



REPORT

Townsville Bushfire Hazard Resilience Project

Bushfire Risk Assessment Report

PREPARED FOR
TOWNSVILLE CITY COUNCIL

May 2025



ACKNOWLEDGEMENT OF COUNTRY

Meridian Urban acknowledges the Traditional Custodians of the lands and waters where we live and work.

As resilience practitioners we have a responsibility in listening to and elevating Indigenous voices through our practice, and meaningfully engaging in processes of reconciliation. We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers, and pay our respect to Elders past and present.

Meridian Urban's 'Reflect' Reconciliation Action Plan (RAP) details our commitments to advancing cultural change, active participation and inclusive and informed approaches, with a focus on increasing economic and social equity for Aboriginal and Torres Strait Islander peoples and supporting First Nations self-determination. A copy of our RAP can be viewed online at meridianurban.com.

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Bushfire Risk Assessment Report

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1 Introduction

The intent of this Bushfire Risk Assessment is to examine and understand the potential nature of bushfire risk to people, property and the environment across the Townsville local government area now, and into the future.

This risk assessment focusses on the potential likelihood and consequence of bushfire risk across Townsville, insofar as it relates to strategic land use planning, having regard to factors of exposure, vulnerability and tolerability.

This whole-of-city risk assessment seeks to inform Council's strategic land use and infrastructure planning approaches to the Townsville local government area, adopting a risk-informed evidence base upon which to consider potential strategic land use planning options.

It achieves this by adopting risk-based principles to determine appropriately risk-informed zoning and other strategic planning controls.

This fit-for-purpose risk assessment is prepared pursuant to the current **State Planning Policy July 2017 (SPP)**, and the State interest guidance materials which are required to be appropriately integrated into a local planning instrument.

The risk assessment process is based upon that set out by the Queensland Emergency Risk Management Framework (QERMF), which is aligned with the National Emergency Risk Assessment Guidelines (NERAG), and in accordance with AS/NZS ISO 31000 – Risk Management as well as AS5334: Climate Change Adaptation for Settlements and Infrastructure – A Risk-Based Approach, having regard to the critical elements of likelihood, exposure, vulnerability, tolerability and consequence with consideration of existing and potential future risk exposure framed by an analysis of:

- Risks to people
- Risks to property
- Risks to infrastructure
- Potential cascading environmental and economic risks.

2 Risk assessment scope

The purpose of this landscape-scale strategic risk assessment is to assess the nature of bushfire risk associated with Townsville local government area and to recommend land use planning controls for the area under an amended Planning Scheme which responds to the specific bushfire risk profile of the area.

The broader bushfire risk analysis, of which this risk assessment forms part, will develop cutting edge, locally refined and pragmatic land use planning approaches to bushfire risk management to enhance the protection of the Townsville community from the threat of natural hazard.

This risk assessment forms Part B of the bushfire risk analysis. The planning scheme provisions development forms Part C – Planning issues and options.

This risk assessment adopts a risk-based land use planning lens in the critical analysis of the magnitude of potential risk likelihood, exposure, vulnerability, tolerability and consequence having regard to a range of scenarios to test a variety of risk outcomes, and mitigation and treatment opportunities. This process seeks to inform Council decision making in relation the preparation of an amended Planning Scheme, having regard to the risk profile of the city.

This approach seeks to satisfy the current State Planning Policy (SPP) and its guidance materials prepared by the State government, which together articulate the suite of bushfire hazard and risk considerations which are required to be appropriately considered as part of strategic planning activities in Queensland.

2.1 Risk assessment assumptions and exclusions

The following assumptions and exclusions apply to this risk assessment:

- It is assumed the evidence sources utilised to inform this risk assessment are accurate and up-to-date, and can be reasonably relied upon for the purposes of its application.
- This risk assessment is not a bushfire management plan.
- It may offer options or recommendations for Councils consideration as part of strategic land use planning processes pursuant to its obligations under the SPP. It does not make any decisions in relation to land use.
- It is assumed a range of other planning-related issues are likely to be taken into account as part of Council's consideration of the observations made by this risk assessment.
- This risk assessment seeks to analyse the extent of bushfire risk relevant to the city with respect to the existing situation and potential future risk, based upon a series of defined scenarios. This assessment makes no inference as to the probability of any scenario coming to fruition.
- Any scenarios adopted for the purpose of this assessment are hypothetical only, designed to test a range of potential risk profiles, mitigation options and residual risk profiles to determine potential 'optimal' options having regard to bushfire risk.
- This assessment does not incorporate any traffic modelling or analysis with regard to bushfire emergency evacuation, and remains qualitative in this regard only.
- This assessment does not have regard to potential vegetation clearing, such as clearing to facilitate development or clearing to protect or maintain infrastructure. It is acknowledged, and noted accordingly at certain points in the report, that the clearing of vegetation may affect the bushfire hazard context, exposure, and level of risk for a site or reporting locality. The clearing of vegetation is regulated under a framework established by local, state and commonwealth legislation and associated subordinate legislation, including (but not necessarily limited to) the *Nature Conservation Act 1992*, *Vegetation Management Act 1999*, *Planning Act 2016* and *Environmental Protection and Biodiversity Conservation Act 1999*. This framework, amongst other functions, determines whether the clearing of vegetation is accepted / exempt clearing works and may be carried out without an approval or permit, or whether clearing is assessable development and requires approval

or determination by the relevant assessing authority before it can proceed. The framework has regard to various factors relating to the vegetation itself (i.e. the biodiversity status, vegetation management class, vegetation height and type, connectivity to other vegetation communities and bioregions) but also has regard to the context and characteristics of the site and proposed development or works (i.e. historical development approvals, type of land use, zoning and other land use designations, presence of waterways and wetlands).

As the vegetation clearing framework can vary the likelihood and extent vegetation clearing on a site-by-site basis, it has not been incorporated into this city-wide risk assessment.

2.2 Mapping data assumptions and limitations

This risk assessment was undertaken on the basis of the following data assumptions and limitations:

- Data sources are as provided by Council and as made publicly available, refer to Section 4.3 for further detail.
- Where relevant, the analysis considers zoned land only (i.e. unzoned land, such as road reserve, waterways and the like are excluded).
- The assessment of exposure is based on 2014 BPA Mapping
- Geometries used to determine exposure are outlined in Section 4.3 of this report.
- The following considerations were taken into account in regard to dwelling exposure:
 - There is no known publicly available dataset that accurately identifies residential buildings, particularly within significant urban areas
 - The cadastre was aligned to the underlying zoning to identify only residential zoned land. Rural dwellings located in the suburb of Cunggulla were included in the assessment; however, dwellings in other rural areas were not considered due to data availability limitations.
 - To estimate the number of potential dwellings per parcel, a unique identifier was created in the cadastral dataset by combining lot and plan values. The building outlines dataset was converted to points and spatially joined with the cadastre to calculate the number of building points per parcel.
 - The dataset indicated a potential total of 73,838 residential buildings. This compares to Geoscience Australia NEXIS data that indicates as at 2023 there were 74,365 residential buildings in Townsville suggesting a high level of confidence for the dataset.
- Road exposure is based on a road centreline dataset and considers higher order roads only. Local streets, laneways and other minor roads were excluded from the assessment.

3 Guiding methodologies

In order to appropriately inform strategic land use planning controls, a fit-for-purpose bushfire risk assessment is necessary in order to examine potential risk and the nature of potential risk-responsive planning controls to address the various aspects of bushfire risk across Townsville local government area.

3.1 Objectives and priorities

The objectives and priorities of this fit-for-purpose risk assessment are:

1. The delivery of **risk-informed land use planning policy**, strategy and statutory controls to underpin a amended Planning Scheme for Townsville.
2. The **quantification of risk** across the Townsville local government area to formulate policy and strategy responses across the spectrum of:
 - Avoid
 - Mitigate
 - Accept
 - Transfer
3. The identification of any **potential acceptable or tolerable risk opportunities** where development could be considered subject to statutory provisions. This includes understanding how land management and other bushfire protection measures can be undertaken to facilitate potential development having regard to risk to life and property, essential community infrastructure, and the natural environment.
4. Identification of the relevant potential **strategic and statutory land use planning policy and provisions** for consideration in response to the above matters.

3.2 Principles

The principles of this risk assessment serve as the foundation which guide the approach and implementation of methodologies. This risk assessment is:

- evidence-based
- stakeholder-led, guided by specialist expertise
- locally contextualised
- fit-for-purpose
- both quantitative and qualitative in assessment
- guided by benchmarks to appropriately determine 'acceptable risk'
- transparent to ensure integrity of process
- aligned with the strategic planning requirements of SPP and its guidance materials.

3.3 Process

As established above, this risk assessment process is undertaken through the specific lens of risk-based land use planning and using the processes outlined by the Queensland Emergency Risk Management Framework (QERMF), aligned with NERAG, as well as AS/NZS ISO 31000:2018 Risk Management: principles and guidelines (ISO 31000) and AS5334: Climate Change Adaptation for Settlements and Infrastructure – A Risk-Based Approach.

This process aligns with that required by the SPP and its guidance materials.

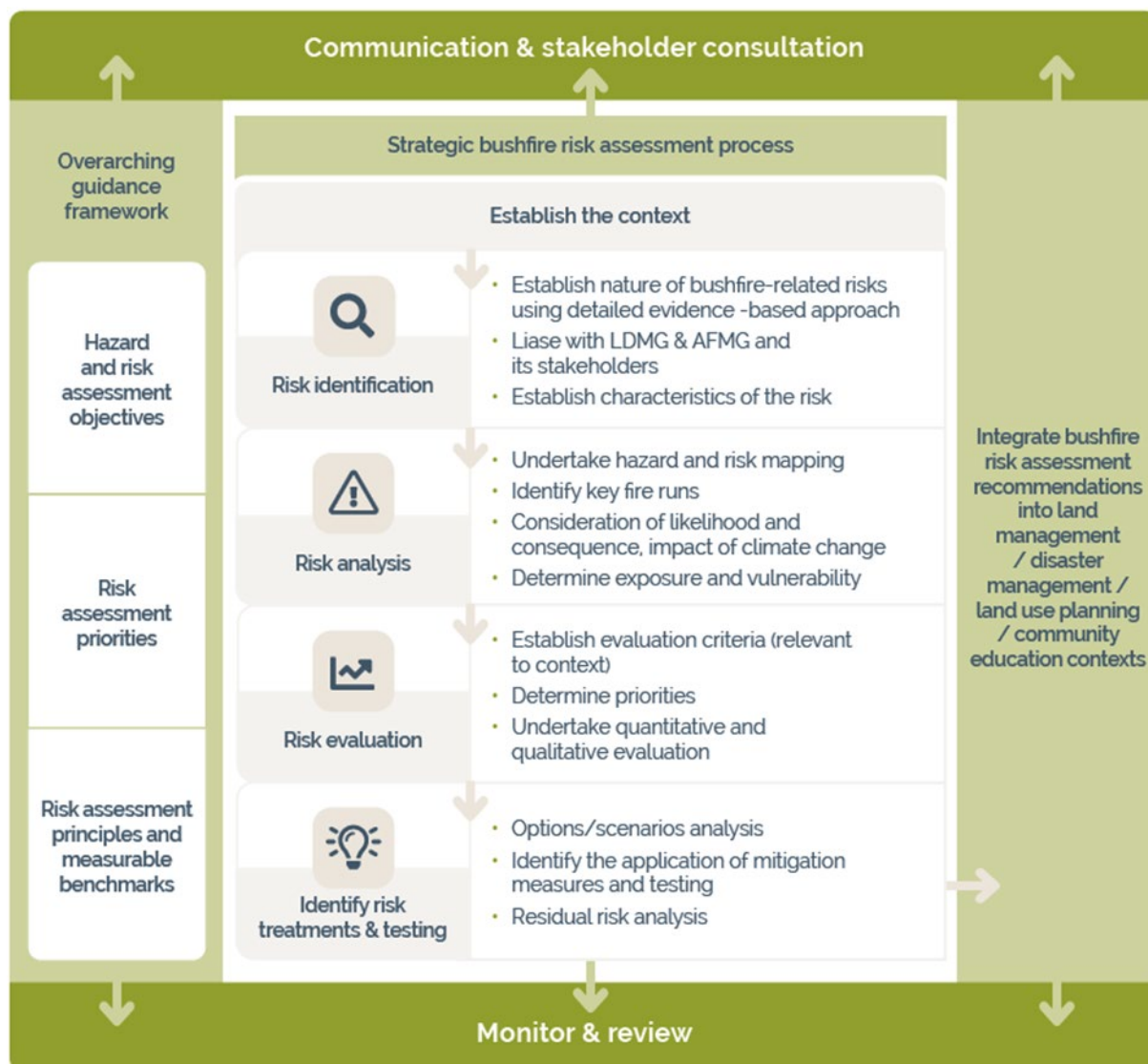


Figure 3-1: Fit-for-purpose risk assessment framework in accordance with NERAG

Pursuant to NERAG, AS/NZS ISO 31000 and AS5334, the essential first stage of any natural hazard risk assessment process is establishing the context to understand the policy and regulatory environment, the physical environment, weather and climatic trends and event history (AIDR, 2017).

How risk is considered by strategic land use planning processes accords with the NERAG framework but attracts different procedures than may otherwise be applied in operational contexts. This is an important distinction to make.

The AIDR Land Use Planning for Disaster Resilient Communities Handbook identifies how risk management procedures are applied in strategic land use planning contexts, outlined below.

Table 3-1: Parallels between land use planning and risk management procedures (Source: AIDR, 2020)

Risk management procedure	Land use planning procedure
Establishing the context	Visioning, overarching desired futures
Risk assessment	Analysis of the circumstances and problems / opportunities

Risk management procedure	Land use planning procedure
Selection of risk treatment options	Identification of planning alternatives and evaluation and selection of them
Risk treatment implementation	Planning implementation.
Ongoing communication and consultation	Communication and consultation
Ongoing monitoring and review	Monitoring effects and adjusting

3.4 An integrated approach

This risk assessment also incorporates an integrated and multi-disciplinary approach to the consideration and quantification of bushfire risk.

