Bellingen Shire Council Bushfire Strategic Study – E4 Lands

Bellingen Shire Council

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Template 2.8.1

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1. Introduction

1.1 Background

This Strategic Bushfire Study (the Study) has been prepared to inform and assist with the preparation of a Planning Proposal for lands zoned E4 Environmental Living in the Bellingen Shire Council Local Government Area (LGA). The objectives of the Planning Proposal are to include development of dual occupancy, eco-tourist facility, rural industry, secondary dwelling, tourist and visitor accommodation within the E4 zone through an amendment to the Bellingen Shire Local Environment Plan (LEP).

As the E4 zones are identified as Bush Fire Prone Land (BFPL) and therefore Council must address Ministerial Direction 4.4 (Planning for Bushfire Protection (PBP)) issued under Section 9.1 of the Environmental Planning and Assessment Act. The gateway determination issued by the Department of Planning and Environment (DPE) requires Council to consult with the RFS prior to public exhibition.

Consultation with the NSW Rural Fire Service in January 2018 resulted in the request for further bush fire studies to be undertaken to satisfy that future development under the planning proposal can meet the requirements of PBP. As such, this assessment addresses the minimum requirements for a strategic study, as listed in Table 4.2.1 of PBP 2019, with additional information provided where necessary.

1.2 Legislative Framework

The Bellingen Shire E4 lands Planning Proposal seeks to amend the Bellingen Shire Local Environmental Plan (LEP) 2010. Specifically, the proposal plans to amend the permitted uses with development consent to include:

- Secondary dwellings;
- Attached dual occupancies;
- Eco-tourist facilities;
- Tourist & visitor accommodation (with the exception of backpackers accommodation, hotel or motel accommodation and serviced apartments);
- Home businesses; and
- Rural industries.

The proposal also seeks to include farm buildings (within the meaning of State Environmental Planning Policy (Exempt & Complying Development Codes 2008) are included as a category of exempt development in Schedule 2 – Exempt development, of BLEP 2010, when carried out within Zone E4.

The legislative framework guiding the assessment of bushfire risk and the application of bushfire protection measures at the strategic level are the NSW *EP&A Act* and the *Rural Fires Act 1997* (RF Act). Key aspects of these instruments are outlined below.

1.2.1 NSW Environmental Planning and Assessment Act (1979)

The NSW *EP&A* Act is the principal planning legislation for the state, providing a framework for the overall environmental planning and assessment of development proposals. Various legislation and instruments are integrated with the *EP&A Act*, including the *RF Act*.

Section 10.3 of the *EP&A Act* requires the identification of BFPL and development of BFPL maps, which act as a trigger for bush fire assessment provisions for strategic planning and development.

When investigating the capability of BFPL to be rezoned for residential purposes, consent authorities must have regard to s.9.1 (2) Direction 4.4 – 'Planning for Bushfire Protection' of the *EP&A Act*. The objectives of Direction 4.4 are:

- To protect life, property and the environment from bushfire hazards, by discouraging the establishment of incompatible land uses in bush fire prone areas; and
- To encourage sound management of bush fire prone areas.

Direction 4.4 instructs the consent authority on the bushfire matters which need to be addressed when drafting LEPs. This includes:

- Consultation with the Commissioner of the NSW RFS, and take into account any comments so made;
- Draft LEPs shall have regard to PBP; and
- Compliance with numerous bushfire protection provisions where development is proposed.

Further, there are various provisions within the *EP&A Act* that may be applicable to proposals on BFPL, as outlined below:

- Section 3.29 of the *EP&A Act* relates to the development of State environmental planning policies (SEPPs) and within these policies, bushfire considerations may apply;
- Section 4.14 relates to infill and other development;
  - Requires that all development on BFPL conforms to the specifications and requirements outlined in PBP, i.e. the specific requirements for residential infill in chapter 7,
  - The consent authority should be satisfied that the development conforms to PBP, or otherwise consult with the RFS Commissioner,
- Section 4.46 relates to integrated development and triggers the *RF Act* and Clause 44 of the *Rural Fires Regulation 2013;*
  - Applicable to Subdivision, with specific requirements in chapter 5 of PBP,
  - Applicable to SFPP Developments, with specific requirements in chapter 6 of PBP,
  - Requires a bush fire safety authority under section 100b of the *RF Act*,
- Section 9.1 relates to strategic or Local planning;
  - Applicable to land use planning that covers large areas and may include a variety of land uses and longer-term development objectives. Specific requirements are outline in chapter 4 of PBP.

In the context of this proposal, it is likely that most future development on E4 lands, particularly those related to tourism, would be assessed under section 4.46, noting that other legislative provisions may also apply. Where future development includes increased residential densities as a result of additional dwellings or dual occupancy, as per chapter 8 of PBP, the same principles of subdivision would apply.

1.2.2 Rural Fires Act 1997 (RF Act)

The *RF Act* is integrated into the *EP&A Act* and triggered by section 4.46 as outlined above. The key objectives of the act are to provide for the:

- prevention, mitigation, and suppression of bushfires;
- co-ordination of bush fire fighting and bush fire prevention;
- protection of persons from injury or death, and property from damage, arising from fires;
- protection of infrastructure and environmental, economic, cultural, agricultural and community assets from damage arising from fires; and
- protection of the environment by requiring certain activities have regard to the principles of ecologically sustainable development

In the context of the proposed amendments, the *RF Act* requires a Section 100b assessment and the issue of a bush fire safety authority for SFPP development. For this proposal, future development within the E4 zones is therefore likely to require a section 100b assessment, and address the specific requirements outlined in Chapter 6 of PBP.

1.3 Assessment Approach

This bush fire strategic study provides an assessment of the landscape bushfire risk associated with the proposed E4 zone land use amendments in the Bellingen LEP. Section 9.1 (2) of the *EP&A Act* triggers consideration of PBP for strategic planning. Chapter 4 of PBP (RFS 2019) contains the broad principles and assessment considerations required for strategic planning proposals. The strategic planning principles are summarised as, ensuring:

- Land is suitable for future development in the context of bush fire risk;
- Future development on BFPL can comply with PBP 2019 with minimal reliance on performance-based solutions;
- There is sufficient infrastructure associated with emergency evacuation and firefighting operations; and
- Appropriate land management practices can be implemented for future development.

These principles trigger the consideration of bushfire protection measures at the strategic planning stage, to provide an opportunity to consider the suitability of future land uses within the broader bushfire hazard setting and that future land uses can meet the objectives of PBP outlined below:

- Afford buildings and their occupants protection from exposure to a bush fire;
- Provide for a defendable space to be located around buildings;
- Provide appropriate separation between a hazard and buildings which, in combination with other measures, minimises material ignition;
- Ensure that appropriate operational access and egress for emergency service personnel and residents is available;
- Provide for ongoing management and maintenance of bush fire protection measures; and
- Ensure that utility services are adequate to meet the needs of firefighters.

1.3.1 Aims and Objectives

The aim of this study is to review the proposed Bellingen E4 Zone LEP amendments in relation to the applicable bushfire planning framework for strategic planning outlined in PBP. The key objective in achieving this outcome are to:

i Undertake a strategic assessment as per the strategic planning principles and assessment considerations outlined in PBP, identified in Table 4.2.1 of PBP, summarised in Table 1 below.

Table 1 – Summary of requirements for a strategic bush fire study (RFS 2019) (adapted from Table 4.2.1 of PBP).

Issue	Summary of Assessment Considerations
Bush fire landscape assessment	A bush fire landscape assessment considers the likelihood of a bush fire, its potential severity and intensity and the potential impact on life and property in the context of the broader surrounding landscape.
Land use assessment	The land use assessment will identify the most appropriate locations within the masterplan area or site layout for the proposed uses.
Access and egress	A study of the existing and proposed road networks both within and external to the masterplan area and site layout.
Emergency services	An assessment of the future impact of the new development on emergency services provision.
Infrastructure	An assessment of the issues associated with infrastructure provision.
Adjoining land	The impact of new development on adjoining landowners and their ability to undertake bush fire management.

1.4 Study Area

The study area encompasses the E4 zones (the Subject Land) and a 5 km buffer surrounding these sites as shown if (Figure 1). The E4 zones are situated in the Thora and Kalang Valleys and include the localities of Darkwood, Kalang and Thora. In addition to bushfire constraints a large proportion of the subject land is affected by other development constraints including flooding and threatened biodiversity. The surrounding area contains the Bellingen River National Park, Dorrigo National Park, New England National Park and the Baaljin and Juugawarri Nature Reserves

1.4.1 Bushfire Prone Land Status

The E4 zone includes land classified as bush fire prone on the Bellingen Shire Councils' BFPL map (Figure 2).

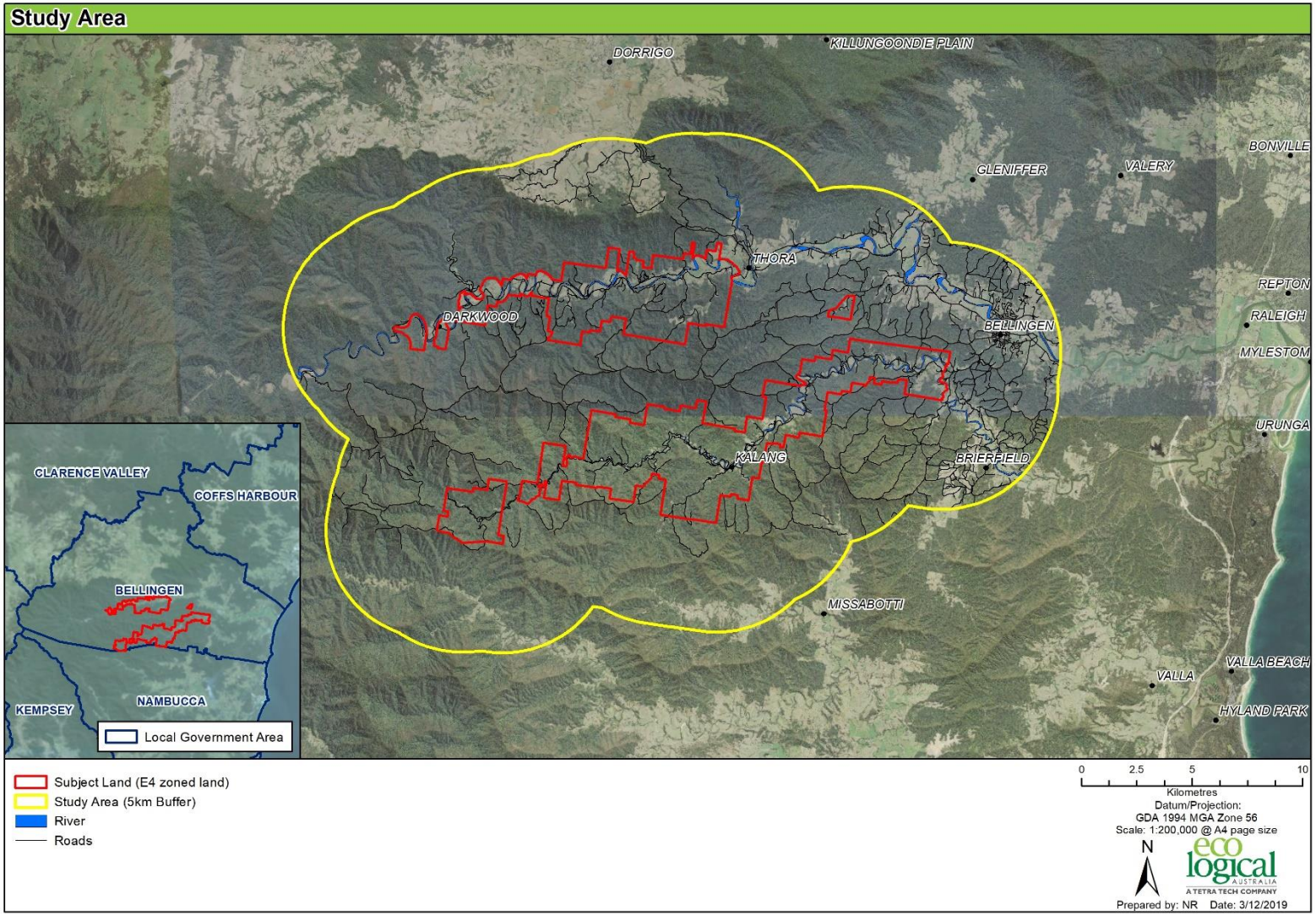

Figure 1: Study Area

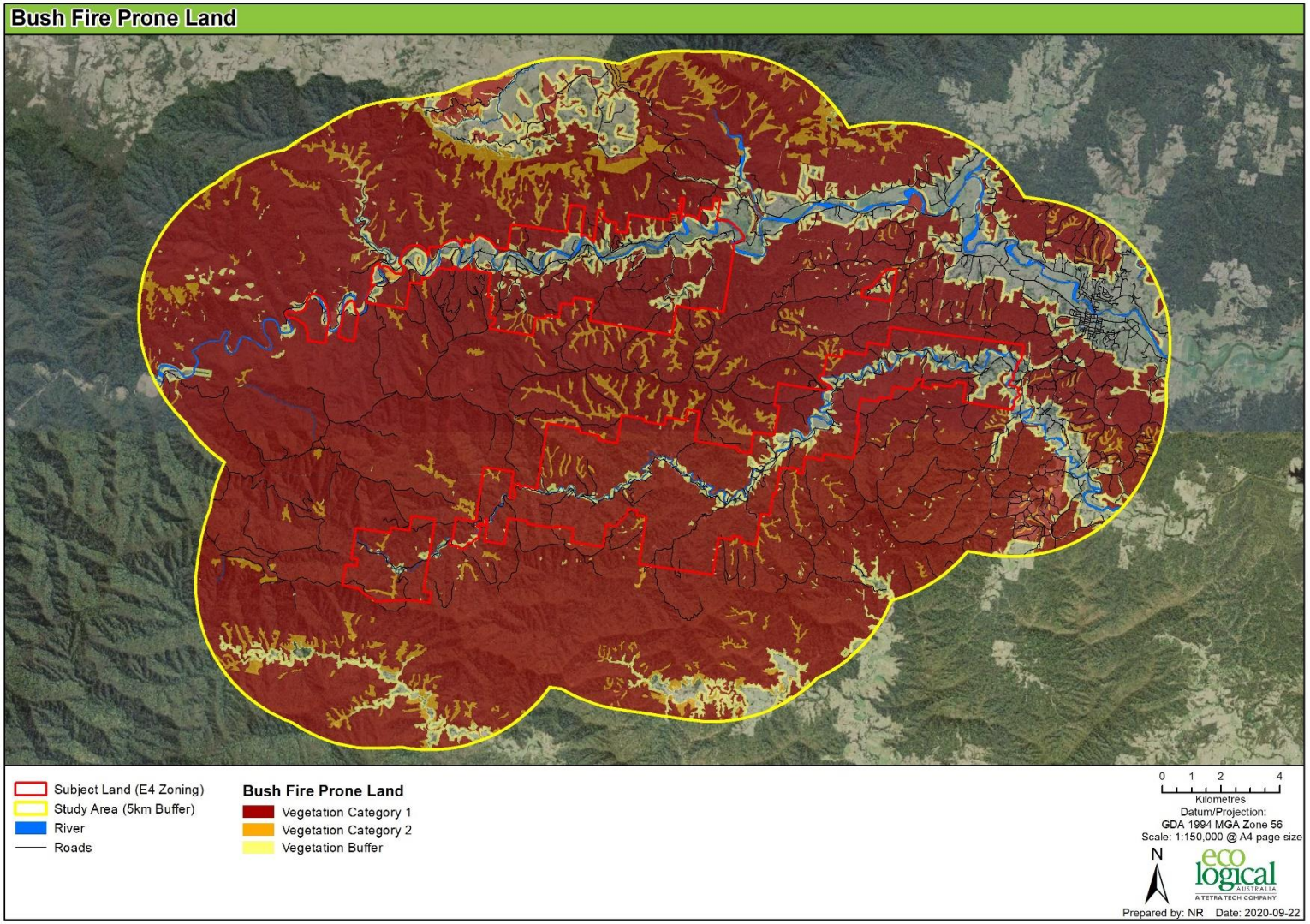

Figure 2: Bush Fire Prone Land

2. Bushfire Landscape Risk Assessment

The landscape bushfire risk includes assessment of bushfire hazard, potential fire behaviour and bushfire history within a 5 km radius of land zoned as E4 – Environmental Living, herein called the 'study area'.

