Section 1, the NSW RFS Shoalhaven District Office would seek contact with local brigade(s) as future residents occupy dwellings to assess access and egress and discuss Bush Fire Survival Plans.

## 10 Conclusions

The Strategic Bushfire Assessment has addressed the requirements of Section 4 of Planning for Bushfire Protection 2019 and has specifically addressed the components of Table 4.2.1. The Assessment found no significant adverse effects of the proposed re-zoning under the Table 4.2.1 assessment considerations of bushfire landscape, land use, emergency services, infrastructure and adjoining land.

The environmental and heritage constraints of the site meant two issues under 'access and egress' could not be resolved with PBP Acceptable Solutions. However, the Study found that it is likely the PBP Performance Criteria can be met by the proposed fire trail (with locked gates) between Grange Road and Nebraska Road as an appropriate means of lowering the risk of the 175 m portion of single egress road to the south of the subject land on Waterpark Road. It also found that the 300 m single access road to proposed dwelling sites 9 and 10 meets the PBP Performance Criteria, as it is only 100 m longer than the Acceptable Solution and it is only for two lots.

The proposed Conceptual Subdivision and Development Plan includes various measures to reduce the bushfire risk associated with the re-zoning, including:

- Enlarged and clustered APZs;
- Integration of non-combustible infrastructure within APZs such as roads, easements and parking areas;
- The existing bridge at the intersection of Pelican Road and Waterpark Road should be upgraded to two lanes (8 m);
- Management of fuel loads between Grange Road and Waterpark Road be formalised through a Vegetation Management Plan and positive covenant to ensure environmental objectives are met in the future;
- A study of the likelihood of traffic blockages occurring at the intersections of Waterpark Rd and Pelican Rd, and Waterpark Rd and Clarendon Cres undertaken prior to the infrastructure design stage;
- Underground electricity services provided, where possible;
- PBP compliant water supplies;
- Emergency response planning, including community education and engagement with local brigades on Bushfire Survival Plans and access/egress as dwellings are constructed and occupied.

It is concluded that the planning proposal (and supporting draft DCP) is consistent with Ministerial Direction 4.3 (Planning for Bushfire Protection) issued on 4<sup>th</sup> April 2020 under section 9.1 of the Environmental Planning and Assessment Act subject to the inclusion of the bushfire risk reduction strategies identified in this Assessment.

The proposed Conceptual Subdivision and Development Plan for the Subject Land provides the bushfire protection measures, including the required APZ's for the residential development proposed.



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# Appendix A: Access Specifications

The following extract is from page 44 of PBP (RFS 2019).

**Table 4: Performance criteria for access for residential and rural residential subdivisions**

## 5.3.2 Access

**Intent of measures:** to provide safe operational access to structures and water supply for emergency services, while residents are seeking to evacuate from an area.

### Table 5.3b

Performance criteria and acceptable solutions for access for residential and rural residential subdivisions.

PERFORMANCE CRITERIA		ACCEPTABLE SOLUTIONS	
The intent may be achieved where:			
ACCESS (GENERAL REQUIREMENTS)	<ul style="list-style-type: none"> <li>firefighting vehicles are provided with safe, all-weather access to structures.</li> </ul>	<ul style="list-style-type: none"> <li>property access roads are two-wheel drive, all-weather roads;</li> <li>perimeter roads are provided for residential subdivisions of three or more allotments;</li> <li>subdivisions of three or more allotments have more than one access in and out of the development;</li> <li>traffic management devices are constructed to not prohibit access by emergency services vehicles;</li> <li>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;</li> <li>all roads are through roads;</li> <li>dead end roads are not recommended, but if unavoidable, 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;</li> <li>where kerb and guttering is provided on perimeter roads, roll top kerbing should be used to the hazard side of the road;</li> <li>where access/egress can only be achieved through forest, woodland and heath vegetation, secondary access shall be provided to an alternate point on the existing public road system; and</li> <li>one way only public access roads are no less than 3.5 metres wide and have designated parking bays with hydrants located outside of these areas to ensure accessibility to reticulated water for fire suppression.</li> </ul>	
	<ul style="list-style-type: none"> <li>the capacity of access roads is adequate for firefighting vehicles.</li> </ul>	<ul style="list-style-type: none"> <li>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.</li> </ul>	
	<ul style="list-style-type: none"> <li>there is appropriate access to water supply.</li> </ul>	<ul style="list-style-type: none"> <li>hydrants are located outside of parking reserves and road carriageways to ensure accessibility to reticulated water for fire suppression;</li> <li>hydrants are provided in accordance with the relevant clauses of AS 2419.1:2005 - <i>Fire hydrant installations System design, installation and commissioning</i>; and</li> <li>there is suitable access for a Category 1 fire appliance to within 4m of the static water supply where no reticulated supply is available.</li> </ul>	

**Table 5.3b** *Continued*

PERFORMANCE CRITERIA		ACCEPTABLE SOLUTIONS	
The intent may be achieved where:			
PERIMETER ROADS	<ul style="list-style-type: none"><li>➤ access roads are designed to allow safe access and egress for firefighting vehicles while residents are evacuating as well as providing a safe operational environment for emergency service personnel during firefighting and emergency management on the interface.</li></ul>	<ul style="list-style-type: none"><li>➤ are two-way sealed roads;</li><li>➤ minimum 8m carriageway width kerb to kerb;</li><li>➤ parking is provided outside of the carriageway width;</li><li>➤ hydrants are located clear of parking areas;</li><li>➤ are through roads, and these are linked to the internal road system at an interval of no greater than 500m;</li><li>➤ curves of roads have a minimum inner radius of 6m;</li><li>➤ the maximum grade road is 15 degrees and average grade of not more than 10 degrees;</li><li>➤ the road crossfall does not exceed 3 degrees; and</li><li>➤ a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.</li></ul>	
NON-PERIMETER ROADS	<ul style="list-style-type: none"><li>➤ access roads are designed to allow safe access and egress for firefighting vehicles while residents are evacuating.</li></ul>	<ul style="list-style-type: none"><li>➤ minimum 5.5m carriageway width kerb to kerb;</li><li>➤ parking is provided outside of the carriageway width;</li><li>➤ hydrants are located clear of parking areas;</li><li>➤ roads are through roads, and these are linked to the internal road system at an interval of no greater than 500m;</li><li>➤ curves of roads have a minimum inner radius of 6m;</li><li>➤ the road crossfall does not exceed 3 degrees; and</li><li>➤ a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.</li></ul>	