While this risk assessment is land use planning-based in its focus, it is necessary to consider the multitude of disciplines and mitigation approaches beyond land use planning that combined, enhance overall bushfire resilience.

This approach fundamentally recognises that it is not the role of strategic land use planning to necessarily avoid or reconcile all aspects of risk, but to contemplate the magnitude of risk in varying scenarios to consider how the quantum of mitigation measures may reduce risk exposure, or not, and whether such risk can reasonably be expected to limit risk to life, property, essential community infrastructure, and the natural environment to an acceptable or tolerable level. Effective strategic land use planning approaches can minimise reliance on other mitigation measures by incorporating risk considerations at an early stage.

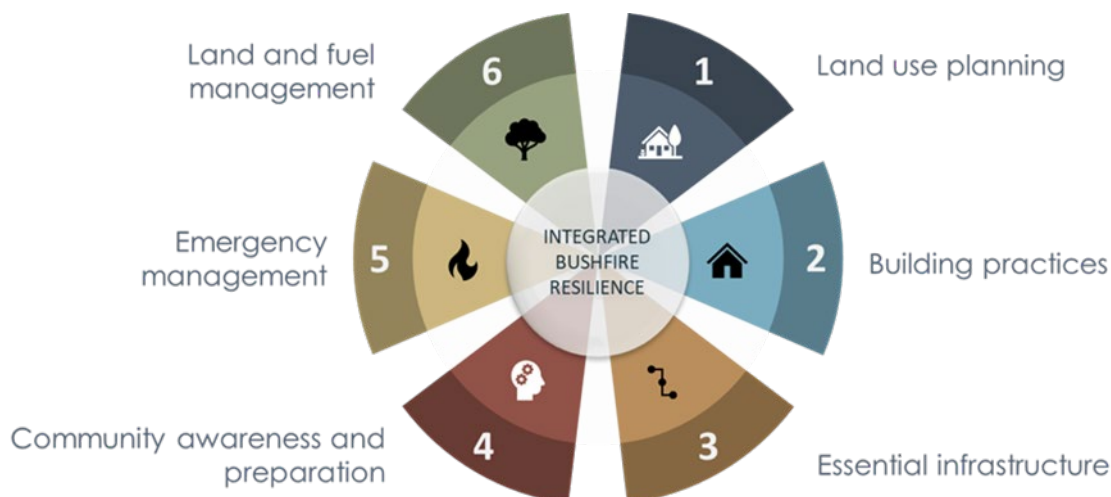


Figure 3-2: An integrated approach to bushfire resilience

As part of this integrated approach, this risk assessment has regard to the Queensland Emergency Risk Management Framework (QERMF) prepared by the then Queensland Fire and Emergency Services (QFES) (now Queensland Fire Department (QFD)). This framework is intended to be contemplated by multi-disciplinary approaches, including land use planning activities.

While the framework diverges in certain respects from NERAG, the overarching framework remains similar. This risk assessment has regard to the provisions of the QERMF, to that extent possible.

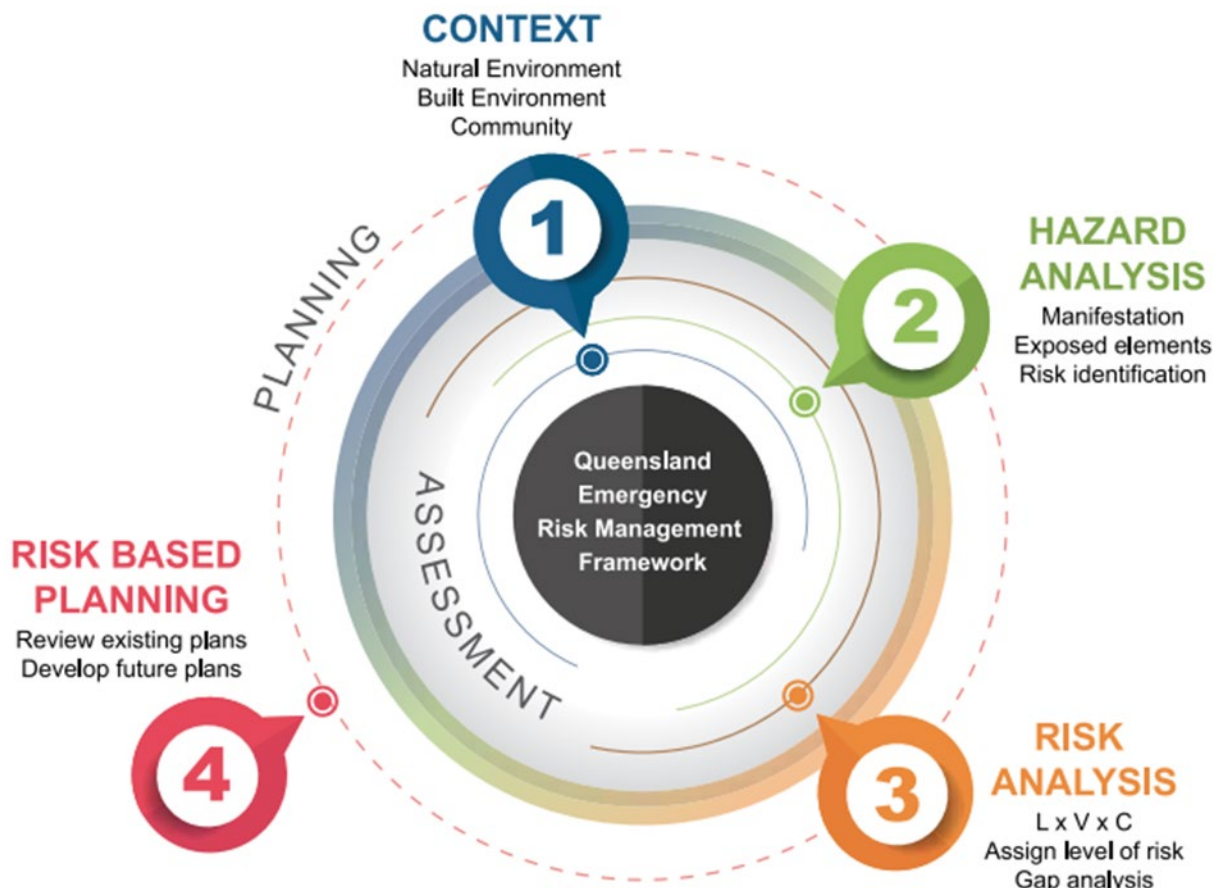


Figure 3-3: The Queensland Emergency Risk Management Framework (Source: QFES, 2018)

3.5 State interest compliance

In 2017 the current SPP came into statutory effect. Further to the SPP are the three non-statutory guidance documents:

- Integrating state interests in planning schemes – Guidance for local government (November 2021)
- Natural hazards, risk and resilience state interest – Bushfire – Example planning scheme assessment benchmarks (May 2021)
- Bushfire resilient communities – technical reference guide for the State planning policy State interest 'Natural hazards, risk and resilience – bushfire' (October 2019).

This risk assessment considers the SPP and its guidance material as a consolidated package of State expectations with regard to satisfaction of the State interest for bushfire hazard, risk and resilience, when read as part of the broader suite of documents prepared as part of this risk analysis process.

One of the components of the current SPP and its guidance material is the requirement for fit-for-purpose risk assessments for natural hazards, including bushfire. This process aims to ensure that bushfire risk is appropriately considered as part of strategic planning activities, having regard to the nature of potential risk rather than mere compliance with statutory bushfire protection measures.

State interest policy two (2) for natural hazards, risk and resilience establishes the expectations of a fit-for-purpose risk assessment which guide how the strategic consideration of bushfire risk is to be integrated into strategic planning processes. These include:

- the characteristics of the bushfire hazard in the area

- the relevant fire and fire weather history of the area
- the population and land uses currently exposed to bushfire hazard
- the anticipated growth of the community and the options for accommodating that growth
- the location of current and proposed community infrastructure and services
- the suitability of existing studies to inform the risk assessment
- the potential social, economic and environmental impacts that would result from a bushfire event
- local and district disaster management planning, including emergency response and recovery capacities.

The *Integrating state interests in planning schemes guidance material* establishes three steps for a risk assessment to follow:

- Step 1 – Hazard identification (to address State interest policy 1)
 - Including identification and local refinement of hazard mapping.
 - This risk assessment has identified the State-wide bushfire prone area (BPA) mapping as being appropriate to meet State interest policy 1.
- Step 2 – Risk analysis (to address State interest policy 2)
 - Including the identification of risk (including the level of exposure, sensitivity and vulnerability) and acceptability of that risk (including whether the risk is acceptable, tolerable or intolerable).
 - The risk assessment includes a risk analysis in the following sections.
- Step 3 – Risk response (to address State interest policies 2 and 4)
 - Based on the outcomes of the risk assessment, preferred land use planning strategies will be developed.
 - The risk response forms Part C of this risk assessment.

The *Bushfire Resilient Communities Technical Reference Guide* prepared by QFES (now QFD) articulates a further ten (10) policy positions with regard to land use planning for bushfire hazard in Queensland. These are specifically addressed in the following section.

The risk assessment responds to the requirements of the SPP and state interest guidance materials, with relevant policies of the Bushfire Resilient Communities Technical Reference Guide also functioning as the 'acceptable risk criteria' benchmarks for the assessment, as outlined below.

3.5.1 North Queensland Regional Plan

Regional plans consider economic, social and environmental factors of a region and integrate land use and infrastructure planning to guide growth and development at a regional scale. The urban form direction and provisions and policies in regional plans must be integrated into local planning schemes and to the extent of any inconsistency between planning schemes and the regional plan, the latter will prevail. Therefore, the outcomes and policy direction of the North Queensland Regional Plan (2020) are considered relevant for any planning scheme amendment.

The North Queensland Regional Plan (March 2020) is a statutory 25-year framework to guide the sustainable growth of the region and support future jobs in the region. The plan identifies key changes in the region to include a growing and ageing population; shifting economic and employment patterns; impacts from climate change; and continued technological advances.

The regional plan establishes the Urban Area for Townsville to manage future urban residential growth within the city and to contain future urban growth within the mapped boundary. Of note, nine (9) areas of regional economic significance are identified in Townsville, demonstrating the city's economic importance to the wider region.

Building resilience, climate change adaptation and mitigation are identified in the plan, with associated regional outcomes and policies of which some are of relevance to bushfire planning in Townsville:

- **Regional Outcome 2.3** Respond to the impacts of climate variations in land use planning and natural asset management decision-making.
 - **Regional Policy 2.3.2** Minimise the region's vulnerability to natural hazards through disaster risk management planning and adaptation strategies, including the avoidance of areas at high risk from natural hazards.
- **Regional Outcome 3.2** Create communities that achieve consolidated and connected urban settlement patterns, with diverse housing and design choices that maximise safety, use of established infrastructure and create a strong sense of place.
 - **Regional Policy 3.2.6** Maintain and improve natural assets that can mitigate risks associated with natural processes and hazards such as flooding, salinity and bushfire, while promoting healthy outdoor opportunities.

It is noted the current Townsville City Plan was prepared prior to the adoption of the North Queensland Regional Plan and consequently the planning scheme does not necessarily integrate the regional outcomes and policies of the Regional Plan.

3.6 Acceptable risk criteria and benchmarking

The determination of outcomes which represent 'acceptable' or 'tolerable' risk versus 'intolerable' risk, and those measures, treatments and controls which might assist in achieving mitigated residual risk, must be measured against a set of benchmarks, or risk acceptability criteria. This provides clarity and transparency of assessment against key criteria.

The acceptable risk criteria established for this risk assessment are derived from the Bushfire Resilient Communities Technical Reference Guide policies.

Due to the multiplicity of criteria, this enables a clear measurement of risk across multiple factors, being the core principles to be satisfied by strategic planning outcomes. It clearly articulates the suite of standards which strategic planning outcomes are expected to meet.

This risk assessment adopts a principles-based approach to the determination of 'acceptable or tolerable' risk, being that risk which is considered within the risk tolerance appetite of land use planning authorities, or which is considered sufficiently low that it is deemed acceptable.

The approach adopted aligns with that of the 'ALARP' principle relating to risk tolerance levels set out by both the Australian Institute of Disaster Resilience 2020 Land Use Planning for Disaster Resilient Communities Handbook, and the 2016 Planning Institute of Australia publication, the National Land Use Planning Guidelines for Disaster Resilient Communities.

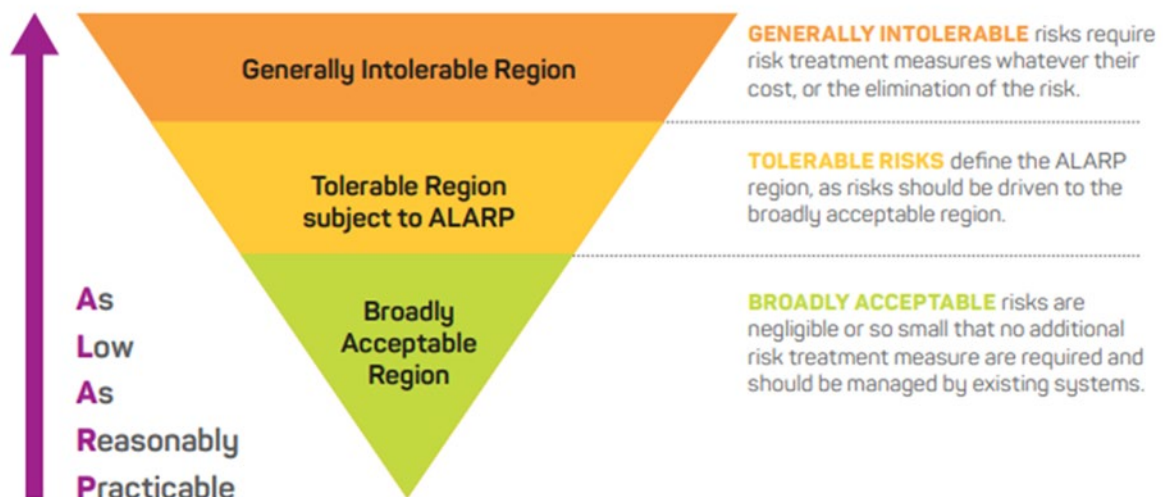


Figure 3-4: The 'ALARP' principle for risk tolerance (Source: AIDR, 2020)

It is likely the assessment of strategic planning options against these benchmarks may not be 'black or white' or a clear 'pass or fail'. This is because qualitative and contextual considerations which extend beyond the contemplation of bushfire risk, relating to other strategic planning matters, are likely to apply.