2.1 Bushfire Hazard

A large proportion of the Subject Land is classified as bush fire prone land and is located within a wider landscape of bush fire prone land (**Figure 2**). The bushfire hazard is extensive and continuous enough to potentially expose the subject land to larger sized bushfires. Larger potential fire catchments 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 study area is within a landscape comprised predominantly of wet sclerophyll forest. The northern study area also features subtropical and warm temperate rainforests. Small areas of coastal floodplain forest occur nearer to the E4 Zone (Subject Land) with larger areas of wet sclerophyll forest dominating the landscape within 5 km of the site (**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 Table A1.2.8 from PBP (RFS 2019). **Figure 3** and **Table 2** show the vegetation

Table 2: Vegetation formation, class and fuel allocation for the study area

Vegetation formation	Keith Class	Overall fuel including bark and canopy (t/ha)*
Forested Wetland	Coastal Floodplain Forest	15.1
Forest (Shrubby and Grassy)	Hunter-Macleay DSF; North Coast WSF; Northern Gorge DSF; Northern Hinterland WSF; Northern Tableland WSF	36.1
Rainforest	Northern Warm Temperate Rainforests; Subtropical Rainforest	13.2

*Overall fuel load including Bark and Canopy from Table A1.12.8 from PBP (RFS 2019)

2.1.2 Topography and Slope

Figure 4 shows that elevation within the study area is generally lower to the east, with higher elevations evident in the northern and western portions of the study area. Topography within the E4 zones displays a similar trend, however elevation also increases away from the Bellingen River in the Thora Valley (northern E4 Zone) and the Kalang River in the Kalang Valley (southern E4 zone).

Slope has been captured from a Digital Elevation Model (DEM) generated from 10 m contours and classified into the following slope classes (see **Figure 5**):

- Flat (0°);
- >0° – 5°;
- >5° – 10°;
- >10° – 15°;
- >15° – 20°; and
- >20°.

Steeper areas where fire control is typically more difficult occur in the western portion of the subject land and adjacent study area.

2.1.3 Bushfire Weather

Adverse fire weather conditions associated with the bush fire danger period in the Bellingen region are associated with South-westerly to North-westerly winds accompanied by high daytime temperatures. 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 Coffs Harbour 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 FFDI, where suitable inputs are available from over 70 weather stations across Australia. Data from the Coffs Harbour 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 2006).

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

- North to south-east (clockwise);
- South-east to South-west (clockwise); and
- 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 3**). 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).

Table 3: FFDI for a 1 in 50-year event

Weather Station	Max Recorded FFDI	N to SE	SE to SW	SW to N
Coffs Harbour	95	31	50	89

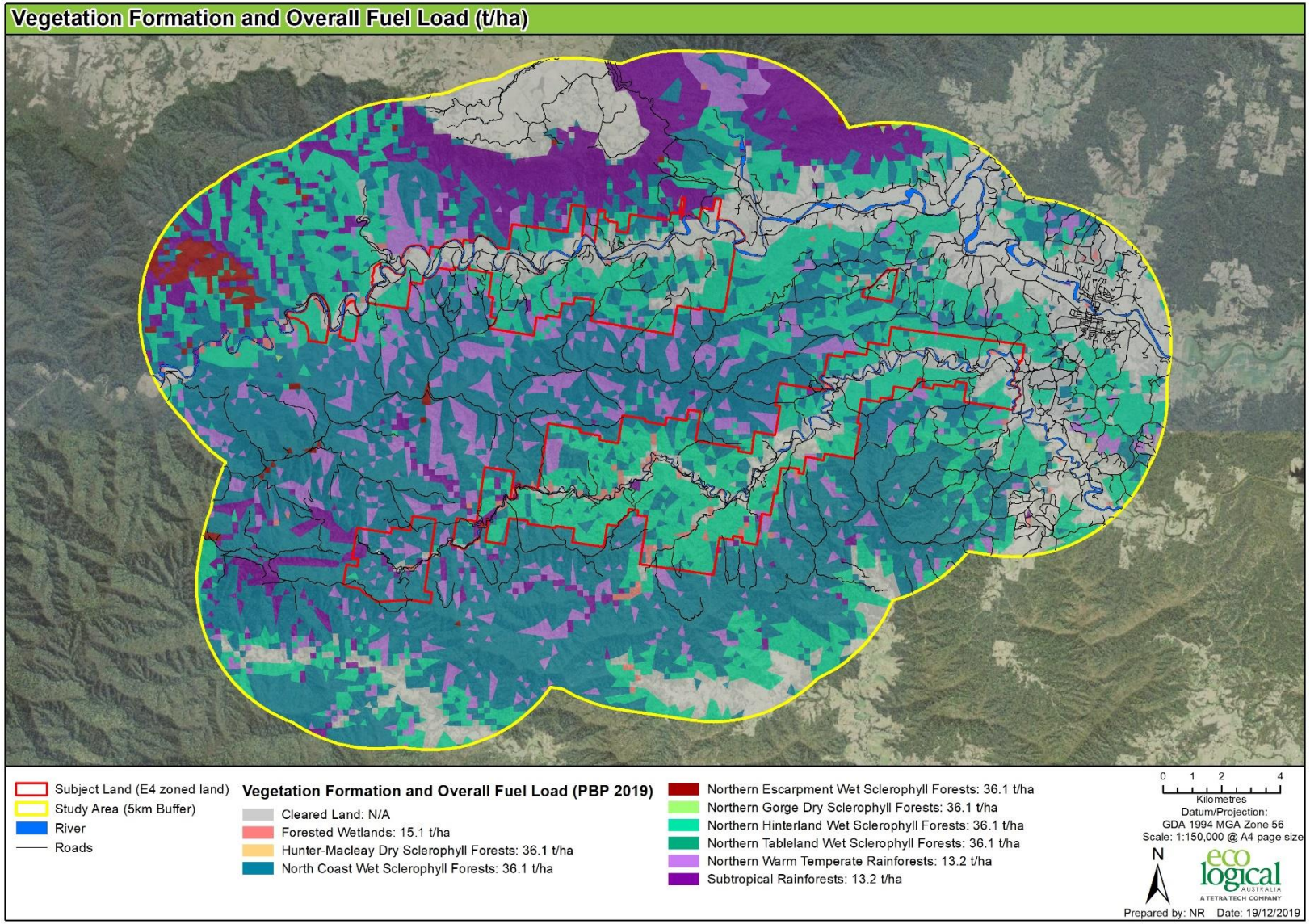

Figure 3: Vegetation Formation and Fuel Classification of the E4 Zone and Study Area

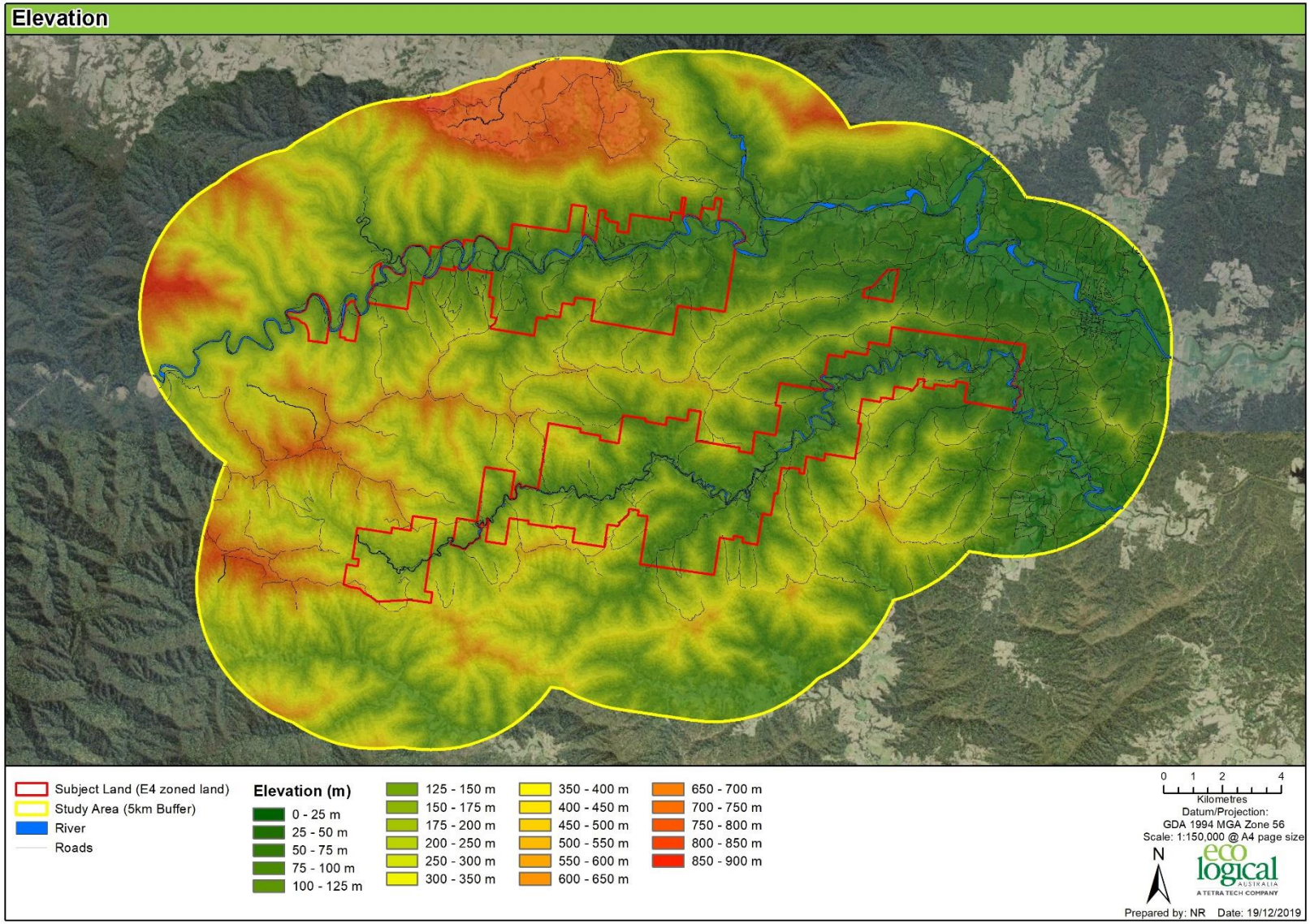

Figure 4: Elevation of the E4 Zone and Study Area

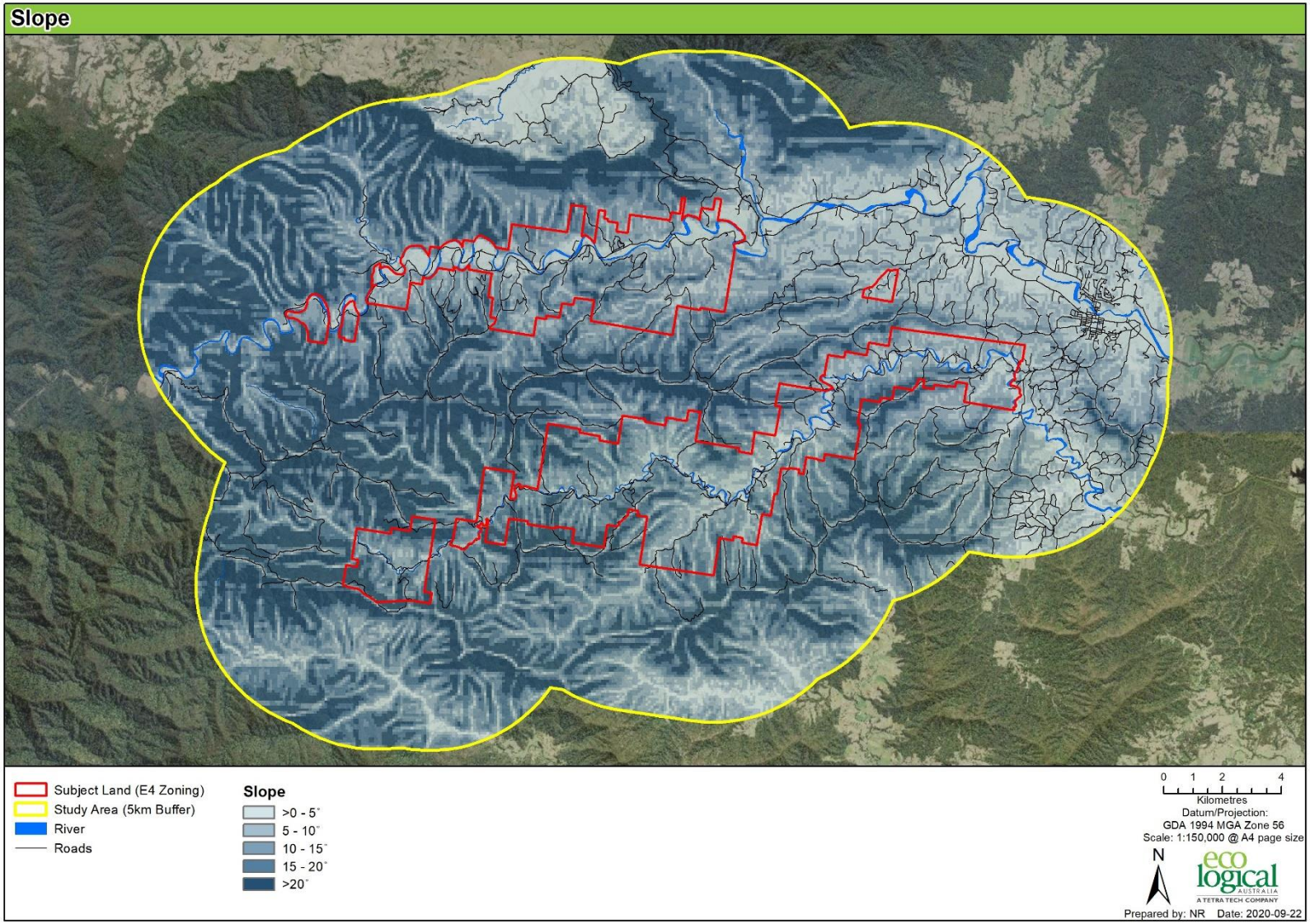

Figure 5: Slope of the E4 Zone and Study Area

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 McArthur (for Forest, Woodland and Wetlands) and Catchpole (for Heath). Three models where prepared for the following bushfire attack scenarios:

- Bushfire attack from the north to south-east direction (clockwise) at FFDI 31 (Figure 6**)**;
- Bushfire attack from the south-west to north direction (clockwise) at FFDI 89 (Figure 7); and
- Bushfire attack from the south-east to south-west direction (clockwise) at FFDI 50 (Figure 8).