**Table 5.3b** *Continued*

PERFORMANCE CRITERIA	ACCEPTABLE SOLUTIONS
The intent may be achieved where:	
<div>PROPERTY ACCESS</div> <ul style="list-style-type: none"> <li>➤ firefighting vehicles can access the dwelling and exit the property safely.</li> </ul>	<ul style="list-style-type: none"> <li>➤ There are no specific access requirements in an urban area where an unobstructed path (no greater than 70m) is provided 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.</li> </ul> <p>In circumstances where this cannot occur, the following requirements apply:</p> <ul style="list-style-type: none"> <li>➤ minimum 4m carriageway width;</li> <li>➤ 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;</li> <li>➤ a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches;</li> <li>➤ provide a suitable turning area in accordance with Appendix 3;</li> <li>➤ curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress;</li> <li>➤ the minimum distance between inner and outer curves is 6m;</li> <li>➤ the crossfall is not more than 10 degrees;</li> <li>➤ maximum grades for sealed roads do not exceed 15 degrees and not more than 10 degrees for unsealed roads; and</li> <li>➤ a development comprising more than three dwellings has access by dedication of a road and not by right of way.</li> </ul> <p>Note: Some short constrictions in the access may be accepted where they are not less than 3.5m wide, 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.</p>

## Appendix B: Services Specifications

The following extracts on the provision of water, gas and electricity are from PBP (RFS 2019).

### 5.3.3 Services – Water, electricity and gas

**Intent of measures:** *to 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 5.3c**

Performance criteria and acceptable solutions for water, electricity and gas services for residential and rural residential subdivisions.

	PERFORMANCE CRITERIA	ACCEPTABLE SOLUTIONS
	The intent may be achieved where:	
WATER SUPPLIES	<ul style="list-style-type: none"> <li>adequate water supplies is provided for firefighting purposes.</li> </ul>	<ul style="list-style-type: none"> <li>reticulated water is to be provided to the development where available;</li> <li>a static water and hydrant supply is provided for non-reticulated developments or where reticulated water supply cannot be guaranteed; and</li> <li>static water supplies shall comply with Table 5.3d.</li> </ul>
	<ul style="list-style-type: none"> <li>water supplies are located at regular intervals; and</li> <li>the water supply is accessible and reliable for firefighting operations.</li> </ul>	<ul style="list-style-type: none"> <li>fire hydrant, spacing, design and sizing complies with the relevant clauses of Australian Standard AS 2419.1:2005;</li> <li>hydrants are not located within any road carriageway; and</li> <li>reticulated water supply to urban subdivisions uses a ring main system for areas with perimeter roads.</li> </ul>
	<ul style="list-style-type: none"> <li>flows and pressure are appropriate.</li> </ul>	<ul style="list-style-type: none"> <li>fire hydrant flows and pressures comply with the relevant clauses of AS 2419.1:2005.</li> </ul>
	<ul style="list-style-type: none"> <li>the integrity of the water supply is maintained.</li> </ul>	<ul style="list-style-type: none"> <li>all above-ground water service pipes are metal, including and up to any taps; and</li> <li>above-ground water storage tanks shall be of concrete or metal.</li> </ul>
ELECTRICITY SERVICES	<ul style="list-style-type: none"> <li>location of electricity services limits the possibility of ignition of surrounding bush land or the fabric of buildings.</li> </ul>	<ul style="list-style-type: none"> <li>where practicable, electrical transmission lines are underground;</li> <li>where overhead, electrical transmission lines are proposed as follows: <ul style="list-style-type: none"> <li>lines are installed with short pole spacing of 30m, unless crossing gullies, gorges or riparian areas; and</li> <li>no part of a tree is closer to a power line than the distance set out in ISSC3 <i>Guideline for Managing Vegetation Near Power Lines</i>.</li> </ul> </li> </ul>
GAS SERVICES	<ul style="list-style-type: none"> <li>location and design of gas services will not lead to ignition of surrounding bushland or the fabric of buildings.</li> </ul>	<ul style="list-style-type: none"> <li>reticulated or bottled gas is installed and maintained in accordance with AS/NZS 1596:2014 - <i>The storage and handling of LP Gas</i>, the requirements of relevant authorities, and metal piping is used;</li> <li>all fixed gas cylinders are kept clear of all flammable materials to a distance of 10m and shielded on the hazard side;</li> <li>connections to and from gas cylinders are metal;</li> <li>polymer-sheathed flexible gas supply lines are not used; and</li> <li>above-ground gas service pipes are metal, including and up to any outlets.</li> </ul>

**Table 5: Performance criteria for services provision for residential and rural residential subdivisions**

**Table 6: 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 (<1000m <sup>2</sup> )	5000L/lot
Rural-residential lots (1000-10,000m <sup>2</sup> )	10,000L/lot
Large rural/lifestyle lots (>10,000m <sup>2</sup> )	20,000L/lot
Multi-dwelling housing (including dual occupancies)	5000L/dwelling

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eco  
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