To this end, this acceptable risk methodology adopts the 'traffic light' methodology of the ALARP approach, where the quantum of quantitative and qualitative aspects of the risk assessment are considered against a system which indicates potential levels of risk acceptability or tolerability.

Table 3-2 – ALARP levels per SPP 2017 definitions

Risk benchmark	Description as per SPP 2017
Acceptable	A risk that, following an understanding of the likelihood and consequences, is sufficiently low to require no new treatments or actions to reduce risk of the natural hazard further. Individuals and society can live with this risk without feeling the necessity to reduce the risk any further.
Tolerable, subject to treatment	A risk that, following an understanding of the likelihood and consequences, is low enough to allow the exposure to the natural hazard to continue, and at the same time high enough to require new treatments or actions to reduce risk. Society can live with this risk but believes that as much as is reasonably practical should be done to reduce the risks further.
Intolerable	A risk that, following an understanding of the likelihood and consequences, is so high that it requires actions to avoid or reduce the risk. Individuals and society will not accept this risk, and measures are to be put in place to reduce the risk to at least a tolerable level.

The determination of risk acceptability or tolerance is essential in the consideration of appropriate risk-informed strategic planning, land use allocation and development controls which are needed to respond to the nature and potential level of risk, as part of the contemplation of Planning Scheme controls.

It must be noted that risk levels vary across the landscape, thus a place-based approach is required which considers specific locations across the city.

Further, there is a need to also consider risk-informed strategic planning, land use allocation and development controls in the context of understanding residual risk. Land use planning decisions and scheme controls often unknowingly transfer risks (of undetermined quantum) to disaster management arrangements, and with implications for insurance.

The following table outlines the risk acceptability / tolerability benchmarks against which risk is to be analysed and evaluated, relative to different risk treatment options. It is informed by the strategic land use policies set out in the Bushfire Resilient Communities Technical Reference Guide prepared by QFES (now QFD).

The consideration of policy options represents the final step of the risk assessment process, having regard to the potential risk treatment options, set out in **Part C** of this report.

BRC policy	QFD policy approaches which guide acceptable and tolerable risk
Mapping	Mapping is robust and locally relevant.
Fit-for-purpose risk assessment	A fit-for-purpose risk assessment informs plan-making or amendments to achieve an acceptable or tolerable level of risk to people and property in bushfire prone areas.
Avoidance, or mitigate to an acceptable or tolerable level	The planning scheme or amendments following a risk assessment are based on the principle of avoidance as the first priority, and then mitigation of the risk to an acceptable or tolerable level.
Disaster management	Disaster management capacity and capabilities are maintained to mitigate the risks to people and property to an acceptable and tolerable level.
Urban design	Lot and neighbourhood layout and design mitigates the risks to people and property to an acceptable and tolerable level.
Vulnerable uses	Vulnerable uses are not located in bushfire prone areas unless there is an overwhelming community need for the development of a new or expanded service, there is no suitable alternative location and site planning can appropriately mitigate the risk.
Revegetation, rehabilitation and land management	Revegetation and rehabilitation avoids an increase in the exposure or severity of bushfire hazard.
Hazardous activities and storage	Development does not locate buildings or structures used for the storage or manufacture of materials that are hazardous in the context of a bushfire within a bushfire prone area unless there is no suitable alternative location.
Protective functions	The protective function of vegetation arrangements that can mitigate bushfire risk are maintained.
Community infrastructure	Community infrastructure for essential services is not located in bushfire prone areas unless there is an overwhelming community need for the development of a new or expanded service and there is no suitable alternative location, and further, the infrastructure can be demonstrated to function effectively during and immediately after a bushfire event.

3.7 Geographic extent and reporting localities

The risk assessment relates to the Townsville local government area. To understand the geographic element of where bushfire hazard and risk manifests across the Townsville local government area, the city has been divided into eight reporting localities.

The reporting localities are primarily based on community profile areas, which are used by Council to understand demographic patterns and community characteristics.

For the purpose of this risk assessment, some profile areas were amalgamated to form a single reporting locality where there was observed to be a largely contiguous urban form and bushfire hazard and risk context. The reporting localities are shown in the map below:

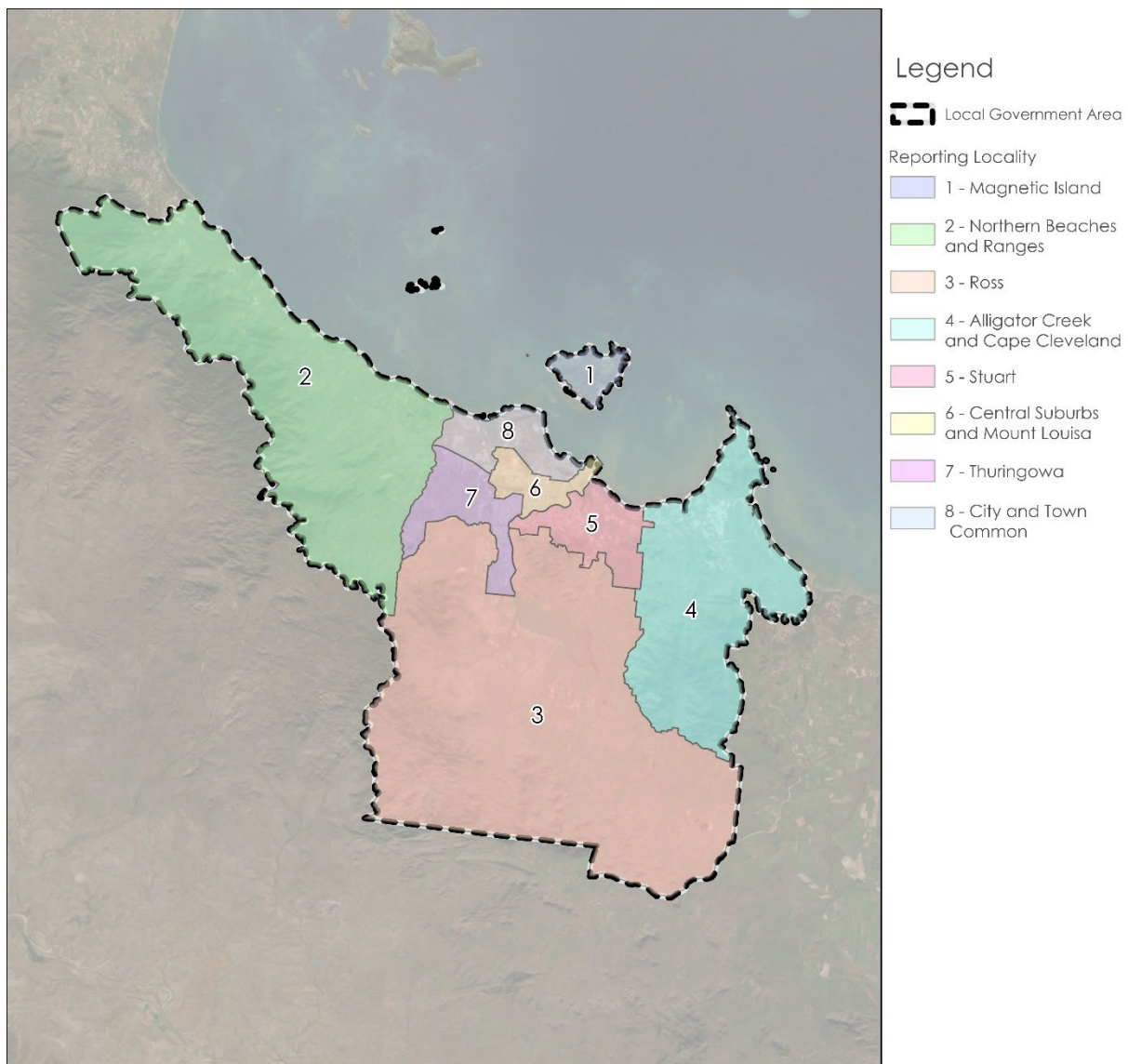


Figure 3-5: Townsville reporting localities

3.8 Bushfire prone areas mapping

State interest policy 1 of the Natural hazards, risk and resilience State Interest requires that bushfire prone areas are identified. To inform this risk assessment, the 2014 BPA Mapping has been applied. The mapping has been subject to a local verification process.

The existing state-wide BPA mapping which supports the SPP was prepared in 2014. The mapping was updated in 2017 however, this update related only to South East Queensland without change to its application in other areas of the state including Townsville.

The State's bushfire hazard mapping methodology was prepared by the CSIRO in conjunction with the then QFES (now QFD). The methodology is set out in the following documents:

- New Methodology for State-wide Mapping of Bushfire Prone Areas in Queensland
- Estimating the potential bushfire hazard of vegetation patches and corridors: An enhancement of Queensland's methodology for State-wide mapping of bushfire prone areas
- Bushfire Resilient Communities technical reference guide.

The mapping methodology is based upon potential fire line intensity using the MacArthur Mk 5 Forest Fire Danger Meter and inputs of total fuel load and effective slope to derive a potential rate of fire spread. A 100m 'buffer' area is also applied under the SPP (replicating the approach under AS3959:2018 – Construction of Buildings in Bushfire Prone Areas), being the zone in which ember attack and radiant heat remain most relevant, adjacent to the actual hazard.

The mapping includes four hazard classes:

- Very high potential bushfire intensity
- High potential bushfire intensity
- Medium potential bushfire intensity
- Potential impact buffer.

The 'Potential impact buffer' comprises a 100m impact area around the full extent of the hazard classes and is susceptible to bushfire attack mechanisms. For the purposes of this risk assessment, land within the Potential impact buffer is considered to be exposed to potential bushfire hazard.

At the time of writing, Council was in the process of incorporating the 2014 BPA mapping into the Development Constraints Overlay Map – Bushfire hazard in the planning scheme via Package 1 Major Amendment. The adoption of Package 1 Major Amendment was forthcoming at the time this report was prepared..

It is noted that QFD is currently preparing draft bushfire prone area mapping (Draft BPA mapping) to be incorporated into the State Planning Policy Interactive Mapping System (SPP IMS) and to support the implementation of the SPP. At time of writing, Draft BPA mapping for Townsville was not available.

3.8.1 Verification process

Pursuant to guidance provided by the State within Integrating State Interests in a Planning Scheme and the Bushfire Resilience Communities technical reference guide, local verification of the 2014 BPA Mapping has been undertaken as part of this Bushfire Risk Assessment.

A local refinement process has been undertaken which focused on small patches and corridors of vegetation, mostly within the urban footprint, to avoid overstating bushfire risk in areas where vegetation is fragmented or unlikely to contribute meaningfully to fire behaviour. The CSIRO's patch and corridor filtering method (2017) was not applied, but a locally verified approach was adopted to identify vegetation that does not warrant the same level of planning or building response.

As a result of this local refinement, a new hazard category 'Lower Impact Area' has been created. This category was applied to vegetation that remains mapped but, due to its management, size, isolation or fragmentation, is unlikely to support the maximum potential rate of spread or fire intensity required to trigger intervention measures. This methodology was adopted to inform the risk assessment process. The 'Lower Impact Area' could inform a locally refined mapping approach for a future version of the Bushfire Overlay within the scheme, pending timing of any future BPA mapping prepared to inform the SPP. Such an approach, if

determined by Council, would see these patches removed from the overlay itself, ensuring risk responses are appropriately calibrated, particularly within the dry tropics context where numerous small patches of vegetation exist within the urban area.

The following rules were used to identify patches suitable for re-categorisation as Lower Impact Area:

- Where a BPA patch intersects a regional park and the patch is 50 ha or less;
- Where an isolated BPA patch is more than 100 m from the nearest patch and is 5 ha or less in area;
- Where a group of BPA patches are within 100 m of one another and their combined area is 5 ha or less.

Throughout this process QFD and DSDIP were engaged regarding the methodology developed and applied. State acceptance of the process was received, documentation for which is available under separate cover.

4 Methodology

This section describes the methodologies deployed to undertake the fit-for-purpose Risk Assessment.

4.1 Risk identification methodology

The Queensland Disaster Management Arrangements (QDMA), Queensland Emergency Risk Management Framework (QERMF) and Queensland Strategy for Disaster Resilience (QSDR) identify the broad framework for the consideration of risks from natural hazards in Queensland.

This section largely relates to Process 1 of the QERMF.



Figure 4-1: Process 1 of the QERMF (Source: QFES, 2018)

From resilience to recovery, five (5) lines of operation guide the types of risk which are contemplated by formal processes, and which are adopted for the purposes of this risk assessment. This also aligns with the approach adopted by NERAG.



Figure 4-2: Resilience and recovery lines of operation (Source: Queensland Government, 2019)

In order to understand the nature of potential risks associated with bushfire hazard across the city, a quantitative GIS-based analysis of hazard mapping was first performed. This process was conducted using 2014 BPA Mapping which adopts a 2 per cent annual exceedance probability (AEP) (generally equivalent to a 1 in 50 year annual return interval (ARI) climate-adjusted scenario.