The models show that the greatest intensities occur in forest vegetation which are prevalent in all directions surrounding the E4 Zones. Lower intensities are evident to the north where a more extensive area of rainforest vegetation is present. Within the study area, cleared areas present within the E4 zone, on the northern boundary and to the east 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 – ember attack and spread ahead of the head fire front;
- Fire tornado/whirls - occur when the turbulent wind conditions combine with the increasing heat from the fire to create a rotating eddy of air;
- Lateral vortices - arises due to wind-terrain-fire interactions that produce vertical vorticity, which rapidly propagates a fire across steep, leeward slopes in a direction nearly perpendicular to the ambient wind direction;
- Junction zones (Jump fires) - point or area where two separate fires meet up and become one fire. Also known as the area of coalescence. Fire intensity generally increases at a junction zone, due to combined convection forces;
- Eruptive fires – extreme acceleration of rate of spread and intensity of a fire in a limited space and time that can overwhelm and suppression capacity;
- Conflagrations - violent pyroconvective events in the atmosphere, that produce fire thunderstorms or pyrocumulonimbus;
- Downbursts - a strong downward current of air from a cumulonimbus cloud, which is usually accompanied by intense rain or a thunderstorm; or
- Pyro-convective events – when heat and moisture generated by bushfires create clouds and even thunderstorms.

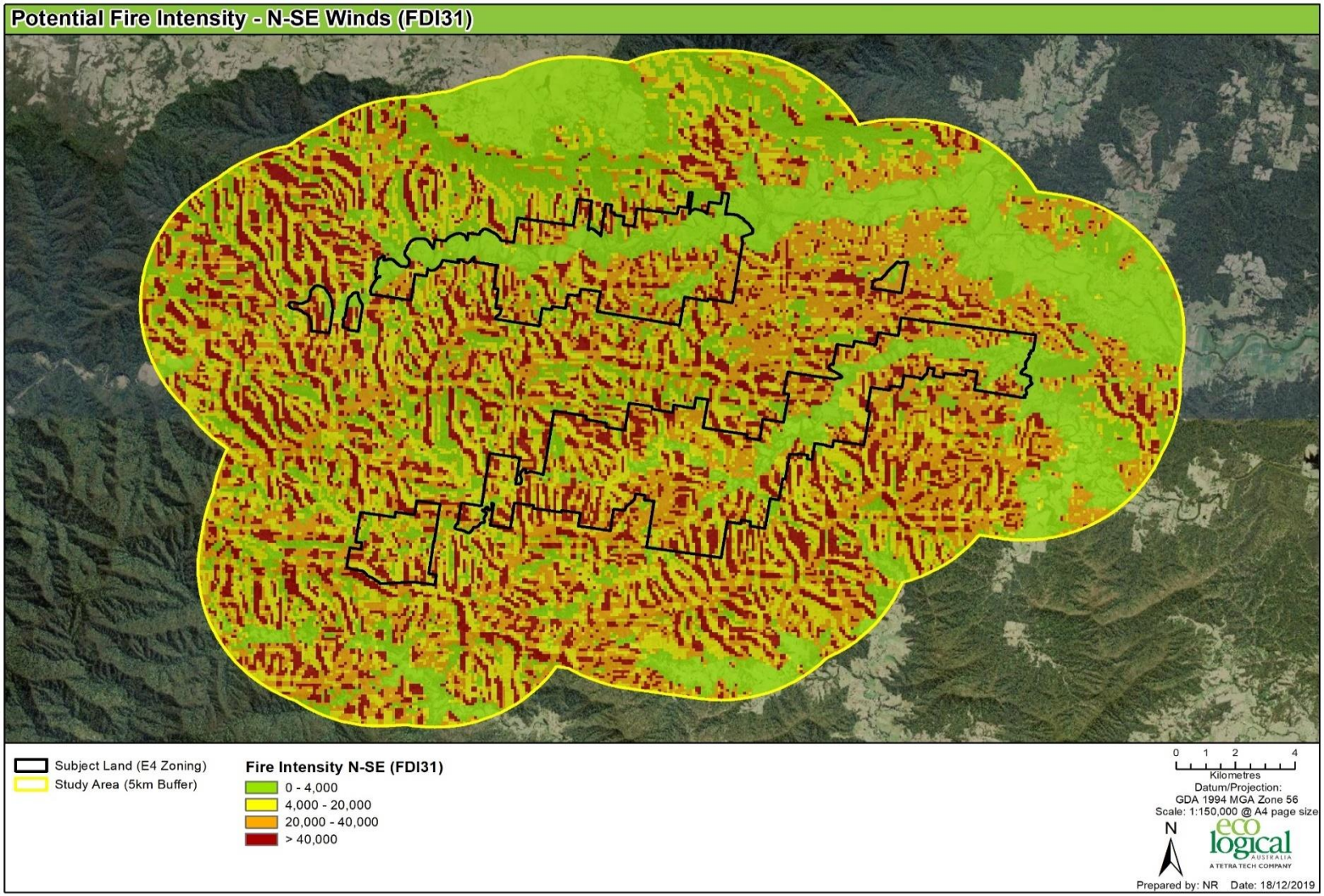

Figure 6: Potential Fire Intensity across the study area (North to south-east wind, FFDI 31)

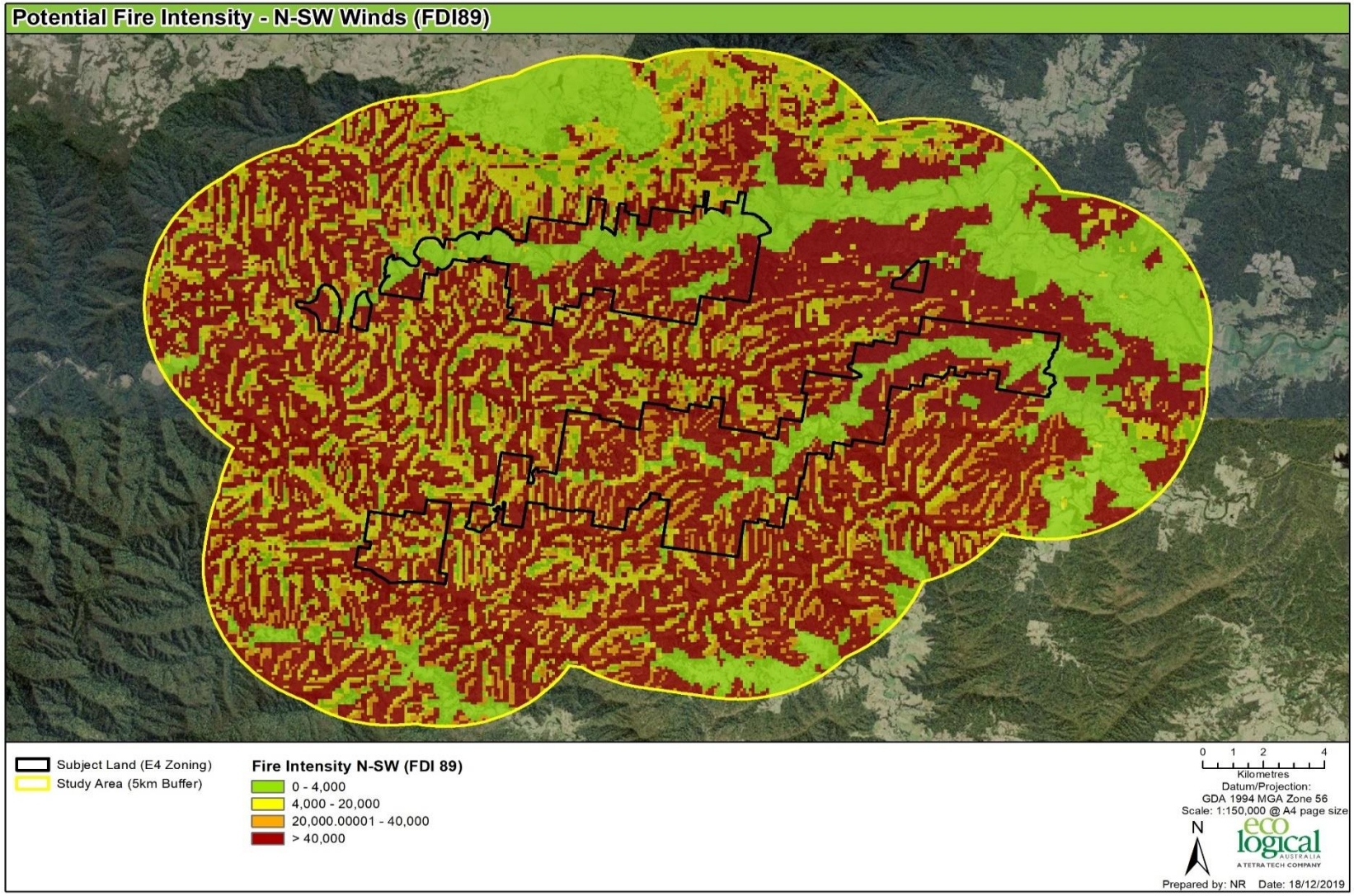

Figure 7: Potential Fire Intensity across the study area (North to south-west wind, FFDI 89)

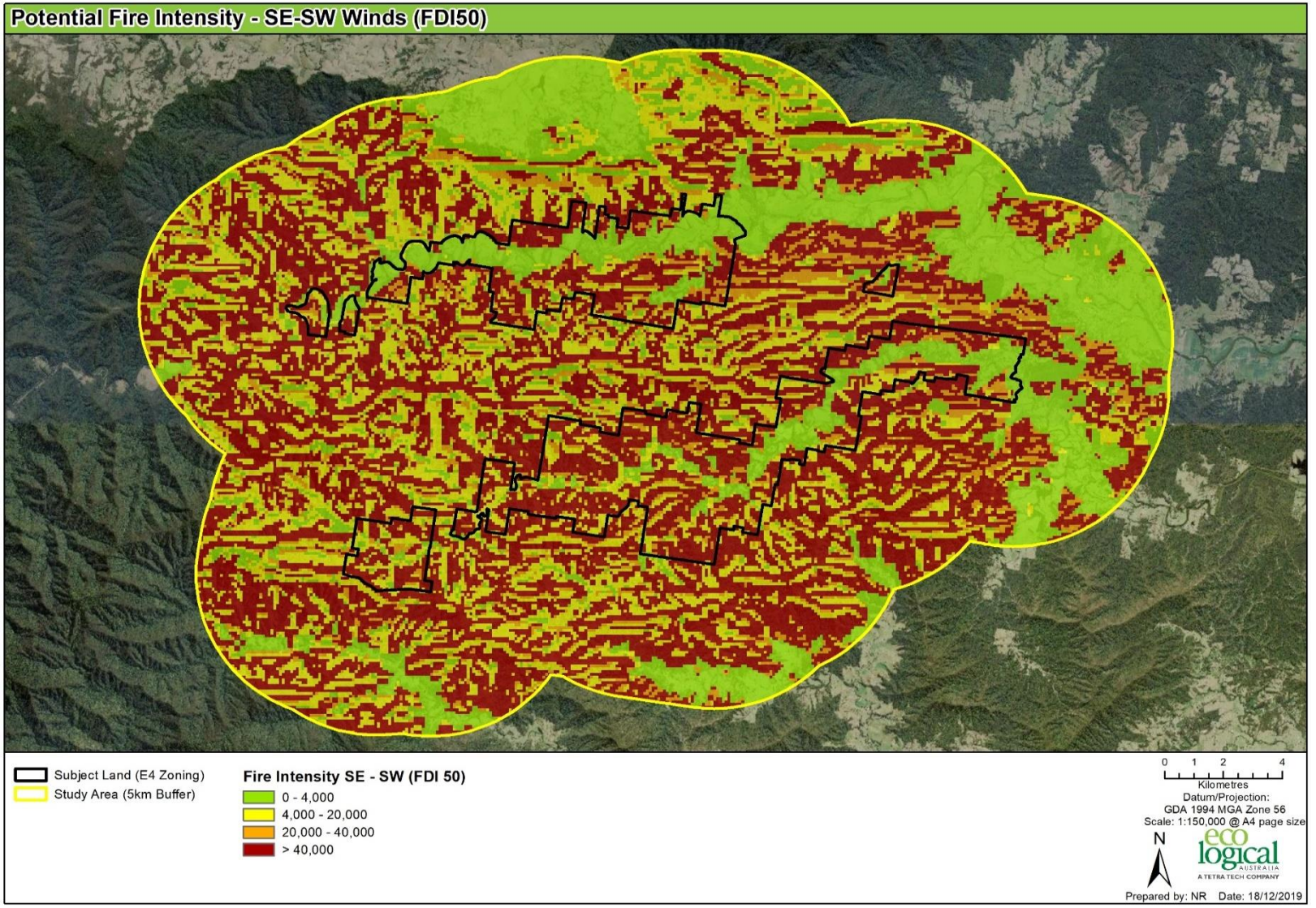

Figure 8: Potential Fire Intensity across the study area South-east to south-west wind, FFDI 50)

2.3 Bushfire History

The Mid North Coast Bush Fire Risk Management Plan (BFRMP) (BFMC 2009) identifies that the main sources of ignition in the Mid North Coast BFMC area are:

- Escaped private hazard reduction burns;
- Lightning strikes; and
- Arson.