The mapping outlined above is based on fireline intensity hazard classes. These classes seek to illustrate, based on specific data inputs, the potential magnitude of bushfire hazard based upon a calculation of fireline intensity.

Fireline intensity is a measure of fire intensity at the fire front. It is measured as the amount of energy released per metre width of the fire edge (CSIRO, 2013).

As noted by Leonard et al. (2014) 'at a landscape scale, the preferred metric for indicating the potential severity of these impact mechanisms is fireline intensity. *Fireline intensity is a standardised measure of the rate that an advancing head fire would consume fuel energy per unit time per unit length of fire front introduced by Byram (1959)*'.

Pursuant to research conducted by Tolhurst, dwelling loss rates are generally observed at around 7,000kW/m and increases where fireline intensity exceeds 30,000 kW/m. As noted earlier by this Bushfire Risk Assessment, increased house loss is also observed in events where FFDI exceeds 50. Direct firefighting is not possible where fireline intensity exceeds 3,500 kW/m.

As per the 2014 BPA Mapping methodology, the potential bushfire intensity classes are outlined below.

Potential bushfire hazard class	Potential fireline intensity
Very High	40,000+kW/m
High	20,000 – 40,000kW/m
Medium	4,000 – 20,000kW/m

Where fireline intensity is below 4,000 kW/m (including for grassfire), the potential bushfire intensity is considered to be unlikely to cause significant impact and is removed from consideration for land use planning in Queensland.

4.2 Spatial analysis methodology

Critical to the analysis of risk, existing Australian research reveals that 80-90 per cent of property loss occurs within 100 metres of the bushland interface, and this is the basis for current planning and building policy and regulation across Australia.

Additionally, comprehensive data interrogation performed by CSIRO demonstrates that 85 per cent of bushfire fatalities in 260 events from 1901 to 2011 have occurred within the first 100 metres of the bushland interface, including persons attempting to evacuate (Blanchi et al. 2012).

Recent research finds that dwelling and property loss can and does routinely occur beyond this 100 metre extent.

The findings handed down by the National Natural Disaster Arrangements Royal Commission following the 2019-2020 'Black Summer' fire season identified that almost all of the dwellings lost during those events were located within 500m of bushland.

In the 2003 Canberra bushfires, and other events over time, property and dwelling loss has occurred within circa 700m of the bushland interface in urban contexts (Leonard & Blanchi, 2012; McAneney & Chen, 2004 and Ahern & Chladil, 1999). This is particularly relevant given recent bush fire disasters across the globe which have penetrated urban areas.

To this end, consideration of flame contact, radiant heat flux and ember attack surrounding bushfire hazard sources to 100 metres, 500 metres and 700 metres (representing the full or maximum extent of loss observed to date in Australia) has been considered by this risk assessment.

It is noted that whilst this data is inclusive of a number of large-scale fire events in South-Eastern Australia, it is the pervasiveness of ember attack beyond the 100m mapped buffer, as well as the need to consider the settlement pattern, densities and evacuation networks in and out of

bushfire prone areas that remains the key purpose for consideration of land out to 500m away from mapped hazard.

It is noted the 100 metre extent remains the basis of planning policy in Queensland and across Australia. This report does not suggest a change to this but rather, seeks to consider the context of the broader landscape around bushfire prone areas for a fulsome consideration of potential bushfire risk. To this extent, when considering areas subject to potential bushfire exposure, this assessment includes the 100m 'bushfire and ember impact area'.

Table 4-1: Indicative distances between hazardous vegetation and loss from bushfire for severe events (Source: Leonard et al. 2014, Leonard & Bianchi, 2009, McAnenery et al. 2009, Ahern & Chladil, 1999)

Bushfire attack mechanism	Typical upper distance for 80% of all house losses (m)	Typical upper distance for house ignition from forest (m)	Maximum reach (km)
Primary ember attack	100	500-700	10
Radiant heat exposure	70	160	N/A
Flame contact / exposure	50	100	N/A

A high level review of the 2014 BPA Mapping indicates that the majority of exposure to existing built form occurs within the first 100m from the bushfire hazard area (i.e. the potential impact buffer)

For the purposes of this Risk Assessment, the 100m potential impact buffer was divided with consideration to the research outlined above to further understand the nature of exposure. Accordingly, two methodologies were applied for the treatment of the impact area.

- **Potential bushfire attack mechanism impact areas** result in the 100m impact area being divided into three components with regard to bushfire attack mechanisms (Figure 4-3):
 - Potential flame contact exposure area (50m)
 - Potential radiant heat exposure area (70m)
 - Potential ember attack area (100m).
- **Hazard category impact areas** result in the 100m impact area being divided into 5 components with regard to the proximate level of bushfire hazard (Figure 4-4):
 - Very High Bushfire Hazard Impact Area (100m)
 - High Bushfire Hazard Impact Area (100m)
 - Medium Bushfire Hazard Impact Area (100m)
 - Lower Threat Area (100m)

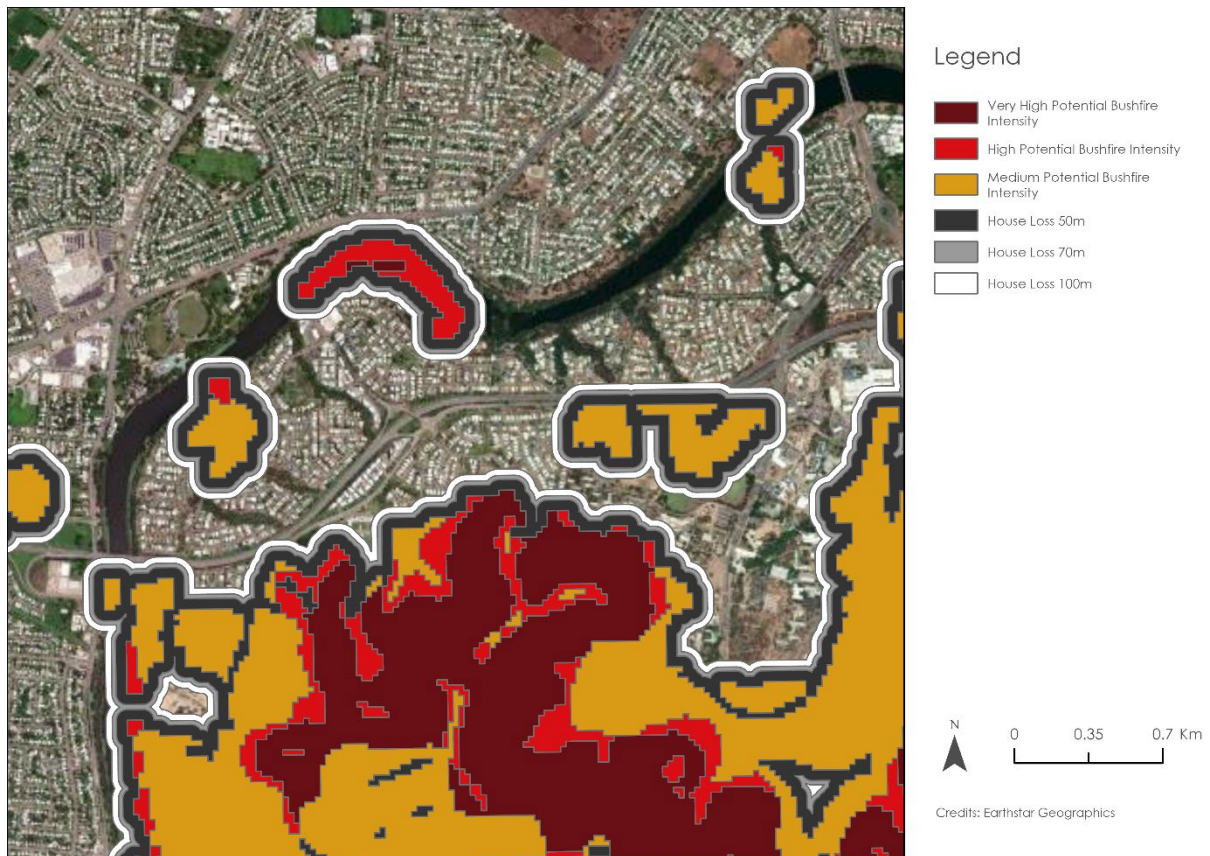


Figure 4-3: Potential bushfire attack mechanism impact areas

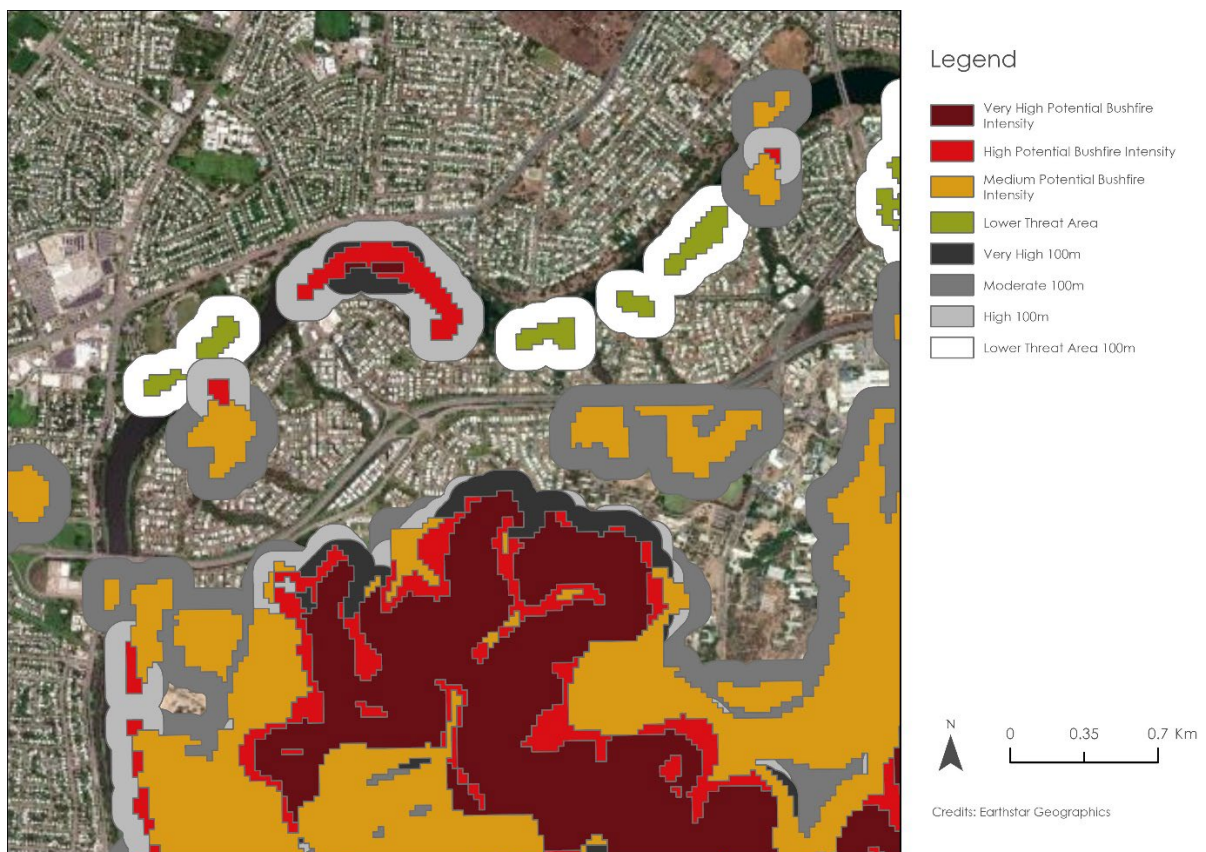


Figure 4-4: Hazard category impact areas

In addition to the above, a 100m (bushfire and ember impact area), 500m and 700m extent was mapped around the bushfire hazard to identify the likely upper extent of exposure to potential bushfire hazard. This upper extent was used for the purposes of this risk assessment only to provide context as to the potential upper limit of bushfire exposure.

4.3 Elements of exposure

The risk assessment considered exposure across a number of different elements including:

- Planning scheme zones
- Residential dwellings
- Vulnerable facilities
- Essential community infrastructure
- Roads and evacuation network
- Risk multipliers.

Exposure of elements was considered with regard to the spatial analysis methodology outlined in the previous section. A summary of all elements and facilities considered by this Risk Assessment is provided in the table below. Elements were selected based on availability of data and applicability of that element / facility to land use planning. Each facility was assigned a geometry that best reflected that facilities characteristics and available data to determine the extent of potential exposure. The table also summarises the source for each data layer.