Figure 9 shows the fire history for the study area from 1968 to 2018 for both prescribed burns and unplanned fire (wildfire) from the NPWS fire history mapping data set. As shown in **Figure 9** a number of wildfires have occurred within the broader study area and subject land during this period. Two of the larger fires occurred in the 2001-2002 and 2003-2003 fires seasons. A third large wildfire was also recorded in the same area in the 2009-2010 season. The Andersons Creek Fire, December 2019 is also located in the study area, within the vicinity of the 2012-2013 fire shown in **Figure 9.**

Fires within the subject land have generally been restricted to the southern side of the Bellingen and Kalang Rivers and in National Park and State Forest areas to the south and west of the E4 zones. Whilst these features may provide a potential control line in the future, every fire poses a different suite of risks and control options and future fires may vary within the subject land.

2.4 Summary of landscape bushfire risk assessment

This risk assessment considers the current hazard extent, weather, fire behaviour and fire history. It is important to note that the effective hazard may vary following detailed site inspections for any future development that may occur under the proposed LEP amendments.

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 3959-2018 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 Subject Land; 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 existing roads, waterways and infrastructure (i.e. powerline easement) as well as existing areas of development and land management (existing cleared land).

Although fire history indicates the probability of a future landscape-wide fire or major fire attack on the subject land is likely, landscape fire advantages and the larger allotment size within the E4 zone enabling appropriate bushfire protection measures, means the zoning proposal is not in an unacceptable bushfire landscape. In particular, there is opportunity in the eastern portion of the subject land where existing cleared land would facilitate APZ's without extensive vegetation clearing, and therefore with the E4 zoning. 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.

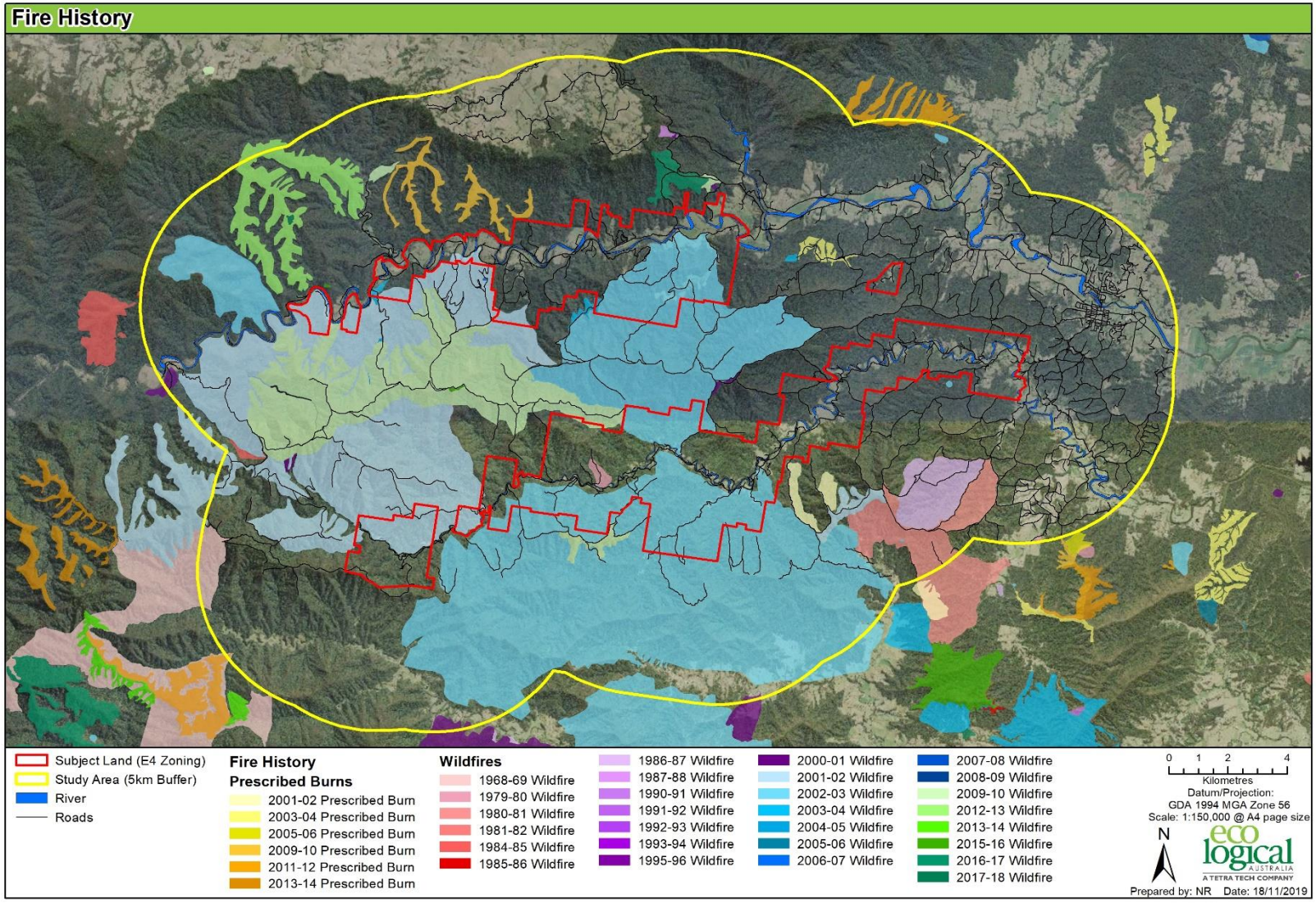

Figure 9: Fire History in the Study Area.

3. Land use assessment

PBP 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). This land use assessment therefore considers the risk profile of the proposal, the suitability of proposed land uses and the feasibility of APZ requirements.

3.1 Risk profile

The feasibility of the Planning Proposal to comply with the bushfire protection measures identified within PBP is a fundamental consideration of the study. Whilst bushfire protection measures and their performance criteria 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 following:

- The bushfire landscape risk context in consideration of the protection measures for future development and their potential adequacy;
- The type/s of development proposed and their suitability given the bushfire risk context;
- The pattern and potential bushfire resilience of the bushland interface; and
- Potential cumulative risk associated with proposed development in the locality and provision of bushfire protection measures.

The feasibility of the subject land to provide for APZ, a key bushfire protection measure, is assessed in the following section. This is followed by an evaluation of the proposed land uses, bushfire risk context, APZ provision and assessed suitability.

The following landuse risk profile has been identified in the Study. The landuse risk profiles are summarised below:

- There is opportunity within the cleared areas in the eastern portion of the E4 zones to locate APZs and other bushfire protection measures to meet the acceptable solutions within PBP 2019;
  - This is not the situation for the western portion of the E4 zone where spatial extent and continuity of forest vegetation types has the potential to support higher intensity and difficult to control fires.
- The placement and juxtaposition of future building envelopes and their APZ can reduce the risk of bushfire spread through the E4 zone and increase their resilience. Situations where APZs of future dwellings abut or overlap APZs of existing dwellings may potentially increase the defendable space of dwellings and reduce the potential fire pathways through the non-APZ components within the E4 zone; and
- The environmental impacts of meeting APZ requirements would need to be considered as part of any assessment process and may further limit the areas of land suitable for development.

3.1.1 Feasibility of Asset Protection Zones

Table 4 below provides the PBP APZ requirements for residential (i.e. to achieve <29kW/m^2 exposure) and SFPP development (i.e. achieving <10kW/m^2 exposure). Given the varied APZ requirements for eco-tourism developments under PBP and also considering opportunities within the E4 zones, it is unlikely that all future development on the subject land would be constrained in the eastern portion of the E4 zone. Figure 10 and Figure 11 demonstrates that based on an indicative interface line derived from the broader landscape hazard impacting the E4 zone, and considering the highest PBP slope class, APZ requirements for both residential and SFPP development can be achieved. The implementation of APZs at the lot level will be dependent upon on the land management practices, however this would be assessed at the DA stage of the planning process for future development on a lot by lot basis.

Further, Section 6 of PBP outlines different specifications for development associated with eco-tourism land uses. The performance criteria for APZ requirements for future SFPP development within the E4 zones varies as detailed in Table 6.8a of PBP and provided in Appendix C. Examples of these variances include:

- Camping and primitive camping – no APZ requirements;
- Bed and Breakfast / farm stay – requirement for building to achieve <29kW/m^2 exposure; and
- Ecotourism – requirement for a refuge building to achieve <10kW/m^2 exposure, along with other specifications.

Table 4: APZs for each to achieve BAL 29

Slope[1]	Vegetation Formation[2]	PBP required residential APZ (BAL 29) (m)[3]	PBP required SFPP APZ (m)[4]	Allowable Outer Protection Area (m)[5] (residential)	Allowable Outer Protection Area (m)[5] (SFPP)
All upslopes and flat land	Forest	20	67	10	20
Downslope >0 to 5 degrees	Forest	25	79	10	25
Downslope >5 to 10 degrees	Forest	31	93	15	25
Downslope >10 to 15 degrees	Forest	39	100	15	25
Downslope >15 to 20 degrees	Forest	48	100	20	15
All upslopes and flat land	Forested wetland	8	34	n/a	n/a

Slope[1]	Vegetation Formation[2]	PBP required residential APZ (BAL 29) (m)[3]	PBP required SFPP APZ (m)[4]	Allowable Outer Protection Area (m)[5] (residential)	Allowable Outer Protection Area (m)[5] (SFPP)
Downslope >0 to 5 degrees	Forested wetland	10	42	n/a	n/a
Downslope >5 to 10 degrees	Forested wetland	13	51	n/a	n/a
Downslope >10 to 15 degrees	Forested wetland	17	62	n/a	n/a
Downslope >15 to 20 degrees	Forested wetland	22	73	n/a	n/a
All upslopes and flat land	Rainforest	9	38	n/a	n/a
Downslope >0 to 5 degrees	Rainforest	12	47	n/a	n/a
Downslope >5 to 10 degrees	Rainforest	15	57	n/a	n/a
Downslope >10 to 15 degrees	Rainforest	20	69	n/a	n/a
Downslope >15 to 20 degrees	Rainforest	25	81	n/a	n/a

1 SLOPE MOST SIGNIFICANTLY INFLUENCING THE FIRE BEHAVIOUR OF THE SITE HAVING REGARD TO VEGETATION FOUND AS PER PBP.
2 PREDOMINANT VEGETATION IS IDENTIFIED, ACCORDING TO PBP.
3 ASSESSMENT ACCORDING TO TABLE A1.12.3 OF PBP 2019.
4 ASSESSMENT ACCORDING TO TABLE A1.12.1 OF PBP 2019.
5ASSESSMENT ACCORDING TO TABLE A1.12.4 OF PBP 2019.
6ASSESSMENT ACCORDING TO TABLE A1.12.6 OF PBP 2019.

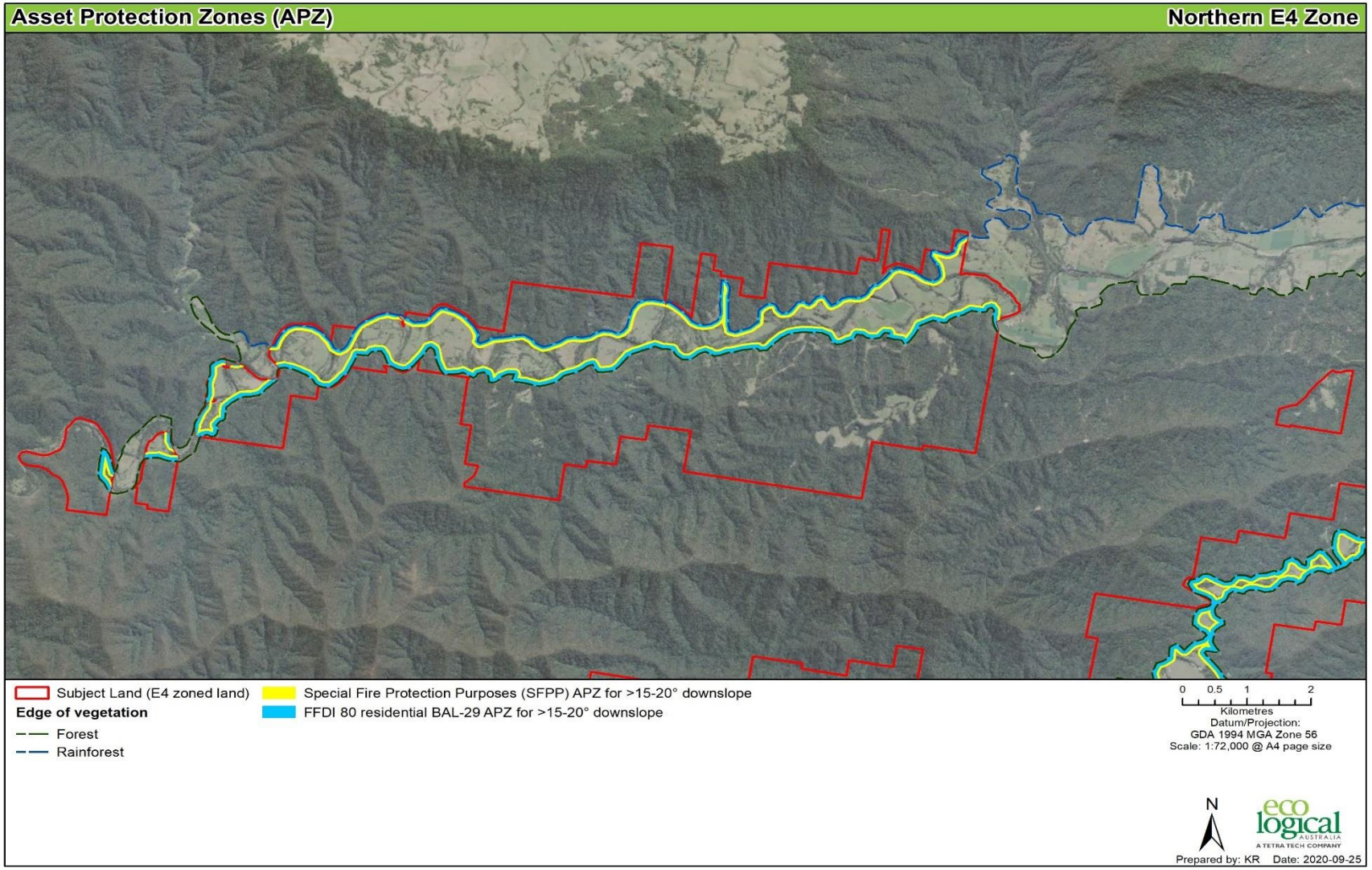

Figure 10: Indicative APZ requirements based off the broader vegetation hazard impacting the E4 Zone – Northern E4 zone (Thora Valley)