Table 4-2: Summary of elements considered in risk assessment and data sources

Element / Facility	Geometry	Source	Comments
Planning scheme zones			
Planning Scheme Zones	Parcel boundary	Townsville City Council Open Data (TCC City Planning Scheme Zoning GDA2020)	Level 2 zoning was used in the risk assessment
Residential dwellings			
Residential dwellings	Point	Qspatial	Residential dwellings were identified by aligning the cadastre with zoning data. Dwelling estimates per parcel were calculated by spatially joining building points to uniquely identified cadastral parcels
Vulnerable facilities			
Aged Care	Point	AIHW - Aged care service list	Extracted from AIHW aged care service list
Child Care	Point	Childcare (Australia Children's &	Extracted from ACCQA service list

Element / Facility	Geometry	Source	Comments
		Care Quality Authority	
Correctional Facility	Point	Qspatial	Extracted from 'infrastructure areas'
Educational Establishment	Point	Qspatial	Extracted from 'infrastructure areas'
Higher Educational Establishment	Point	Qspatial	Extracted from 'infrastructure areas'
Hospital	Point	Qspatial	Extracted from 'infrastructure areas'
Essential community infrastructure			
Sewer Pump Station	Point	Townsville City Council	Extracted from 'Waste Water – Network Structure' Layer
Sewer Treatment Plant	Point	Townsville City Council	Extracted from 'Waste Water – Network Structure' Layer
Water Pump Station	Point	Townsville City Council	Extracted from 'Water regulation' layer
Water Treatment Pant	Point	Townsville City Council	Extracted from ' Water – Network Structure' Layer
Zone Substation	Point	Townsville City Council	
Roads and evacuation network			
Road hierarchy	Lines	Townsville City Council Open Data	

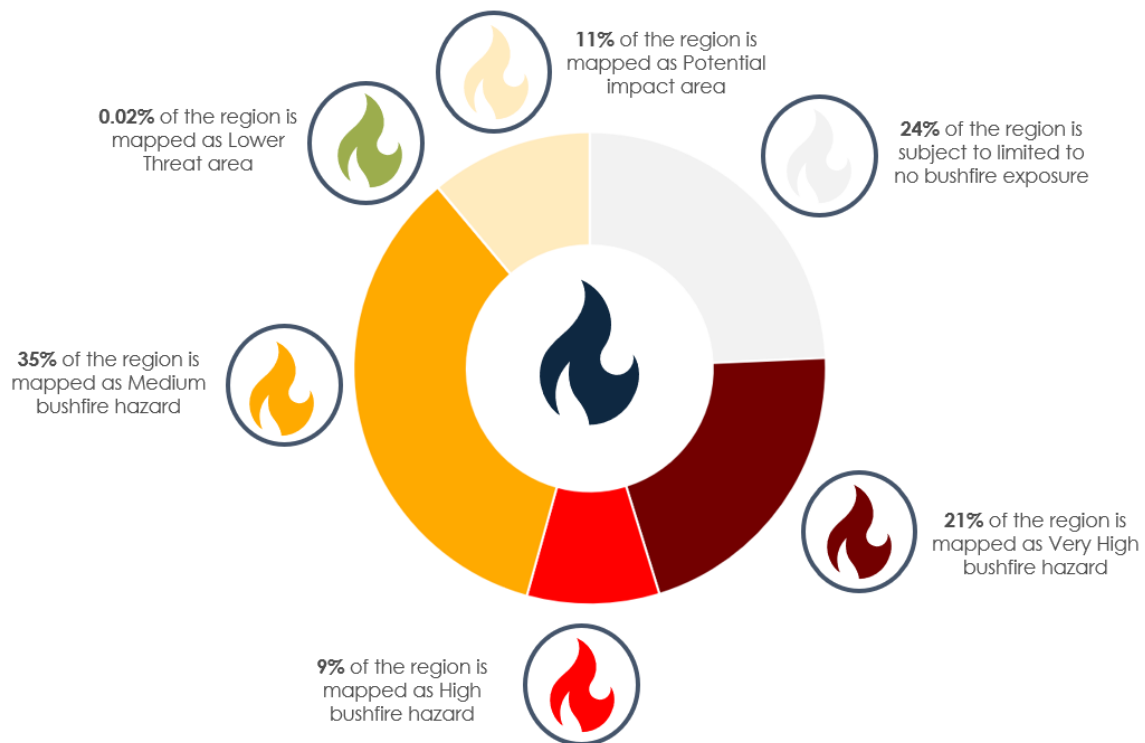
5 City wide risk identification

This section provides an overview of the key aspects of the spatial analysis which informed this risk assessment.

A whole-of-city overview of identified bushfire hazard exposure and vulnerability is provided, culminating in the identification of strategic-level risks which are further explored throughout the risk evaluation process.

5.1 Townsville exposure and vulnerability

Of the 358,480 hectares of zoned land within the Townsville local government area, approximately three quarters is identified as subject to potential bushfire hazard. This is comprised of land within the Very High, High, Medium, Lower threat area bushfire hazard and 100m potential impact area. As identified below, the majority of the city is associated with land mapped as either Medium or Very High bushfire hazard.



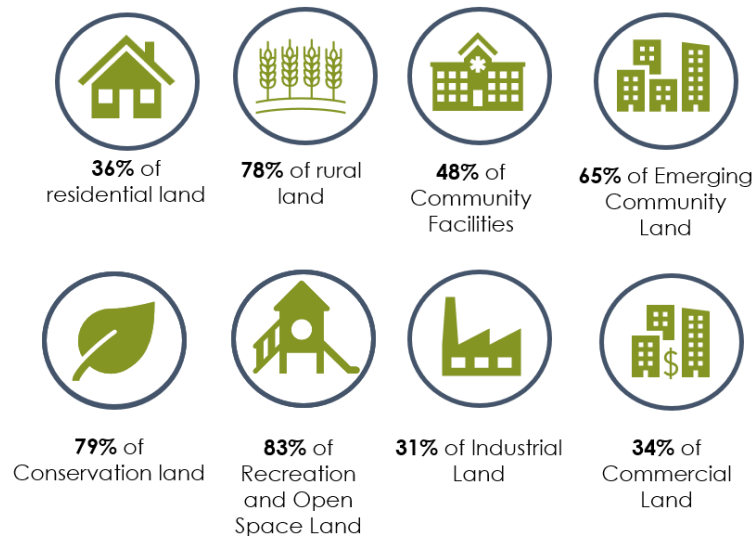
5.2 Land use zones

Potential bushfire hazard mapping has been analysed using the Planning Scheme zones. This provides an understanding of where potential bushfire hazard is present within the city as it relates to land uses and gives an insight as to potential risks and vulnerabilities.

The results demonstrate that potential bushfire hazard is highest within environmental, rural and recreation and open space zones. This level of exposure is expected for the land use intent for these zones.

Emerging Community also has considerable exposure, with approximately two thirds of land affected by potential bushfire hazard. This is largely due to the undeveloped nature of these lands resulting in the presence of vegetated areas.

Half of the land zoned for Community facilities is exposed to potential bushfire hazard. Commercial and Industrial zones also show moderate levels of exposure, with approximately one-third of the land in each category affected.



Exposure is also higher within Rural residential zoned land with half of land affected by potential bushfire hazard. Heightened exposure within these areas is expected due to the bushland and vegetated nature of rural living settings.

A summary of exposure by land use zone is provided in Figure 5-1 below.

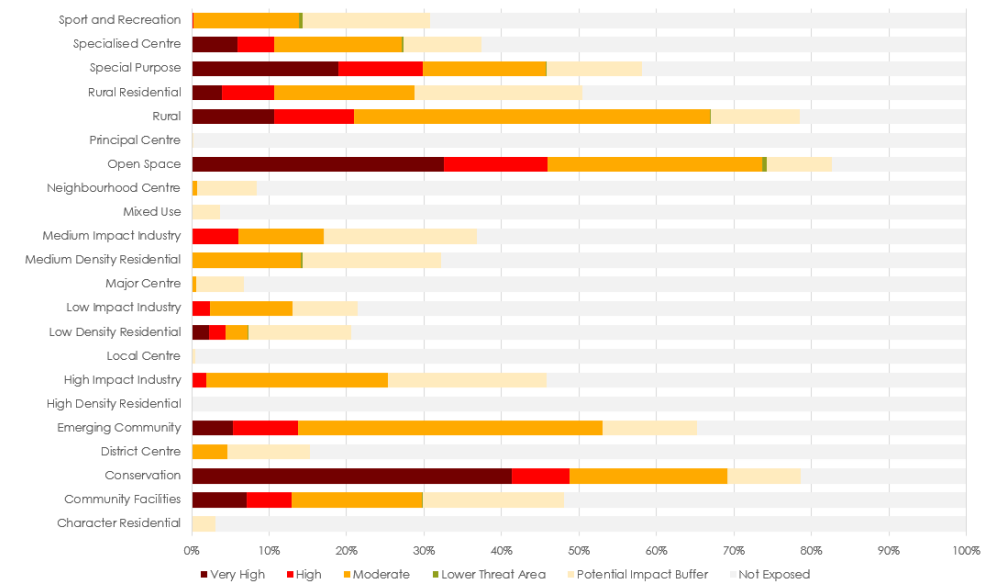


Figure 5-1: Exposure of existing land use zones to potential bushfire hazard

5.3 Residential dwellings and residents

Of the 73,838 residential dwellings considered for this analysis, an estimated 9,926 (13 per cent) are exposed to potential bushfire hazard (including within the potential impact buffer which consists of a 100m impact area from the primary hazard area).

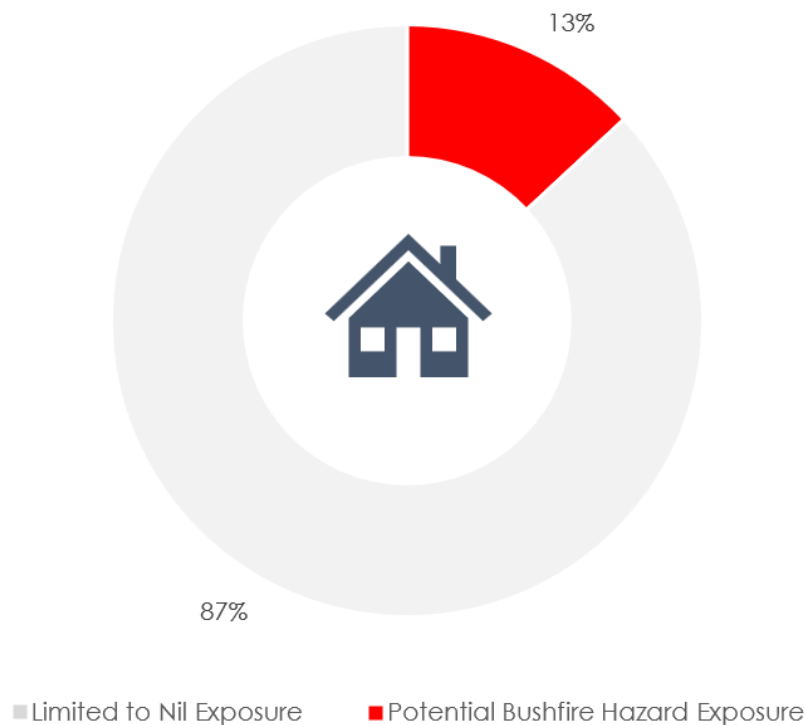


Figure 5-2: Residential dwelling exposure within the Townsville local government area

In relation to exposure of residential dwellings, Figure 5-3 indicates where exposed dwellings are located across Townsville. Despite the relatively low levels of residential exposure across the city, as demonstrated below, there are still some areas that exhibit higher levels of exposure that may warrant further investigation. These areas include Bohle Plains, Condon, Douglas, Oak Valley, Alligator Creek, Nome, and Horseshoe Bay. On Magnetic Island, the suburbs of Arcadia, Nelly Bay, and Picnic Bay also show elevated exposure. Other areas of concern include Wulguru to the south of the city, Mount Louisa and Burdell to the west, and Castle Hill in the city centre. High levels of exposure are also observed in the northern communities of Bushland Beach and Balgal Beach.

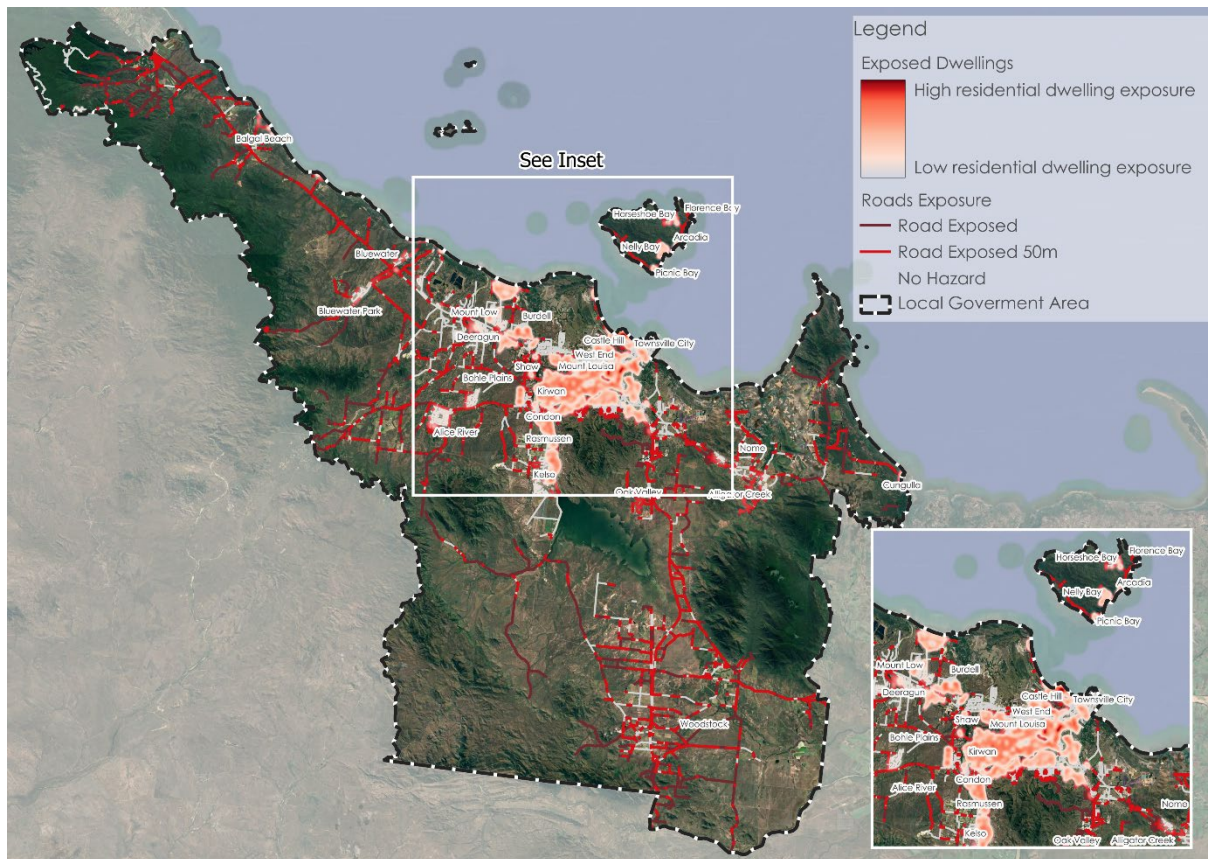


Figure 5-3: Exposure of residential dwellings across Townsville local government area

Analysing the nature of exposed residential dwellings identifies the majority of exposure is within the potential impact buffer, with 81 per cent of exposed dwellings located within 100 metres of the bushland interface (as opposed to being immersed or interspersed within the mapped hazard itself). Considering the nature of the bushfire prone area mapping, this is expected. To further understand the nature of residential exposure, additional analytics have been undertaken of the nature of residential dwelling exposure with regard to the potential bushfire attack mechanism impact areas and hazard category impact areas.