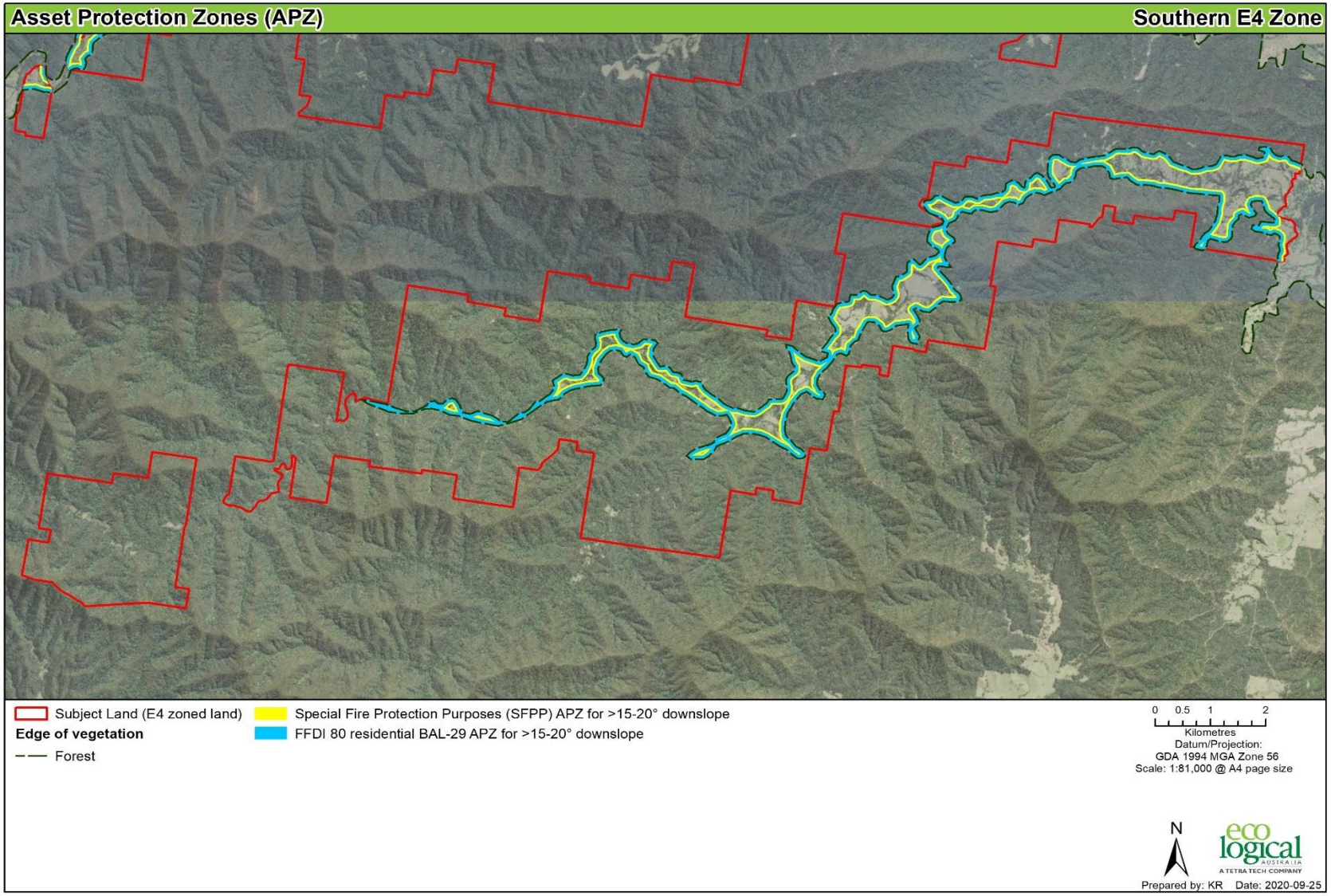

Figure 11: Indicative APZ requirements based off the broader vegetation hazard impacting the E4 Zone – Southern E4 zone (Kalang Valley)

4. Access and egress

Primary access to the Thora Valley is via Waterfall Way and Darkwood Road west of the Thora store. Primary access into the Kalang Valley is via Bowraville Road and Kalang Road. These roads are currently subject to a higher residual risk than sought under PBP and it is not expected that the proposed land use changes would alter this state, particularly given the proposed zoning amendment does not provide additional access roads or egress. Furthermore, given the topographic and environmental constraints within the E4 zone, it is unlikely that alternative access roads are feasible even if proposed.

While traffic analysis commissioned by Bellingen Shire Council (Appendix D) indicates that the proposal would result in only a small increase in traffic on these key routes (72 additional daily movements in the Kalang Valley and additional 51 daily movements in the Thora/ Darkwood Valley, without substantial investment in the road infrastructure any increase in traffic on an already exposed access and egress network is a significant risk and constraint to the E4 zone.

The existing constraints on the primary access network in relation to bushfire access and egress considerations are summarised in Table 5 below.

Table 5. Access and egress constraints of existing main access network

Road name	Pavement type	Average trafficable width (m)	Bridge limitations	Pinch points	Alignment issues	Other factors
Waterfall Way	Sealed	10 m	NA	NA	NA	Main access to east to Bellingen and North to Dorrigo
Darkwood Road	Sealed/gravel	6 m / 4 m	Justin's Bridge - Rigid load limit 11 tonnes, Articulated Load Limit 21 tonnes Richardson's Bridge - Rigid load limit 16 tonnes, Articulated Load Limit 31 tonnes	Bridges at crossings of Bellinger River and associated creeks and tributaries	2240 Darkwood Road; 930 Darkwood Road; The Black Scrub/Bishops Creek/Darkwood road intersection, 1377 Darkwood road (tight road alignment to north); 1314 Darkwood road; crossing near Swing Saw Trail	Extensive roadside vegetation with canopy closure
Bowraville Road	Sealed	10 m	NA	NA	NA	Main access to east to Bellingen
Kalang Road	Sealed/gravel	6 m/4 m	NA	Bridges at crossings of Kalang River	798 Kalang Road; 1058 Kalang Road; 1128	Extensive roadside vegetation

Road name	Pavement type	Average trafficable width (m)	Bridge limitations	Pinch points	Alignment issues	Other factors
				and associated creeks and tributaries	Kalang Road; 1202 Kalang Road; intersection with eastern end of Holbert's Fire Road	with canopy closure

The performance criteria for access under PBP 2019 (Tables 5.3 b; 6.8b) requires that the capacity of any bridge/causeway is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes). Both Justin's bridge and Richardson's bridge do not meet the required capacity specified in PBP. Therefore any development should be restricted to the east of Richardson's bridge to ensure firefighter safety. It is noted that Darkwood RFS station is located to the west of Richardson's bridge, so therefore an argument could be made that development to the west of Richardson's bridge could be services by appliances from the Darkwood brigade. However, this relies on the appliances of that brigade being able to provide suppression capabilities for increased development, as additional appliances traveling from the east of Richardson's bridge should not be traversing the bridge due to the load limitations.

While there are no bridges with load limitations along Kalang Road, there are numerous bridges that create potential pinch points and restrict traffic flows in the event of a mass movement during an evacuation. This is of concern and a limitation to any increase in the number of residents.

Considering that the potential rate of spread on the maximum recorded FFDI of 95 (see Table 3) exceeds 12 km / hour for forest vegetation type with a spotting distance potential of up to 30 km, and that the highest risk of fire is from the west, it is recommended that any potential future development be limited to the cleared areas to the east within 15 – 20 minute travel distance to main roads that provide egress to Bellingen as the nearest town. This would potentially provide future residents with a chance to evacuate ahead of the fire front if emergency warnings were received and acted upon. Knowing the current position of the fire is a critical consideration, but this is often very difficult to determine. Media advice, Fires Near Me app, social media, visual observation, and emergency service radio chatter, can all help estimate the position of a fire, but it is rare that you will know exactly where the fire is. It is important to consider the time to gather valuables and those in the household, load the car and a slow travel time on the road because of smoke or congestion.

Given the limitations identified above the following options, whilst not removing the inherent risks from a single access road in a heavily vegetated landscape, the following actions and recommendations would help to improve both current and future access issues:

- Any increase in development resulting from the planning proposal should be limited to the eastern more cleared areas approximately a maximum 15 -20 minutes travel time from main access roads (Waterfall Way for the Thora Valley and Bowraville Road for the Kalang Valley);
  - For the Thora Valley, Richardson's bridge is approximately 20 minutes to Waterfall Way;

  - For the Kalang Valley, Woutis Bluff (Holbert's Fire Trail intersection with Kalang Road) is approximately 15 minutes from Bowraville Road and Kalang road intersection, with the Rickerby's Road – Kalang Road intersection being approximately 5 minutes additional travel time beyond Woutis Bluff.
- Strategies around management of visitors and activities within the E4 zones on days when the Fire Danger Rating for the Mid North Coast is Extreme or Catastrophic (i.e. roads closed to local traffic/residents only) to mitigate any increased risk of the road network failing in the event of an emergency due to increased traffic movements resulting from future development,
- Achievement of access advantages at the property level. Given the size of rural allotments in this area, it is feasible that future development can incorporate improvements to property access, as per the property access requirements of Table 5.3b of PBP (See Appendix A) as well as additional measures such as multiple egress options from the property to the primary road;
- Maintenance and upgrade of fire trails within the E4 zone and surrounding National Park and State Forest for emergency vehicles only; and
- Strengthen community resilience

Future development applications will need to address access requirements in more detail as per PBP 2019 (see Appendix A and C) and consider access solutions that facilitate:

- safe access and egress for residents and emergency service personnel, including multiple access/egress options for each area (noting as above that this is an identified constraint for the areas, and it is unlikely that alternative access roads are feasible). This will limit the feasibility of development in areas to the east, with development further west unviable due to the access constraints,
- provision of fire trail/s to support operational activities in strategic locations.

Depending on the future land use, access and property access requirements will differ, and therefore some developments will be able to more readily meet the requirements of PBP. For example, access variations related to eco-tourism developments as per Table 6.8b of PBP and include:

- Primitive Camping: Firefighting vehicles are provided safe with all-weather access to structures and hazard vegetation and access is provided in accordance with property access requirements of Table 5.3b of PBP,
- Bed and Breakfast /Farmstay: Firefighting vehicles are provided with safe all-weather access to structures and access is provided in property access requirements of Table 5.3b of PBP,
- Ecotourism: Firefighting vehicles are provided safe all-weather access to the proposed refuge building and:
  - Vehicular access is provided to the refuge building from a public road in accordance with property access requirements of Table 5.3b of PBP,
  - Accommodation is within 100 m of the refuge building, and
  - Pedestrian paths from accommodation to the refuge buildings are provided and clearly signposted.

The intent of a Strategic Study is to minimise the reliance on performance solutions for future developments. Many existing properties within the E4 zone would retrospectively not meet the current acceptable solutions of PBP in relation to access, and improvements to access and safety may be able to be achieved through the application of performance solutions noting the actions and recommendations identified above. Performance solutions in the eastern areas potentially suitable for activities under the planning proposal may be able to be considered, and may result in increased bushfire protection to existing developments that would not otherwise be achieved. For example, provision could be made for extended APZ's, increased construction standards, and emergency evacuation plans where the future land use will provide tourist facilities – noting that environmental constraints may restrict the ability of sites to provide these requirements. However, access remains a key bushfire protection measure and is the most significant constraint and risk for the study areas, limiting the suitability of any increased development to the eastern, more cleared sections as discussed above.

5. Emergency Management

The following is recommended for strategic land use planning to achieve the objectives and strategic planning principles of PBP 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. resource adequacy and emergency evacuation) that have implications for land use planning, including:

a. Consideration of the increase in demand for emergency services,
b. Emergency evacuation planning, and
c. Evacuation adequacy assessment.

5.1.1 Emergency Services

As indicated in the traffic analysis (Appendix D), it is anticipated that the proposed land use changes would result in a small increase in the future population in the Thora Valley (34 people) and Kalang Valley (48 people). Therefore, given the proximity of emergency services to the precinct and the low anticipated increase in persons, provided emergency management and planning fosters a 'leave early' approach, existing services are considered adequate. RFS brigades within the Thora and Kalang Valleys include:

Kalang Valley

- Kalang Brigade
- Scotchman Brigade

Thora Valley

- Thora Brigade
- Darkwood Brigade

Under section 6 of PBP, there are also specific requirements related to emergency management that future land-uses related to ecotourism will need to meet. These are outlined in Table 6.8d of PBP and detailed in Appendix C of this report and include a bush fire emergency management and evacuation plan.

5.1.2 Evacuation

The safety of people within the E4 zones exposed to bushfire attack, is paramount. Multiple options should be afforded future development to facilitate the highest level of safety, including:

1. Offsite Evacuation - suitable offsite evacuation options, that can be utilised when safe to do so,
2. Onsite Evacuation - the provision of areas or the dedication of sites suitable for the establishment of Neighbourhood Safer Places (NSPs), either open space or building NSPs with the proposal area,
3. In situ refuge - the siting of development and the choice of development type that responds to the bushfire risk, such that people unable to safely utilise option 1 or 2, can take shelter in a building (i.e. dwelling) and be afforded an appropriate degree of safety.

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 south-west),

- Identification of evacuation and refuge locations, and
- An evaluation of evacuation adequacy and option for the shortcomings identified.