As identified in Figure 5-4 below, 39 per cent of exposed dwellings are identified within the flame contact exposure area (50m from potential bushfire hazard). An additional 17 per cent are within the radiant heat exposure (70m from potential bushfire hazard) and 26 per cent are within the potential ember attack area (100m from potential bushfire hazard).

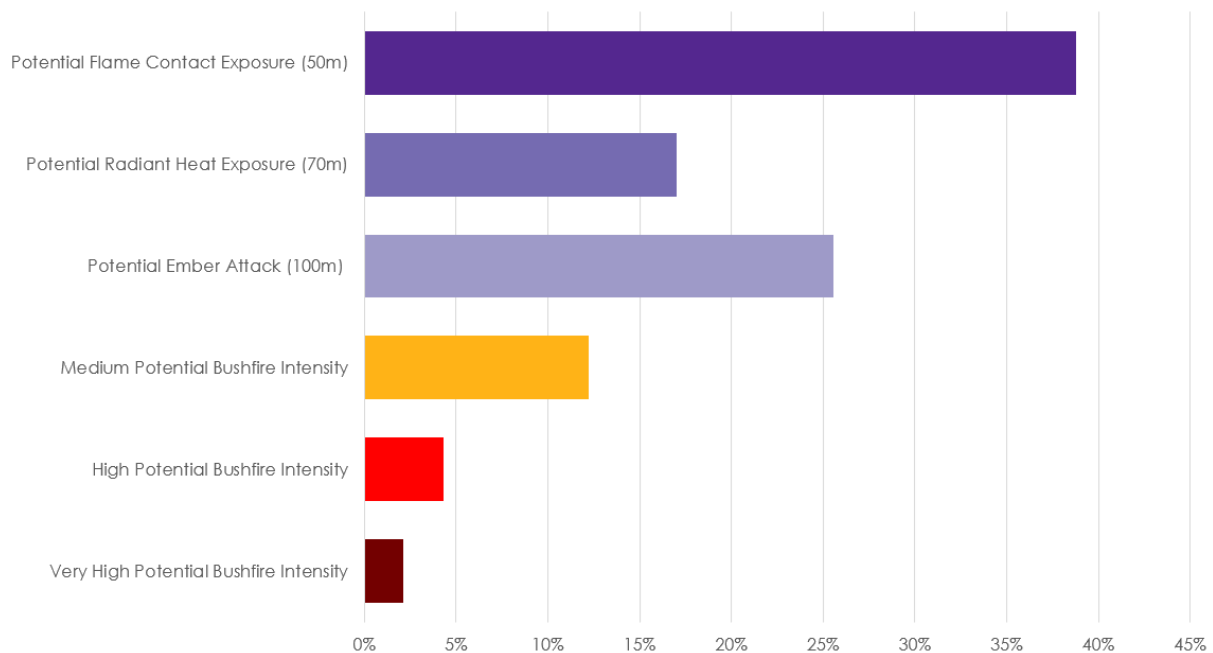


Figure 5-4: Analysis of proximity of exposed residential dwellings to potential bushfire attack mechanisms

Having regard to the proximate hazard classification of dwellings within the bushfire and potential impact buffer (Figure 5-5), majority of dwellings are proximate to moderate bushfire hazard (43 per cent), followed by high (24 per cent) and very high (15 per cent).

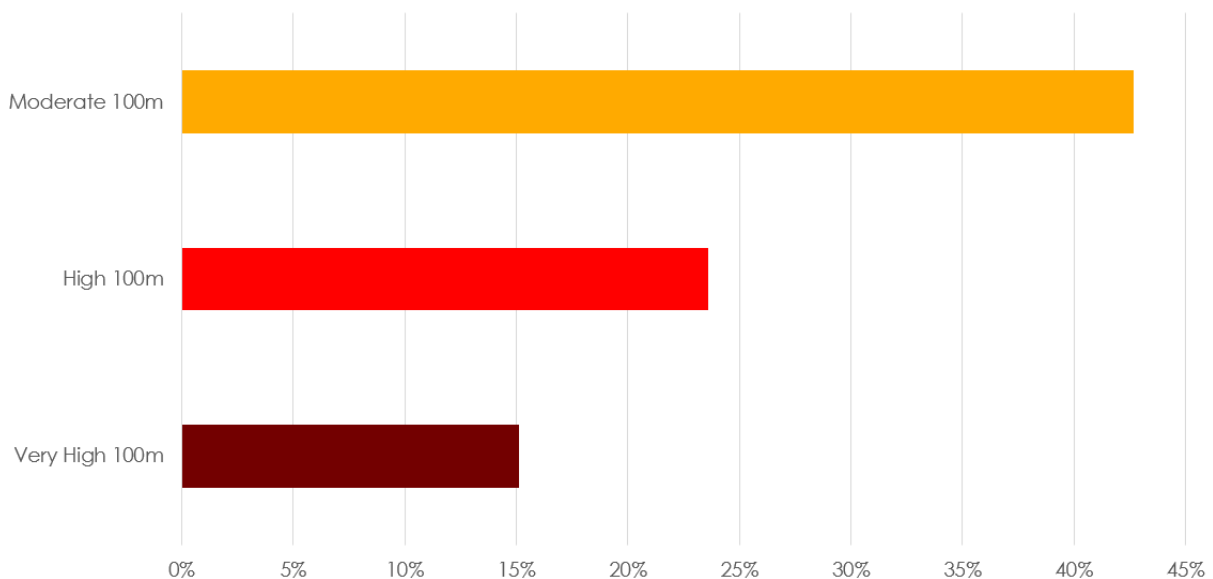


Figure 5-5: Analysis of proximate hazard classification of dwellings within the potential impact buffer

Beyond the primary bushfire hazard area (which comprises the hazard categories and the potential impact buffer) it is relevant to also consider the typical upper distance of ignition from ember attack. As summarised in Figure 5-66 below, over a third of residential dwellings (33 per cent) are located within 500 metres of potential bushfire hazard, 11 per cent are within 100 metres, and 10 per cent are within 700 metres.

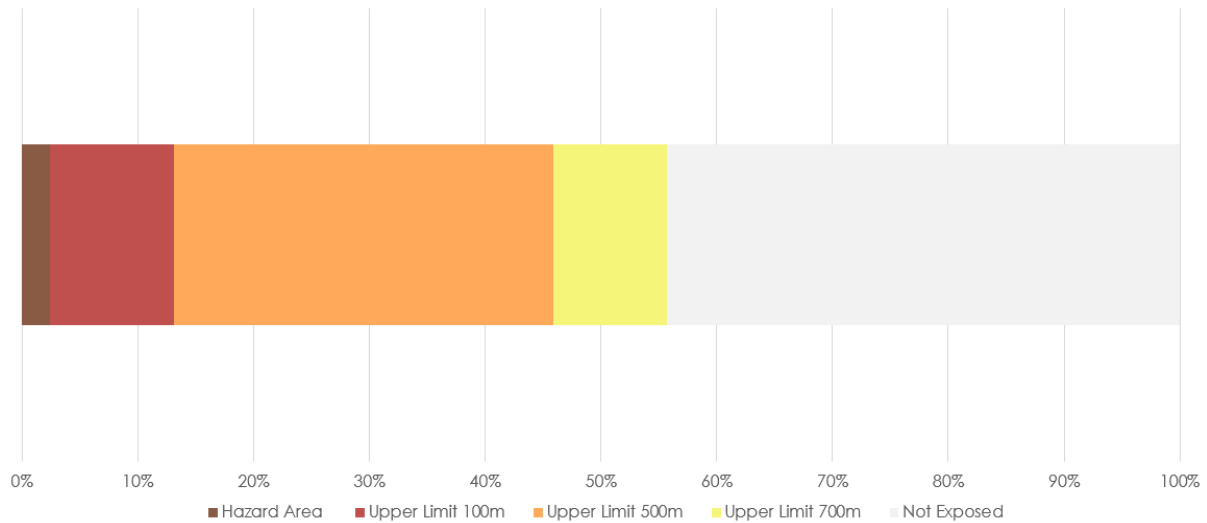


Figure 5-6: Residential dwellings exposed to potential bushfire hazard within the local government area

Further assessment of the exposed dwellings from a land use zone perspective indicates that majority of residential exposure (72 per cent) across the city exists within the Low density residential zone. Much of this exposure is associated with dwellings located at the bushland interface within inner suburbs of the LGA. Key suburbs contributing to this exposure include Condon, Rasmussen (specifically the dwellings along the Townsville Ring Road), West End, Magnetic Island, North Ward, Stuart, Deeragun, and other locations. Low density residential communities along the coastline to the north of the LGA also show higher concentrations of exposure, as illustrated in Figure 5-3 above.

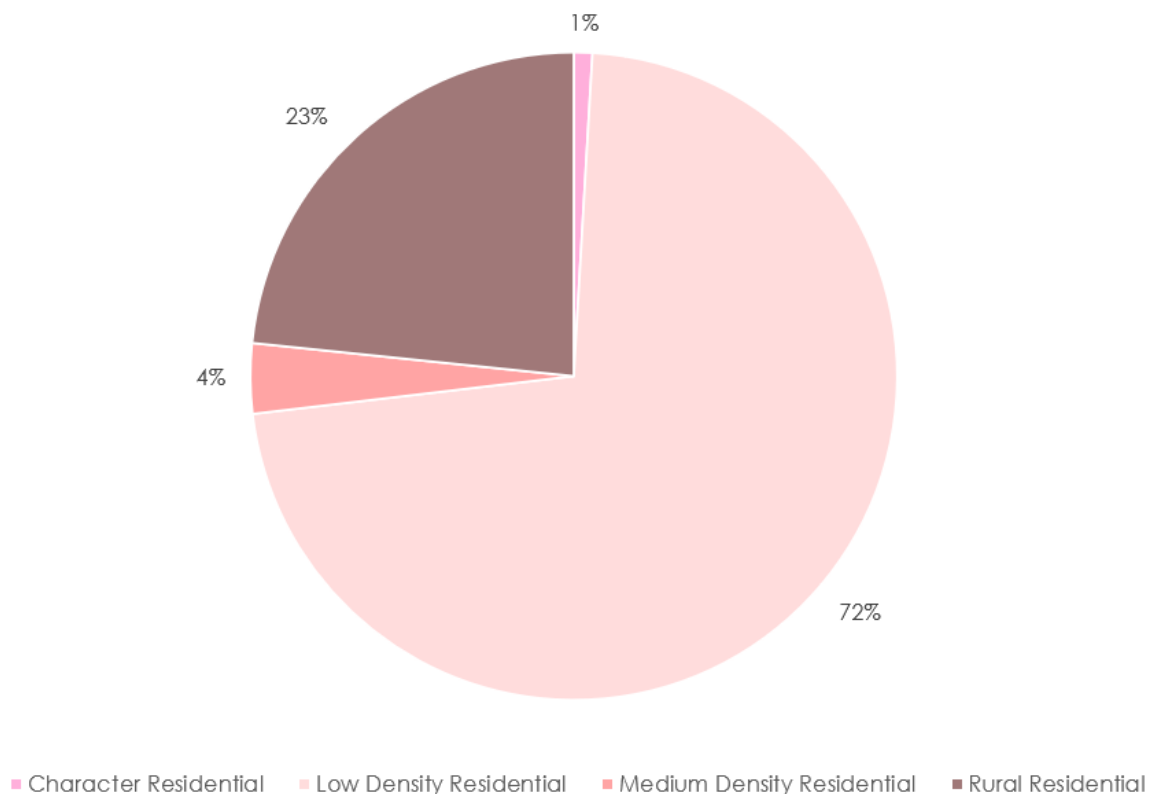


Figure 5-7: Residential dwellings exposure by land use zone

While the greatest quantum of exposure is in Low density residential areas, Rural residential dwellings are exposed to the highest intensity of bushfire hazard. Figure 5-9 shows that Rural residential dwellings have a much higher proportion exposed to very high, high, and medium

potential bushfire intensity compared to the other land use categories. In contrast, the majority of exposure for Low density residential dwellings lies within the 100 metre impact buffer zone.

In the Rural residential zone, the minimum lot size is 4,000 square metres. Of the 6,635 Rural residential zoned dwellings across the region, 2,252 (34 per cent) are exposed to potential bushfire hazard. Notably, 1,273 lots within the LGA are larger than 8,000 square metres, meaning they could be eligible for subdivision under current zoning rules (which equates to about 20 per cent of allotments in the Rural residential zone). Of these larger lots, 738 dwellings (58 per cent) are exposed to potential bushfire hazard. This suggests that at a regional level, a proportion of the rural residential dwellings exposed to bushfire hazard may be capable of subdivision to accommodate additional dwellings, potentially increasing the number of dwellings at risk if subdivision were to occur.

The high proportion of exposure within the Low density residential zone reflects the extensive spatial distribution of this zoning across the city's outer suburbs and urban-bushland interface areas, many of which border vegetated land. In contrast, higher density zones are typically located in more urbanised central areas that are less likely to be adjacent to dense vegetation or large vegetated areas capable of supporting extreme bushfire behaviour.