In considering the time to evacuate the site, **Figure 12** demonstrates the predicted Rate of Spread (ROS) scenarios for each fire danger rating, based on:

- Rainforest fuel loads to the north,
- Manage land to the east,
- Forest fuel loads in all other directions,
- Maximum PBP Slope class of 15-20° downslope, and
- FFDI 89 – based on likely direction of fire - see Table 3 for analysis)

The outputs of this modelling give an indication of the geographic distance from the E4 zone that a fire may be capable of spreading within 1 hour. The outputs of this analysis (Figure 12) show that a fire igniting just over 5 km from the E4 zone (shown as the yellow line on Figure 12), would afford residents 60 minutes to safely evacuate. However this does not account for spotting potential, and for the western end of the E4 zone in particular that has heavier forest vegetation it may be too late to evacuate as the access may be cut, or the fire closer than that distance. It is important to consider the time to gather valuables and those in the household, load the car and a slow travel time on the road because of smoke or congestion. Coupled with bushfire management plans/evacuation plans for tourism facilities, along with the RFS position of a leave early approach, it is feasible to consider evacuation as a safe option for the more cleared areas to the east of the zone, particularly if consideration is given to restrictions around the transient population on days of extreme or catastrophic fire danger ratings. It is a reasonable assumption, in considering the fire history record and fire intensity analysis, that the evacuation route to the east is likely to remain open. Therefore as discussed in Section 4, any increase in development resulting from the planning proposal should be limited the eastern more cleared areas approximately a maximum 15 -20 minutes travel time from main access roads (Waterfall Way for the Thora Valley and Bowraville Road for the Kalang Valley).

5.1.3 Assessment of Neighbourhood Safer Places (NSPs)

Existing NSPs as identified, assessed, and approved by the RFS in proximity to the subject land are identified in Table 5. Egress to each of these NSP is dependent on access options remaining open, as discussed in Section 4 and Section 5.1.2 and would generally form part of the offsite evacuation plan. The existing NSPs are located east of the E4 Zone.

RFS (2017b) 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*

To increase the safety of future occupants of the precinct, there is scope with the subject land for additional NSPs to be established to assist people when there is imminent threat of bushfire and evacuation out of the E4 zone is not possible. This should occur via the incorporation of NSPs into the

planning proposal, as per the guidance in the document *Neighbourhood Safer Places guidelines for the identification and inspection of neighbourhood safer places in NSW* (RFS, 2017). NSPs can be provided as Open Space or Building NSPs, and must be sighted to have a radiant heat exposure of less than 2 kW/m^2 and 10 kW/m^2 respectively, or meet the required distance thresholds.

Figure 13 demonstrates, bases on the indicative hazard and initial assessment of the subject land, distance and radiant heat thresholds for NSPs can be achieved and that strategic location of additional NSPs can provide strategic advantages in regard to evacuation and mitigate access concerns.

Table 6: Existing Neighbourhood Safer Places

Neighbourhood Safer Place	Type	Address	Distance and Direction		
			Darkwood	Thora	Kalang
Bellingen Showground	Open Space	Black Street North Bellingen	28.5 km East	12.5 km East-South-East	16.2 km North East
Uniting Church Hall	Building	Hyde Street Bellingen	28.1 km East	12.2 km East-South-East	15.8 km North East
Connell Park	Open Space	Waterfall Way Bellingen	28.4 km East	12.5 km East-South-East	16.2 km North East

The criteria and principles for NSPs are documented in RFS (2017b) and shown in Table 8 and **Table 7**.

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

Factor	Performance Criteria	Acceptable Solution
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.
	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
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

Table 8: Principles for Site Identification (RFS 2017b)

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.

5.1.4 In Situ Refuge

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 show that rapid onset bushfire attack is possible under extreme/favourable conditions. In these circumstances, offsite evacuation may not be feasible or safe. For certain developments such as eco-tourism facilities a refuge building is a requirement of PBP, whilst for other developments, on-site or in situ refuge is beyond the Acceptable Solutions. However, for rural lots, such as those within this planning proposal, additional protection measures related to in situ refuge are not only desirable but offer additional evacuation options which is paramount in settings where there is an increased bushfire landscape risk.

For ecotourism developments, PBP offers prescriptive requirements in regard to APZs, construction standards, services and access requirements of refuge buildings. For example, Table 6.8a and Table 6.8a of PBP (seen Appendix C), call for (along with other provisions):

- A refuge building constructed to radiant heat threshold of 10kW/m^2 must be provided and located within 100 m of accommodation cabins.
- The provision of vehicle access to the refuge building from a public road in accord with Table 5.3b of PBP.

Other strategic measures include the clustering of building envelopes to afford larger APZs, higher building construction standards, as discussed in Section 4.1, and the utilisation of cleared areas as managed open space. These additional bushfire protection measures significantly improve the on-site last resort value of the future development, which is highly desirable for the proposal.

Furthermore as shown in Figure 13, the are likely to be opportunities for management of cleared areas to meet 2kW/m^2 threshold which may be formalised as designated open space refuge.

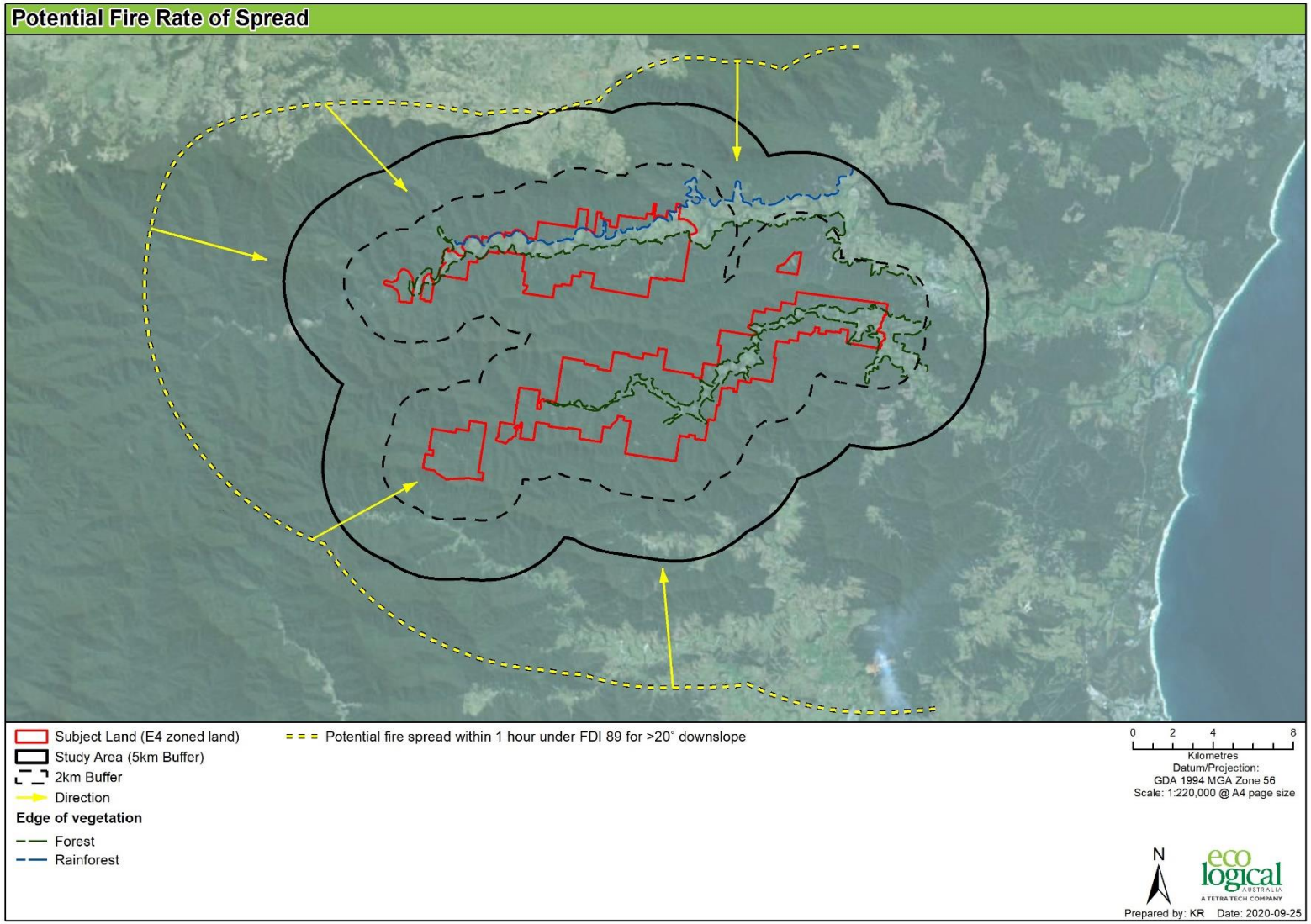

Figure 12: Potential fire rate of spread within 1 hour under FDI 89 and >20°downslope (note modelled included 25° slope values)

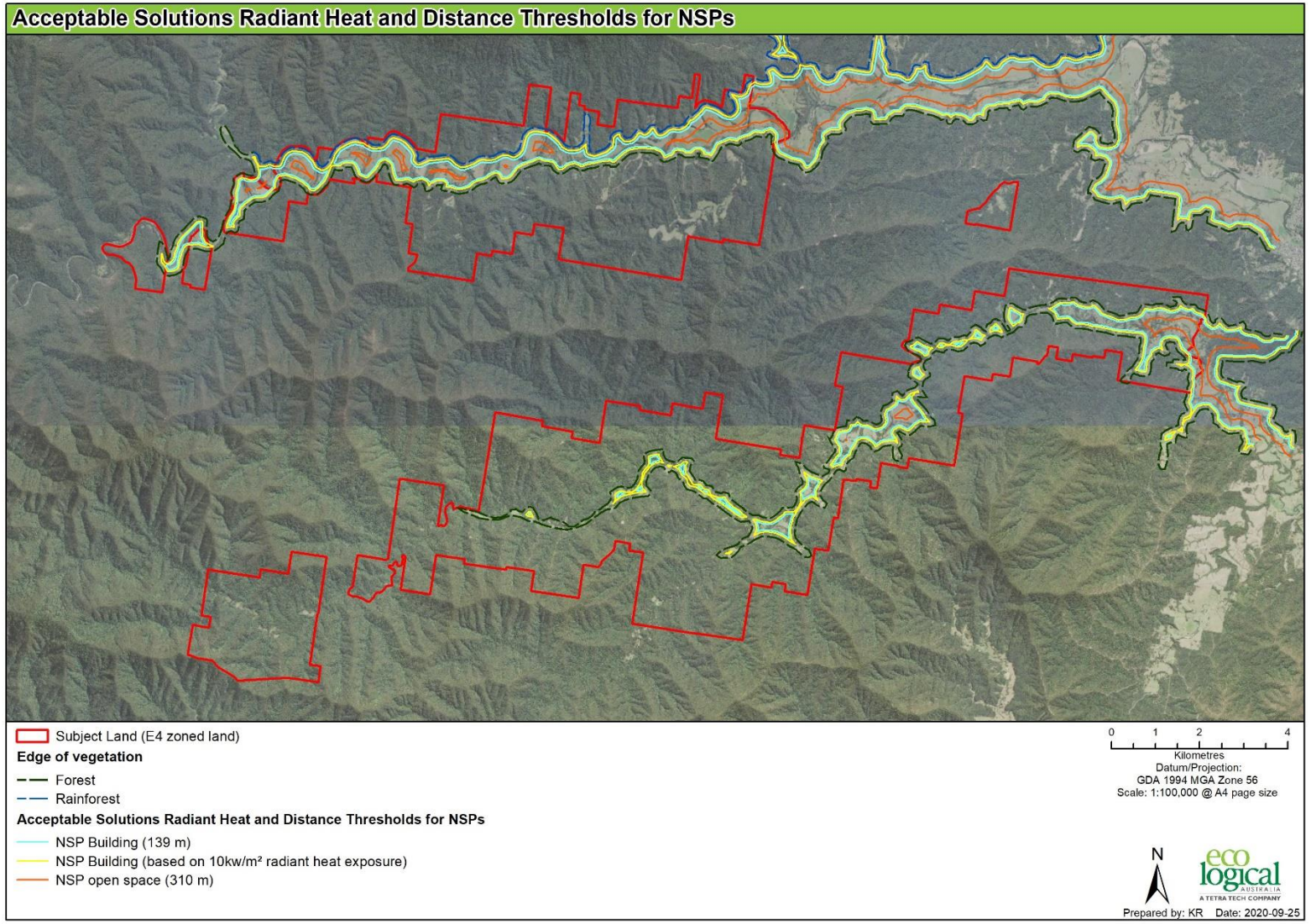

Figure 13: Acceptable Solutions Radiant Heat and Distance Thresholds for NSPs

6. Infrastructure

6.1 Water

To comply with PBP, future development will need to meet the requirements of PBP. For eco-tourism development, these are detailed in Table 6.8c of PBP. For other development, the requirements outlined in Table 5.3c may apply. Future requirements are outline in Appendix B and C of this report.

It is likely that future developments will be supplied by static water systems as is the case for all existing development, where a minimum of 10,000L will generally apply. It is not expected that there would be any key constraints preventing the future developments achieving the PBP acceptable solution requirements for water supply.

6.2 Electricity and gas

To comply with PBP, future development will need to meet the requirements of PBP. For eco-tourism development, these are detailed in Table 6.8c of PBP. For other development, the requirements outlined in Table 5.3c may apply. Future requirements are outline in Appendix B and C of this report.

It is likely that future developments will be supplied by overhead transmissions lines and this should occur with consideration of the *ISSC3 Guideline for Management of Vegetation Near Power Lines*.

Gas services should be installed and maintained in accordance with AS/NZS 1596:2014.

It is not expected that there would be any key constraints preventing the future developments achieving the PBP acceptable solution requirements for electricity or gas services.

7. Adjoining land

Future development should not be reliant on any off-site bushfire mitigation measures. All buildings and use should be designed to be resilient to bushfire attack in circumstances where no additional fuel management occurs outside of APZs etc.

Local Bushfire Management Committees will be updated annually of the bushfire protection measures in-built. Two Strategic Fire Advantage Zone (SFAZ) are present in the Thora Valley, which 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' (Map 4, Mid North Coast BFRMP, 2017). This management practice is expected to continue, with no additional impacts to the management regime as a result of the proposed development in the study area.

The proposed land uses should not have a deleterious impact on the ability for bushfire management activities to be undertaken on adjoining land. Given the adherence to PBP 2019 and other land use planning requirements, the proposed land uses should not increase bushfire management needs for retained and/or adjoining bushfire prone vegetation.

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 part

of the community education treatment strategy within the Mid North Coast BFRMP (BFMC 2009), the NSW RFS Mid North Coast District Office would seek contact with local brigade(s) as future residents occupy dwellings to assess access and egress and discuss facilitation of Bush Fire Survival Plans. This community education may also include community meetings for the wider community.

8. Conclusions

The aim of this study was to review the proposed E4 zone LEP amendments in relation to the applicable bushfire assessment framework for strategic planning outlined in PBP. Analysis of the fire history and potential fire behaviour for the E4 zone indicates that while the probability of a landscape-wide fire or major fire attack is likely, the cleared flood plain area in the eastern portion of the Thora and Kalang Valleys where future development is likely to occur (subject to environmental considerations as well as bushfire considerations) have generally been spared direct impact given the fire management advantages these areas afford such as;

- Gentle sloped cleared areas resulting in reduced fire intensities approaching properties and more manageable fires,
- Larger rural lots, enabling extended APZs and,
- Preparedness and community resilience.