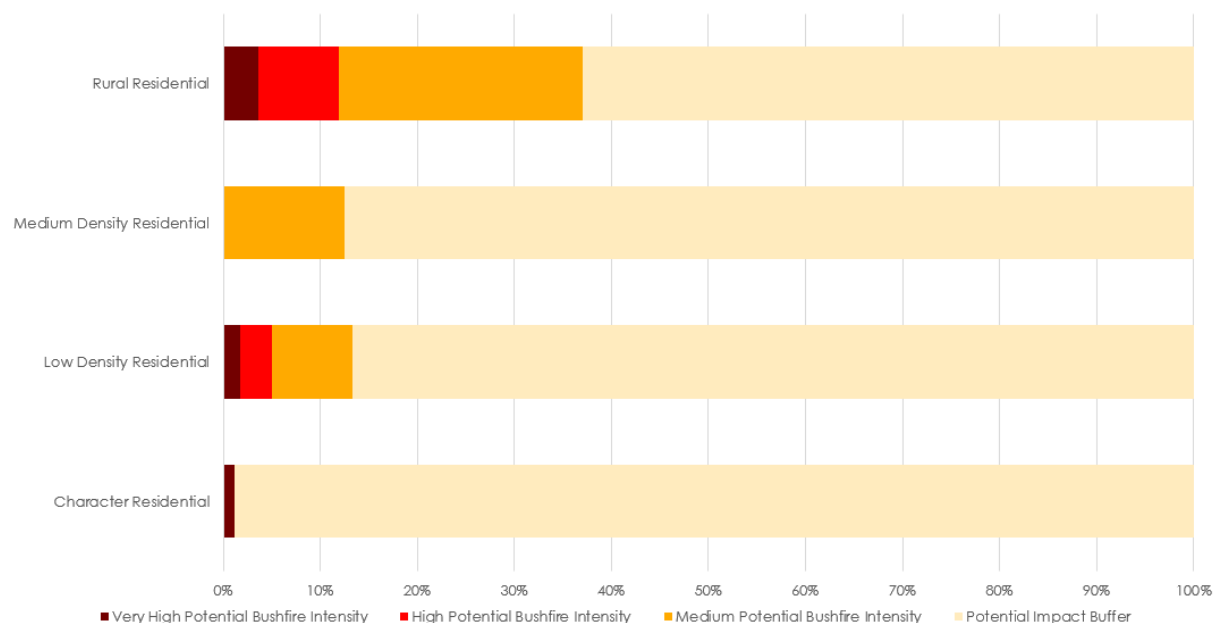


Figure 5-8: Residential dwelling exposure to bushfire hazard, broken down by land use and hazard category

It is noted that the Townsville City Plan Bushfire hazard overlay adopts Bushfire Prone Area mapping that is not consistent with the current 2014 BPA Mapping as depicted on the SPP-IMS and used as the basis of this risk assessment. This has been previously noted by the State government, and directions provided to address this by amendment which Council is underway with.

It is acknowledged that the planning scheme designates areas identified on the Bushfire hazard overlay map as bushfire prone areas for the purposes of the *Building Act 1975* and triggering assessment under AS3959. The disconnect between the Bushfire hazard overlay mapping and that used in the SPP-IMS therefore, may have resulted in residential dwellings being constructed in areas that are outside of the Bushfire hazard overlay mapping but within the 2014 BPA mapping and therefore, based on latest available data being subject to potential bushfire hazard. This means that these dwellings may not have been assessed under AS3959 or subject to bushfire protection measures under the Building Regulation 2006. While it is not possible to quantify the exact number of dwellings affected by this disconnect, based on a visual assessment it is not suggested that this number would be substantial. Notwithstanding, it is still considered worthwhile to note the discrepancy for the purposes of this risk assessment.

5.4 Facilities and infrastructure

5.4.1 Vulnerable facilities

Vulnerable facilities (such as nursing homes, childcare centres and schools) may pose increased risk to bushfire hazard due to the nature of the activity, difficulty of evacuation or vulnerability of the facilities occupants. Figure 5-9 provides an overview of the potential bushfire hazard exposure to vulnerable facilities.

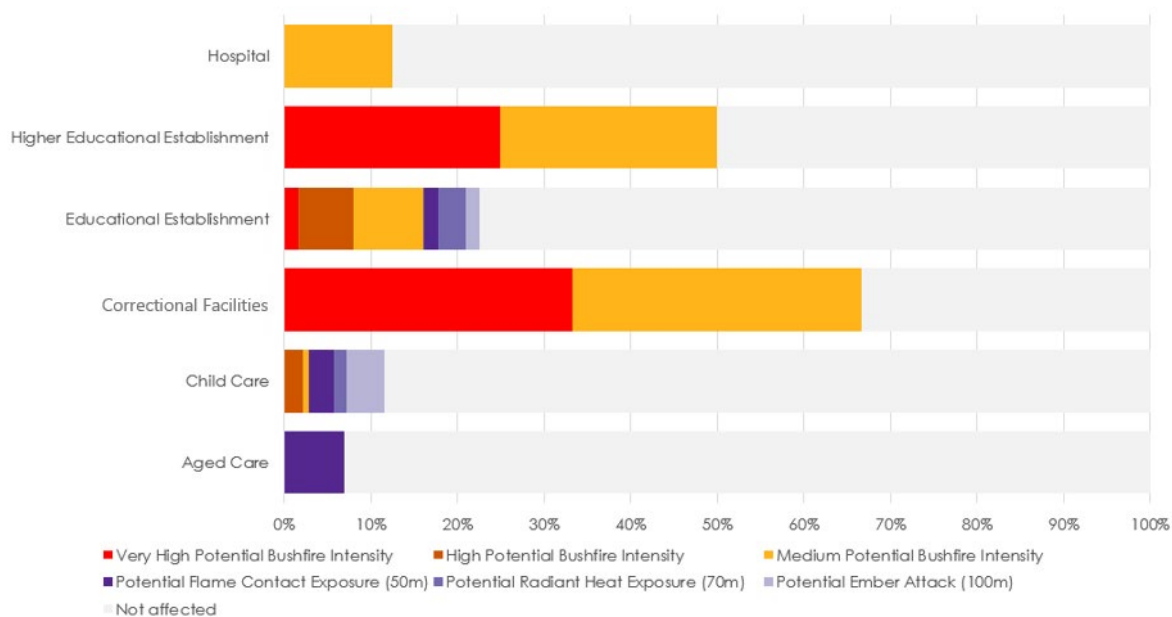


Figure 5-9: Summary of vulnerable facility exposure within the Townsville local government area

As identified above, the LGA area exhibits a level exposure to vulnerable facilities, with 15 per cent of all facilities identified as being exposed to potential bushfire hazard. Exposure is highest among correctional facilities and higher educational establishments. Notably, exposure is largely within the medium and high potential bushfire intensity. Notably, almost a quarter (23 per cent) of educational establishments are exposed to potential bushfire hazard. Exposure amongst child care (12 per cent), aged care (7 per cent) and hospitals (13 per cent) is also considered relatively low.

5.4.2 Essential community infrastructure

Essential community infrastructure (such as services infrastructure) plays an important role in ensuring essential services are provided to the community. Figure 5-10 provides an overview of the potential bushfire hazard exposure to essential community infrastructure.

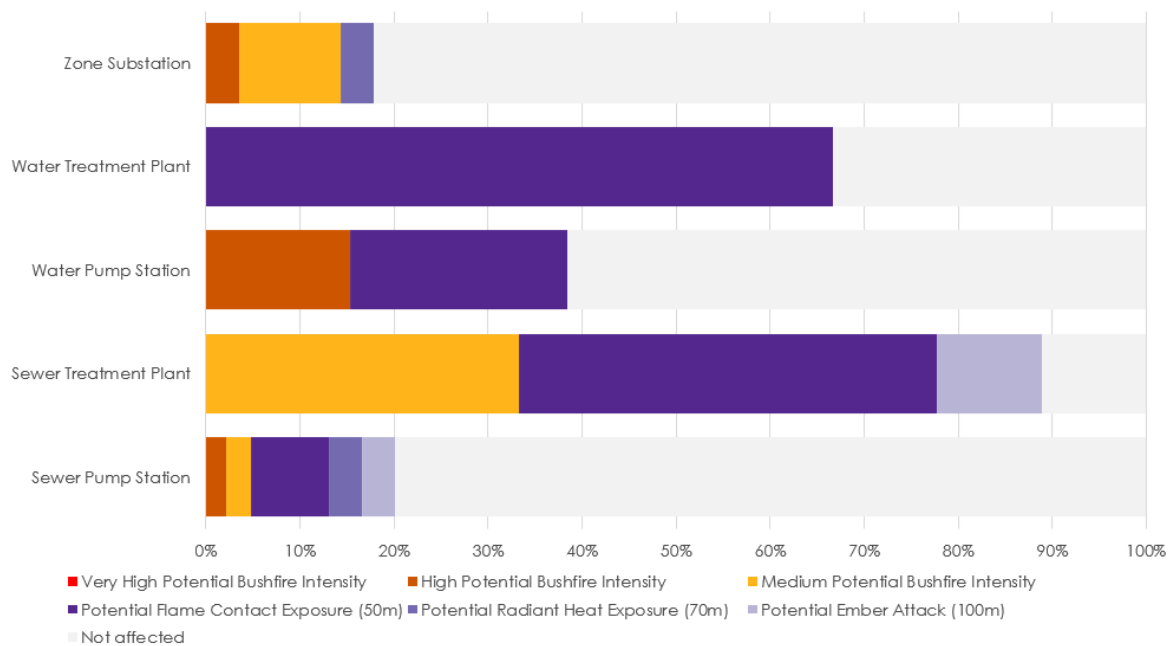


Figure 5-10: Summary of essential community infrastructure exposure within the Townsville local government area

As identified above, the LGA has a degree of exposure to community infrastructure, with almost a quarter (23 per cent) of all assets exposed to potential bushfire hazard. Exposure is highest among sewer treatment facilities (89 per cent) and water treatment facilities (67 per cent), primarily within the 50 metre potential flame contact zone of mapped hazard. Water pump stations are also exposed, with 38 per cent affected 15 per cent of which falls within areas of medium potential bushfire intensity.

5.4.3 Road and evacuation network

Roads and road connectivity are critical to evacuation of residents and access for emergency services during and after an event. Roads within 50 metres of mapped bushfire hazard may experience reduced visibility due to smoke, dense ember attack and varying levels of potential radiant heat exposure. These effects can also occur beyond 50 metres however, it is largely the threat of potential flame contact and extreme radiant heat which land use planning should consider.

For the purpose of this assessment, the state major road network (comprising only the higher order roads) is considered. Of the overall existing road network, 37 per cent is identified within the potential bushfire hazard exposure area, including 28 per cent that is directly exposed to hazard and 8 per cent is within 50m of hazard.



37% of the major road network is exposed to potential bushfire hazard

Exposure across different road hierarchies is shown in Figure 5-11 below. Highways have the highest level of direct exposure at 42 per cent, posing a significant risk given their role in evacuation and emergency response. Freeways, secondary roads, and trafficable roads also show considerable direct exposure (25 - 29 per cent), highlighting widespread vulnerability across the road network.

Exposure within 50 metres is lower overall but remains relevant, particularly for highways (17 per cent) and freeways (14 per cent), where nearby hazards could still impact access and evacuation routes.

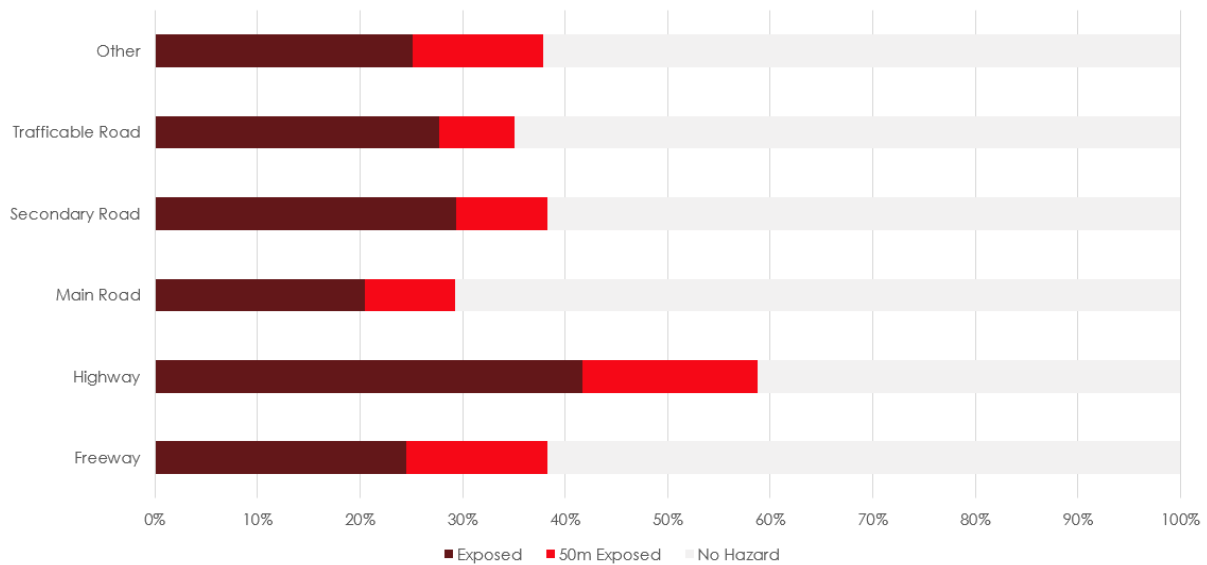


Figure 5-11: Summary of road network to potential bushfire hazard within the Townsville local government area