Despite these advantages, any increased development results in increased pressures on road networks with identified limitations in regard to bushfire protection, particularly during a fire event where the road network not only facilitates evacuation, but ingress for emergency management. While the population increase is expected to be quite small and transient, there remains significant constraints to the feasibility and ability to provide alternate access arrangements, particularly as development moves further west into the valleys. To the east, there is potential that access concerns can be minimised through consideration of potential evacuation travel times, bushfire management plans, the incorporation of additional NSPs and the PBP requirement of on-site refuge buildings for certain tourism developments providing options in regard to evacuation and emergency management.

There are also number of measures that can be taken to improve the bushfire protection of existing and future properties associated with the zoning proposal and include:

- Increased setbacks from bushfire prone vegetation (APZs) to be considered for future development given access constraints,
- Consideration at the property level for the most appropriate action in regard to evacuation in an emergency (leave early, on site refuge, NSP),
- Compliant water supply, gas and electricity services,
- Emergency response planning, including community education and engagement by local brigades with the community on Bush Fire Survival Plans and access/egress as dwellings are constructed and occupied.

If this approach was to be considered, detailed bushfire assessment to accurately prescribe setbacks, APZ management, evacuation and refuge will be required at each individual property Development Application stage. However, it is recommended that the re-zoning application has provisions for this to occur smoothly and achieve the deemed to satisfy standards within NSW in the eastern portion of the E4 zone. While there remain the limitations and constraints around alternate access identified through

this report, whilst not removing the inherent risks from a single access road in a heavily vegetated landscape, the following identified actions and recommendations would help to improve both current and future access issues:

- Any increase in development resulting from the planning proposal should be limited to the eastern more cleared areas approximately a maximum 15 -20 minutes travel time from main access roads (Waterfall Way for the Thora Valley and Bowraville Road for the Kalang Valley);
  - For the Thora Valley, Richardson's bridge is approximately 20 minutes to Waterfall Way;
  - For the Kalang Valley, Woutis Bluff (Holbert's Fire Trail intersection with Kalang Road) is approximately 15 minutes from Bowraville Road and Kalang road intersection, with the Rickerby's Road – Kalang Road intersection being approximately 5 minutes additional travel time beyond Woutis Bluff.
- Strategies around management of visitors and activities within the E4 zones on days when the Fire Danger Rating for the Mid North Coast is Extreme or Catastrophic (i.e. roads closed to local traffic/residents only) to mitigate any increased risk of the road network failing in the event of an emergency due to increased traffic movements resulting from future development,
- Achievement of access advantages at the property level. Given the size of rural allotments in this area, it is feasible that future development can incorporate improvements to property access, as per the property access requirements of Table 5.3b of PBP (See Appendix A) as well as additional measures such as multiple egress options from the property to the primary road;
- Maintenance and upgrade of fire trails within the E4 zone and surrounding National Park and State Forest for emergency vehicles only; and
- Strengthen community resilience

Whilst the E4 zones are not suitable for intensive development that would result in a significant increase in population, the land uses proposed in the LEP amendment are generally compatible, if not desired within the landscape. This study demonstrates there are opportunities and advantages that can be applied at the property level in the largely cleared portions to the east with lower levels of risk to mitigate the increased landscape risk and facilitate development that can meet PBP requirements. However, specific proposals cannot be tested at this stage of the planning process, and will be tested on merit in regard to the requirements of PBP at the DA stage of the planning process.

Therefore it is concluded that, for the largely cleared portions of the land to the east of the E4 zone within 15 – 20 minutes travel time from main access roads (Waterfall Way for the Thora Valley and Bowraville Road for the Kalang Valley), the planning proposal is consistent with Ministerial Direction 4.4 (Planning for Bushfire Protection) issued under section 9.1 of the Environmental Planning and Assessment Act subject to the inclusion of the inclusion of the bushfire risk reduction strategies identified in this report .

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Appendix A Access Specifications

The following access specifications are reproduced from PBP (RFS 2019).

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

Table 9: Performance criteria for access for residential and rural residential subdivisions (from Table 5.3b of PBP)

Performance Criteria		Acceptable Solutions
The intent may be achieved where:		
GENERAL ACCESS REQUIREMENTS	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.
PERIMETER ROAD	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	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

Performance Criteria		Acceptable Solutions
	service personnel during firefighting and emergency management on the interface	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 a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.
NON-PERIMETER ROAD	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.
PROPERTY ACCESS	firefighting vehicles can access the dwelling and exit safely	No specific access requirements apply in an 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 : Services Specifications

The following services specifications (provision of water, gas and electricity) are reproduced from PBP (RFS 2019).

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 10: Performance criteria for services provision for residential and rural residential subdivisions (based on Table 5.3c of PBP)

Performance Criteria		Acceptable Solutions
	The intent may be achieved where:	
WATER SUPPLIES	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.
ELECTRICITY SERVICES	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.
GAS SERVICES	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 11: 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

Appendix C SFFP Development

The following APZ and services specifications (provision of water, gas and electricity) apply to SFPP developments and are reproduced from PBP (RFS 2019).

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 12 - APZs and construction for SFPP development (adapted from Table 6.8a of PBP).

	Performance Criteria	Acceptable Solutions
	The intent may be achieved where:	
ASSET PROTECTION ZONES (APZ)	radiant heat levels of greater than 10kW/m² (calculated at 1200K) will not experienced on any part of the building	the building is provided with an APZ in accordance with table A1.12.1 in Appendix 1.
	APZ maintenance is practical, soil stability is not compromised and the potential for crown fires is minimised.	the APZ is located on lands with a slope less than 18 degrees.
	APZs are managed and maintained to prevent the spread of fire to the building. the APZ is provided in perpetuity.	the APZ is managed in accordance with the requirements of Appendix 4 of this document, and is wholly within the boundaries of the development site; APZ are wholly within the boundaries of the development site; and Other structures located within the APZ need to be located further than 6m from the refuge building.
	VARIATIONS	
	Camping and primitive camping: no performance criteria applicable	N/A
	Bed and breakfast and farmstay: the building will not be exposed to radiant heat levels exceeding 29kW/m² (1090K)	an APZ is provided in accordance with tables A1.12.2 and A1.12.3 in Appendix 1 of this document around the entire building or structure
	Ecotourism: radiant heat levels of greater than 10kW/m² (1200K) are not experienced by emergency service personnel and occupants during firefighting and emergency management around a building on site that can be used as a refuge	an APZ is provided in accordance with table A1.12.1 in Appendix 1 of this document around the entire refuge building or structure
	Manufactured home estates: APZs achieve radiant heat levels that are commensurate with the construction standard for the proposed dwelling.	an APZ in accordance with Table A1.12.1 in Appendix 1 of this document is provided to all new dwellings; or an APZ in accordance with Table A1.12.2 or A1.12.3 in Appendix 1 of this document is provided where it is demonstrated that all new dwellings will be constructed in accordance with BAL-29.
LANDSCAPING	landscaping is designed and managed to minimise flame contact and radiant heat to	landscaping is in accordance with Appendix4; and fencing is constructed in accordance with section 7.6.

	Performance Criteria	Acceptable Solutions
	buildings, and the potential for wind-driven embers to cause ignitions	
CONSTRUCTION	the proposed building can withstand bush fire attack in the form of wind, embers, radiant heat and flame contact	a construction level of BAL-12.5 under AS 3959 or NASH and section 7.5 is applied.
	VARIATIONS	
	Camping and primitive camping: no performance criteria applicable	N/A
	Bed and breakfast and farmstay: the proposed building can withstand bush fire attack in the form of wind, embers, radiant heat and flame contact	construction is applied in accordance with Appendix 1 of PBP
	Ecotourism: the proposed refuge building can withstand bush fire attack in the form of wind, embers, radiant heat and flame contact	a construction level of BAL-12.5 or greater is applied to the refuge building in accordance with AS 3959 or NASH and section 7.5 of PBP
	Manufactured home estates: the proposed manufactured home can withstand bush fire attack in the form of wind, smoke, embers, radiant heat and flame contact	Where an APZ is provided in accordance with Table A1.12.1 in Appendix 1 of this document the construction standards for BAL-12.5 shall apply; or Where an APZ is provided in accordance with Table A1.12.2 and A1.12.3 in Appendix 1 of this document the construction standards for BAL-29 shall apply.
	ECOTOURISM ONLY	
	Occupants of the ecotourism facility are provided with appropriate shelter in the event of a bush fire	a refuge building is provided the refuge building must have sufficient space for all occupants and comply with the occupancy levels permissible for that structure; and the refuge building must be constructed to BAL-12.5 or greater in accordance with AS3959 or NASH standard and section 7.5 of PBP

All APZ modelling for the purposes of SFPP development is based on flame temperature of 1200 Kelvin (K).

Table 13: Performance criteria and acceptable solutions for access for SFPP development (adapted from Table 6.8b if PBP).

Performance Criteria		Acceptable Solutions
The intent may be achieved where:		
FIREFIGHTING VEHICLES	firefighting vehicles are provided with safe, all-weather access to structures and hazard vegetation	SFPP access roads are two-wheel drive, all-weather roads, and access is provided to all structures; traffic management devices are constructed to not prohibit access by emergency services vehicles access roads must provide suitable turning areas in accordance with Appendix 3; and 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.
	VARIATIONS	
	Primitive camping: Firefighting vehicles are provided with safe, all-weather access to structures and hazard vegetation	access is provided in accordance with the property access requirements of table 5.3b
	Bed and breakfast and farmstay: Firefighting vehicles are provided with safe, all-weather access to structures.	access is provided in accordance with the property access requirements of table 5.3b
	Ecotourism: firefighting vehicles are provided with safe, all-weather access to the proposed refuge building	vehicular access is provided to the refuge building from a public road in accordance with property access from table 5.3b; and accommodation is within 100m of the refuge building; and pedestrian paths from accommodation to the refuge building/s are provided and clearly signposted.
ACCESS ROAD CAPACITY	the capacity of access roads is adequate for firefighting vehicles	the capacity of road surfaces and any bridges/ causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges and causeways are to clearly indicate load rating
ACCESS TO WATER	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, and hydrants are provided in accordance with the relevant clauses of AS 2419.1:2005; and there is suitable access for a Category 1 fire appliance to within 4m of the static water supply where no reticulated supply is available

	Performance Criteria	Acceptable Solutions
PERIMETER ROADS	Perimeter access roads are designed to allow safe access and egress for firefighting vehicles while occupants are evacuating as well as providing a safe operational environment for emergency service personnel during firefighting and emergency management on the interface	there are two-way sealed roads; minimum 8m carriageway width kerb to kerb; and parking is provided outside of the carriageway width; hydrants are to be located clear of parking areas; 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; the maximum grade road is 15° and average grade of not more than 10°; the road crossfall does not exceed 3°; and a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.
NON-PERIMETER ROADS	Non-perimeter access roads are designed to allow safe access and egress for firefighting vehicles while occupants are evacuating	minimum 5.5m width kerb to kerb; parking is provided outside of the carriageway width; hydrants are located clear of parking areas; there are through roads, and these are linked to the internal road system at an interval of no greater than 500m; curves of roads have a minimum inner radius of 6m; the maximum grade road is 15° and average grade of not more than 10°; the road crossfall does not exceed 3°; a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.

Table 14: Performance criteria and acceptable solutions for water, electricity and gas services for SFPP development (Adapted from Table 6.8c of PBP)

Performance Criteria		Acceptable Solutions
The intent may be achieved where:		
WATER SUPPLY	An adequate water supply for firefighting purposes is installed and maintained.	reticulated water is to be provided to the development, where available, or a 10,000 litres minimum static water supply dedicated for firefighting purposes is provided for each occupied building where no reticulated water is available.
	VARIATIONS	
	Caravan and camping ground: an adequate water supply for firefighting purposes is installed Primitive camping: an adequate water supply for firefighting purposes is installed	either a reticulated water supply is provided or a 10,000 litres minimum water supply on site.
	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 relevant clauses of Australian Standard AS2419.1:2005; hydrants are not located within any road carriageway; and reticulated water supply to SFPPs uses a ring main system for areas with perimeter roads; and
	flows and pressure are appropriate	fire hydrant flows and pressures comply with the relevant clauses AS2419:2005,
	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;
	water supplies are adequate in areas where reticulated water is not available	a connection for firefighting purposes is located within the IPA or non hazard side and away from the structure; a 65mm Storz outlet with a ball valve is fitted to the outlet; ball valve and pipes are adequate for water flow and are metal; supply pipes from tank to ball valve have the same bore size to ensure flow volume; and underground tanks have an access hole of 200mm to allow tankers to refill direct from the tank; and a hardened ground surface for truck access is supplied within 4m of the access hole; and above-ground tanks are manufactured from concrete or metal; raised tanks have their stands constructed from non-combustible materials on bush fires-resisting timber (see Appendix F AS 3959); unobstructed access is provided at all times unobstructed access is provided at all times tanks on the hazard side of a building are provided with adequate shielding for the protection of firefighters and; underground tanks are clearly marked all exposed water pipes external to the building are metal, including any fittings; and

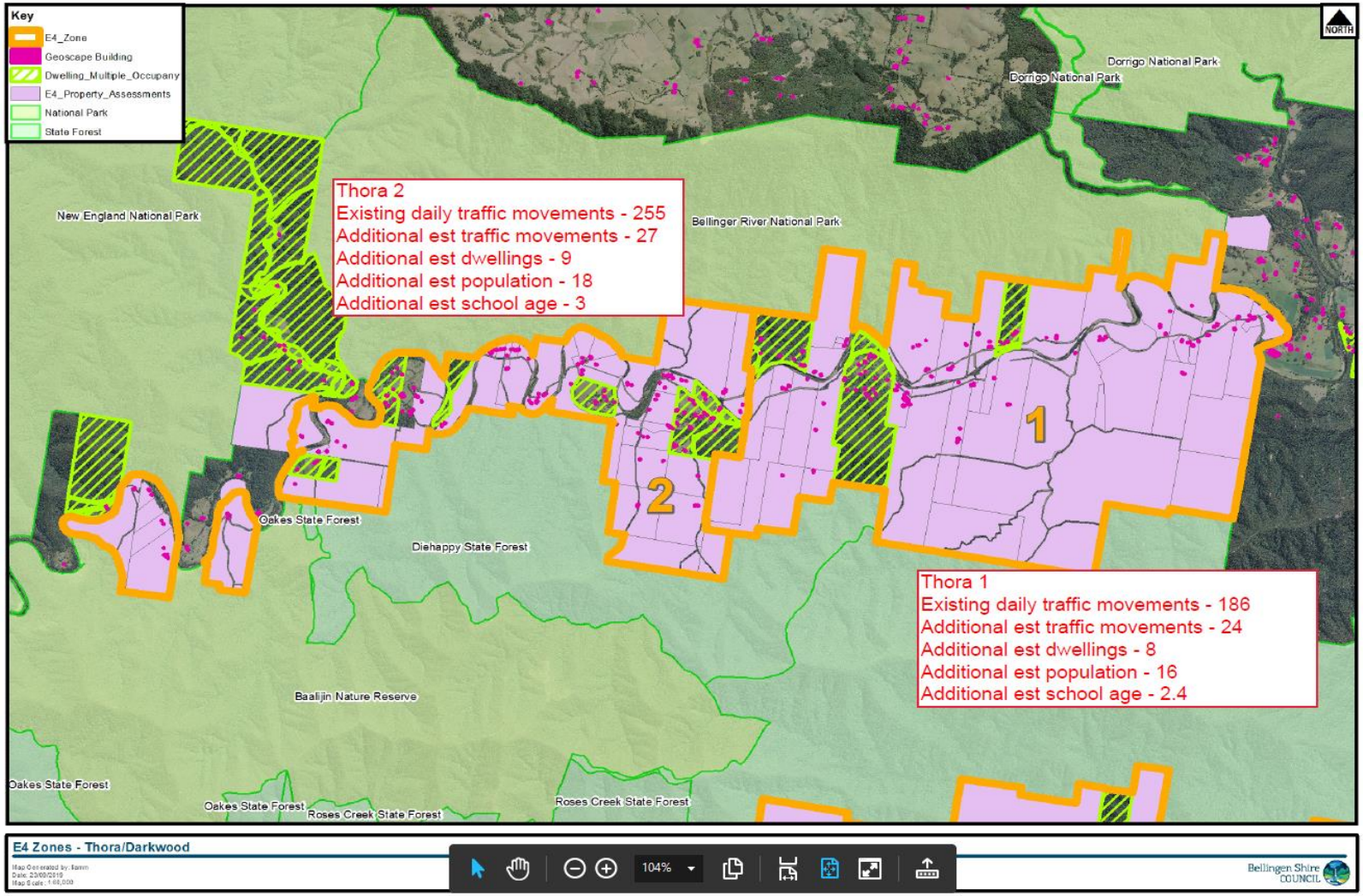
Performance Criteria		Acceptable Solutions
		where pumps are provided, they are a minimum 5hp or 3kW petrol or diesel-powered pump, and are shielded against bush fire attack; any hose and reel for firefighting connected to the pump shall be 19mm internal diameter; and fire hose reels are constructed in accordance with AS/NZS 1221:1997 *Fire hose reels* and installed in accordance with the relevant clauses of AS 2441:2005 *Installation of fire hose reels*.
ELECTRICITY SERVICES	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, and where overhead, electrical transmission lines are proposed as follows: lines are installed with short pole spacing (30m), unless crossing gullies, gorges or riparian areas; and 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*
GAS SERVICES	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; and all fixed gas cylinders are kept clear of all flammable materials to a distance of 10m and shielded on the hazard side; and connections to and from gas cylinders are metal; and if gas cylinders need to be kept close to the building, safety valves are directed away from the building and at least 2m away from any combustible material, so they do not act as a catalyst to combustion; and polymer-sheathed flexible gas supply lines to gas meters adjacent to buildings are not used; and above-ground gas service pipes external to the building are metal, including and up to any outlets.

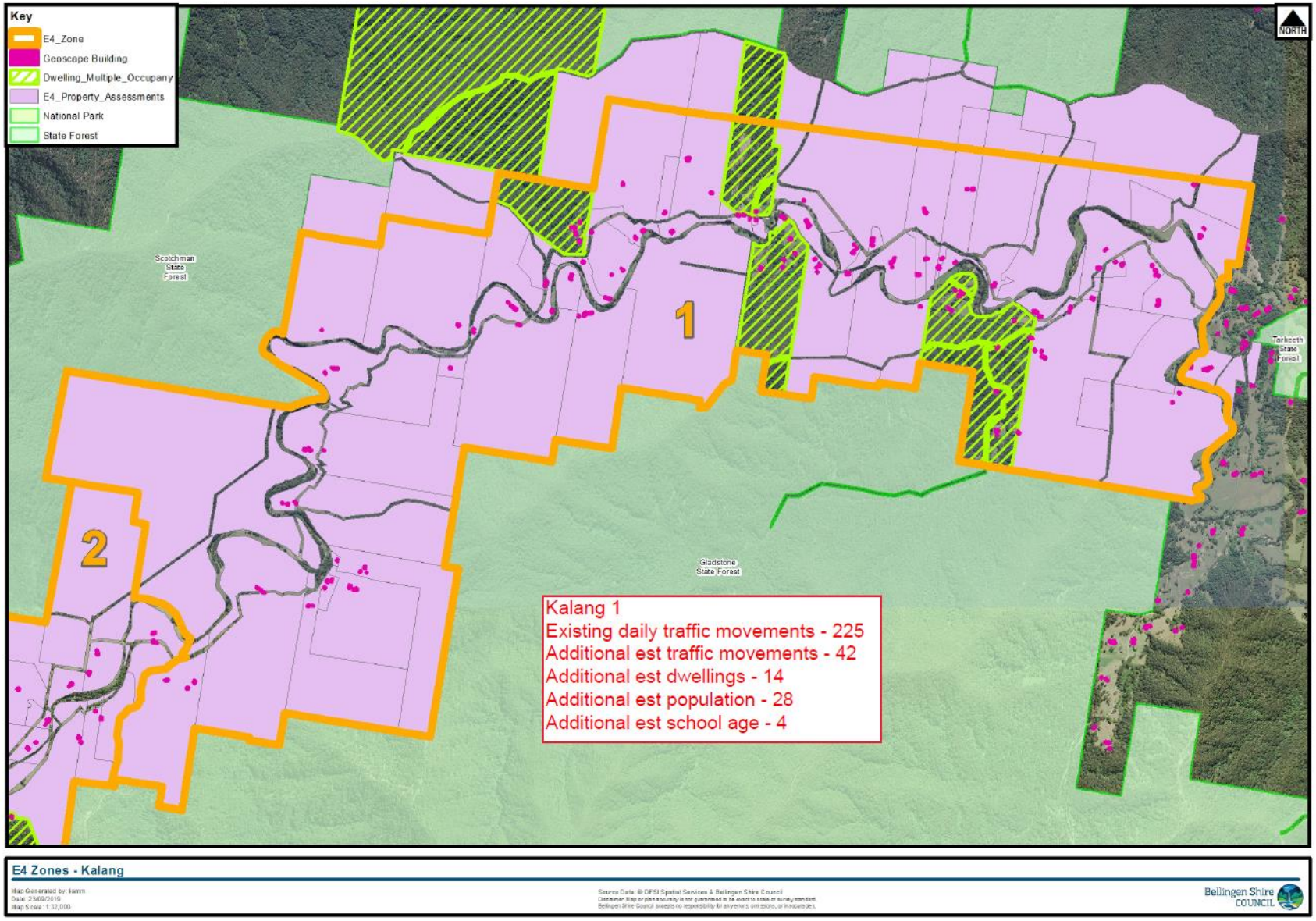
Table 15: Performance criteria and acceptable solutions for emergency management plans for SFPP development (adapted from Table 6.8d of PBP)

	Performance Criteria	Acceptable Solutions
The intent may be achieved where:		
EMERGENCY MANAGEMENT	A Bush Fire Emergency and Evacuation management plan is prepared	bush fire emergency management and evacuation plan is prepared consistent with the: The NSW RFS document: *A Guide to Developing a Bush Fire Emergency Management and Evacuation Plan*; *NSW RFS Schools Program guide*; *Australian Standard AS 3745:2010 Planning for emergencies in facilities*; and *Australian Standard AS 4083:2010 Planning for emergencies – Health care facilities* (where applicable). The bushfire emergency and evacuation management plan should include a mechanism for the early relocation of occupants. Note: A copy of the bush fire emergency management plan should be provided to the Local Emergency Management Committee for its information prior to occupation of the development.
	VARIATIONS	
	Caravan and camping grounds: a bush fire emergency and evacuation management plan is prepared.	a bush fire emergency management and evacuation plan is prepared consistent with the NSW RFS document: A Guide to Developing a Bush Fire Emergency Management and Evacuation Plan, and the Australian Standard AS 3745:2010
	Primitive camping: a bush fire emergency and evacuation management plan is prepared Ecotourism: a bush fire emergency and evacuation management plan is prepared	for proposals in isolated or remote areas which involve large travel distances through bush fire prone vegetation, the following issues should also be determined and addressed: the amount of travel likely to be generated during an emergency evacuation the capacity of the broader road network to facilitate safe emergency evacuation limitations/constraints inherent in the road system management of potential traffic conflicts (such as emergency vehicles versus evacuating members of the public); the bushfire emergency management and evacuation plan should include a mechanism for the early relocation of occupants on days when adverse fire weather is notified or adverse fire activity occurs in the local government area in which the development operates. Note: A copy of the bush fire emergency management and evacuation plan shall be provided to the Local Emergency Management Committee for its information prior to occupation of the development.

Performance Criteria		Acceptable Solutions
	Appropriate and adequate management arrangements are established for consultation and implementation of the bush fire emergency and evacuation management plan.	an Emergency Planning Committee is established to consult with residents (and their families in the case of aged care accommodation and schools) and staff in developing and implementing an Emergency Procedures Manual; and detailed plans of all emergency assembly areas including 'on-site' and 'off-site' arrangements as stated in AS 3745:2010 are clearly displayed, and an annual (as a minimum) emergency evacuation is conducted.

Appendix D – Traffic Analysis

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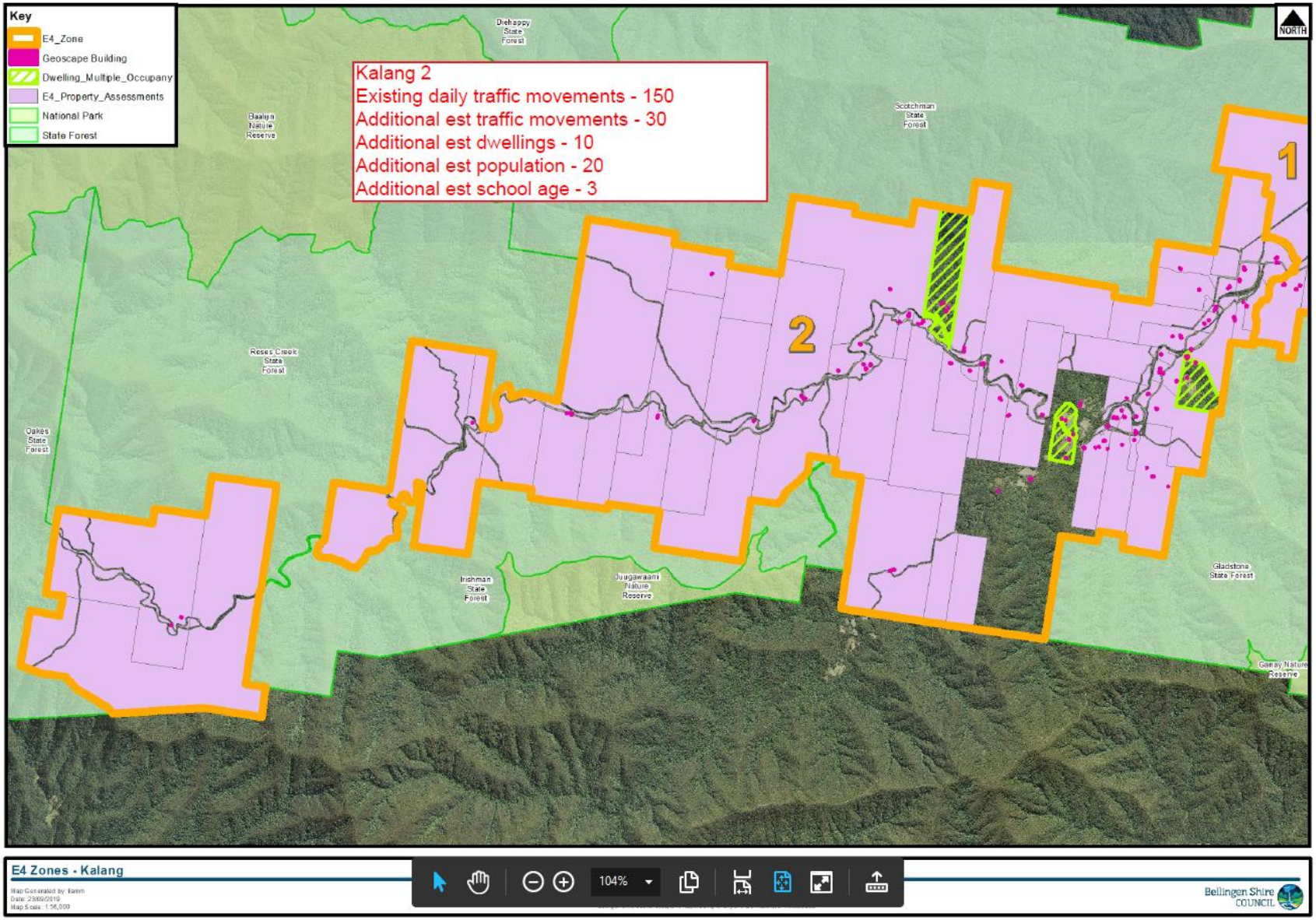
Geoscape Building
Dwelling_Multiple_Occupancy
E4_Property_Assessments
National Park
State Forest
NORTH
Scotchman State Forest
Gladstone State Forest
Tarkeeth State Forest
1
2
Kalang 1
Existing daily traffic movements - 225
Additional est traffic movements - 42
Additional est dwellings - 14
Additional est population - 28
Additional est school age - 4
E4 Zones - Kalang
Bellingen Shire COUNCIL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Geoscape Building
Dwelling_Multiple_Occupancy
E4_Property_Assessments
National Park
State Forest
Kalang 2
Existing daily traffic movements - 150
Additional est traffic movements - 30
Additional est dwellings - 10
Additional est population - 20
Additional est school age - 3
1
2
NORTH
Dirhappy State Forest
Scotchman State Forest
Reses Creek State Forest
Oakes State Forest
Irishman State Forest
Gladstone State Forest
E4 Zones - Kalang
104%
Bellingen Shire COUNCIL

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