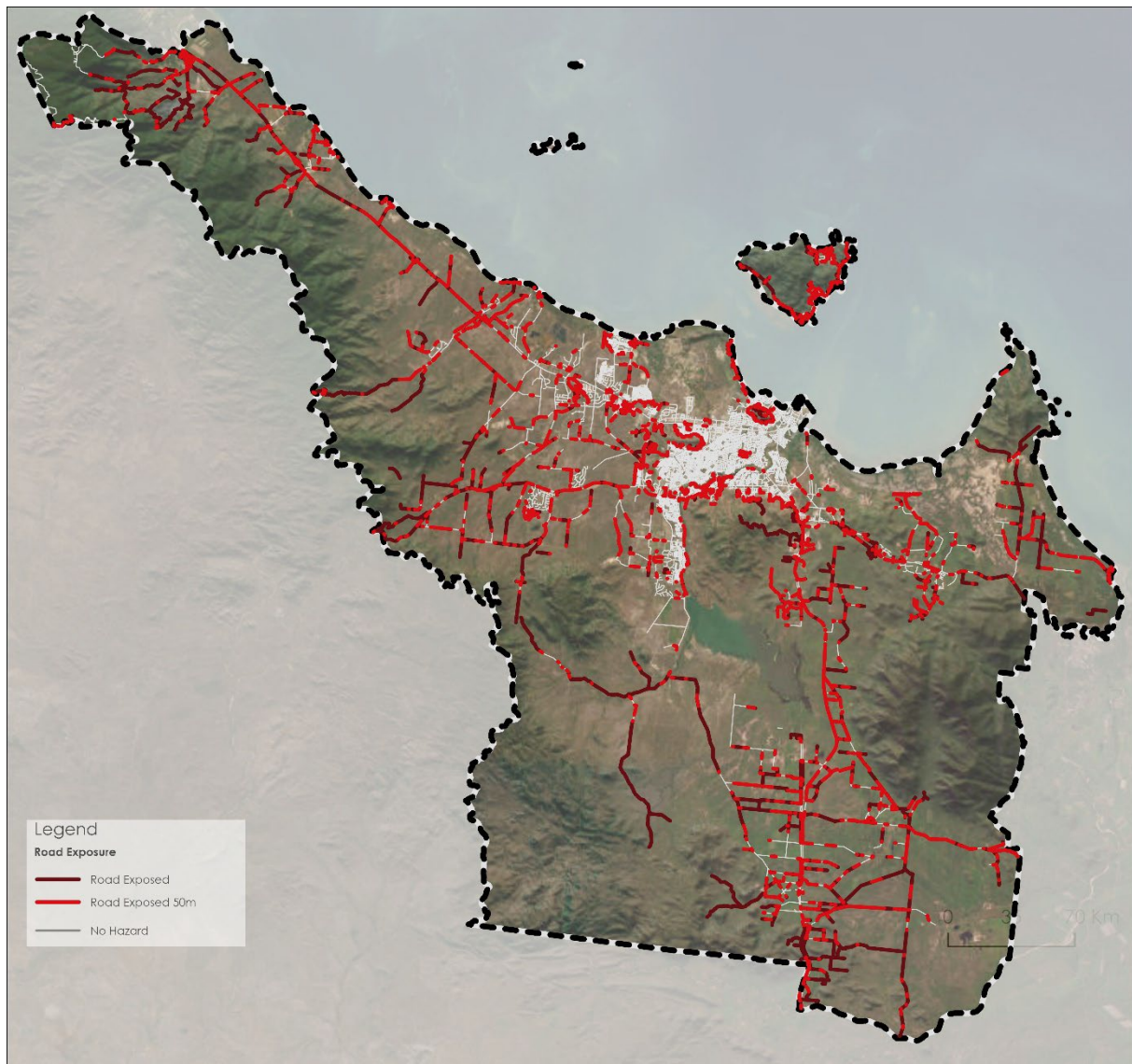


Figure 5-12: Road network Exposure

5.5 Summary of existing exposure and vulnerability

Based on the data above, the following observations are relevant to potential bushfire hazard exposure within the Townsville local government area:

- The majority of zoned land within the Townsville local government area (75 per cent) is identified as being exposed to potential bushfire hazard, including the 100 metre potential impact buffer.
- Land zoned for future development (Emerging Community zone) is highly exposed, with almost two thirds (65 per cent) of this land identified as potentially exposed to bushfire hazard.
- Community facilities zoned land also show a level of exposure, with almost half of the associated land identified as potentially exposed.
- Industrial and commercial zoned lands, both considered employment lands, are exposed with over a third of each identified as potentially exposed to bushfire hazard.
- A notable proportion of residential land is exposed, with over a third (36 per cent) identified as potentially exposed. Of these, the majority (4.5 per cent of total residential land) are within the potential flame contact exposure area (within 50 metres of potential bushfire hazard).
- A proportion of vulnerable facilities are also identified as being exposed to potential bushfire hazard, including the following:
 - Around a quarter of educational establishments (23 per cent)
 - Two of the three correctional facilities
 - Two of the four higher education establishments
 - Approximately 7 per cent of aged care facilities, 12 per cent of child care centres, and 13 per cent of hospitals.
- Approximately a quarter of essential community infrastructure across the city is exposed to potential bushfire hazard, including the following:
 - The majority (89 per cent) of all sewer treatment plants are identified as being exposed.
 - Over two-thirds (67 per cent) of water treatment plants are exposed.
 - Over a third (38 per cent) of water pump stations are exposed.
 - Approximately a quarter of sewer pump stations and zone substations are exposed.
- Almost a third of the road network is exposed to potential hazard with highways having the highest level of direct exposure (42 per cent), posing a significant risk to evacuation and emergency response. While exposure within 50 metres is generally lower, it remains notable for highways (17 per cent) and freeways (14 per cent).

5.6 Summary of identified risks

Based on the analysis of this data, the following risk observations are identified for the Townsville local government area. These strategic-level risks form the basis against which further consideration of issues are explored throughout the evaluation component of this risk assessment.

Risk No.	Identified strategic-level risk	Type of risk
1	Approximately one tenth of the existing population and residential dwelling stock is exposed to potential bushfire hazard. This equates to around 9,638 residential dwellings experiencing some level of exposure. While exposure across the LGA is	Human and social Built environment

Risk No.	Identified strategic-level risk	Type of risk
	considered relatively low, there are a number of locations where exposure is concentrated. Exposure is generally observed within rural residential localities and within urban-bushland interface areas. Exposure is expected to increase cumulatively in the future due to existing use rights and the current and proposed settlement strategy for the city.	
2	It is plausible that a number of residential dwellings that are exposed to potential bushfire hazard have not been constructed in accordance with the provisions contained within AS3959 due to the disconnect between the Bushfire hazard overlay mapping (which the planning scheme designates as bushfire prone land for the purposes of triggering AS3959) and the latest available 2014 SPP BPA mapping. Therefore, it is possible that a proportion of the exposed residential building stock, may not be constructed to meet contemporary bushfire standards.	Human and social Built environment
3	Over half of dwellings within Rural residential zoned land are exposed to potential bushfire hazard. Larger rural residential allotments are generally of a scale that limits ability for private landholders to effectively manage fuel loads outside of asset protection areas, and landholding fragmentation introduces challenges for tenure-blind management. Within Townsville LGA, 1,273 rural residential lots over 8,000 square metres may be eligible for subdivision under current zoning. Of these, over half are already exposed to potential bushfire hazard, suggesting a significant portion of existing stock could support further subdivision, increasing dwellings in bushfire-prone areas.	Human and social Built environment
4	Two thirds of land zoned for or capable of accommodating future growth is exposed to potential bushfire hazard.	Human and social Built environment
5	Risk from grassfire (including on rural land and agricultural cropping lands), and short, sharp interface fire events, are prevalent in the city and likely to remain so.	Human and social Built environment Roads and transport
6	Policy tensions between bushfire hazard protection, as a factor of growth and development, and environmental values have and are likely to continue to generate conflict at the urban bushland interface.	Human and Social Built environment
7	Portions of the city's employment-generating zoned land, including industrial and centre zones, are exposed to potential bushfire hazard, with roughly a third identified as exposed	Economic
8	A high portion of rural zoned land is exposed to potential bushfire hazard across the city much of which is used for livestock and horticultural purposes.	Economic

Risk No.	Identified strategic-level risk	Type of risk
9	Parts of the recreation and open space network are exposed to potential bushfire hazard across the city.	Human and social
10	Some vulnerable facilities are identified as being subject to potential bushfire hazard.	Human and social Built environment
11	A portion of essential community infrastructure is exposed to potential bushfire hazard particularly across the electricity, water and sewerage networks.	Built environment Economic
12	Parts of the evacuation network may be compromised in a fire event and may impact the ability to evacuate in certain locations, under certain conditions.	Human and social Road and transport

6 Bushfire risk analysis

This section provides a detailed analysis of the identified land use planning related risks relating to bushfire hazard across the City of Townsville.

6.1 QERMF Analysis

The risk analysis methodology aligns, and follows, the risk analysis methodologies and matrices set out by the QERMF, as illustrated below.



Figure 6-1 – Process 2 of the QERMF Score

6.1.1 Analysis of overall risk likelihood

The risk assessment seeks to support long-term land use planning. As such, the approach of this risk assessment assumes bushfire events and impact are expected to occur within the city.

The table below outlines the event likelihood definitions, as per the QERMF.

Likelihood Table		
Historical Likelihood	Likelihood Level	Definition
Has occurred 3 or more times in the last year or at least each year over the last 5 years	Almost Certain	Almost certain to occur in most cases
Has occurred twice in the last 5 years	Likely	Likely chance of occurring in most cases
Has occurred twice in the last 10 years	Possible	Might occur in most cases
May occur, and has occurred once in the last 20 years	Unlikely	Not expected to occur in most cases
May only occur in exceptional circumstances or has occurred only once in the last 50 years or more	Rare	Will only occur in exceptional circumstances and has not occurred in most cases

Figure 6-2: QERMF likelihood table

Different parts of the city have experienced bushfire events over time. One of the limitations in determining likelihood accurately is the availability of complete event data dating back over decades, and how historical trends may change into the future as a result of climate change.

The table below considered the potential for fire impact, rather than fire occurrence. This acknowledges from a land use planning perspective, it is the likelihood of impact of bushfire on values (people, dwellings, infrastructure assets) that is most critical to consider, rather than the probability of fire occurring at all.

Given that the BPA mapping is climate-adjusted and future climate scenarios are being considered, an increase in the frequency and intensity of bushfires is anticipated, and the likelihood is therefore considered 'likely'.

Table 6-1: Likelihood assessment as per QERMF

Spatial Context	Likelihood of bushfire impact
City of Townsville	Likely

6.1.2 Analysis of overall risk vulnerability

In terms of vulnerability, the Townsville LGA as a whole contains a mix of older housing stock that was constructed prior to the introduction of AS3959 standards in Queensland and newer housing stock that is built to modern building standards.

However, it is noted that there is a disconnect between the latest available bushfire prone area mapping and that which has been used to designate bushfire prone areas for the purposes of triggering assessment against AS3959. Therefore, it is plausible that some new buildings that are exposed to potential bushfire hazard may not have been constructed to AS3959 standards.

Additionally, the number of vulnerable facilities within the exposed area does not represent a significant proliferation. While exposure to the existing population is considered relatively low, there are a number of locations where potential exposure is increased. Some of these locations are also observed to contain factors that increase risk such as single points of access and cul-de-sac. Given these factors, it is considered appropriate to increase the level of vulnerability.

The assessment of vulnerability below considers vulnerability across the entire city. This is considered to be at the lower end of the 'High' category in that vulnerability issues relate to specific localities rather than across the entire LGA.

Table 6-2: Vulnerability assessment as per QERMF

Spatial Context	Vulnerability of bushfire impact
City of Townsville	High

6.1.3 Analysis of overall risk consequences

Consequence is considered on balance of the extent of people, dwelling and assets which are exposed. Bushfire events impacting more densely populated communities will sustain immediate impacts such as the loss of property, and possible life. Bushfire events in the rural areas of the city can also yield high, long term economic losses.

The ability to evacuate to safety is relatively achievable for much of the city although some locations are exposed to being challenged in this regard.

Table 6-3 - Overall risk consequence levels as per QERMF

Consequence Typology	Summary of risk consequence aspects	Consequence assessment
People	No injuries were reported to emergency services from any recent documented fire event.	Insignificant

Consequence Typology	Summary of risk consequence aspects	Consequence assessment
Financial and economic	A moderate proportion of the region's economic / employment lands are subject to potential bushfire and grassfire hazard however, the region's economy is highly diversified and impacts are likely to be point specific rather than widespread.	Moderate
Community and social	There are several community facilities, sporting and open space zoned lots in the hazard risk area. Whilst built form associated with these land uses may not be intense, often they are high value assets which in some cases, are not covered by Disaster Recovery Funding Arrangements if lost to bushfire. In addition, the region includes a number of isolated communities which are susceptible to bushfire hazard (including magnetic island, Balgal beach and Saunders beach), due to the nature of these communities it is considered that bushfire could have significant impact on affected communities.	Moderate
Governance and infrastructure	Critical infrastructure and vulnerable facilities exposed to bushfire hazard are limited in number but may produce a level of community disruption should impact occur.	Moderate
Environment	Intense, hot bushfires have the potential to impact ecological functions. However, higher risk impacts stem more from inappropriate fire regimes (too frequent or infrequent fire in the landscape) than one-off bushfire events.	Major

6.1.4 Level of risk

The QERMF provides a fit-for-purpose risk matrix which incorporates the assessment of vulnerability, in addition to likelihood and consequence factors.

The QERMF risk matrix is as follows:

Likelihood (X)		Rare (1)					Unlikely (2)					Possible (3)					Likely (4)					Almost Certain (5)				
Consequence (Z)	Vulnerability (Y)	V.Low (1)	Low (2)	Mod (3)	High (4)	Extr (5)	V.Low (1)	Low (2)	Mod (3)	High (4)	Extr (5)	V.Low (1)	Low (2)	Mod (3)	High (4)	Extr (5)	V.Low (1)	Low (2)	Mod (3)	High (4)	Extr (5)	V.Low (1)	Low (2)	Mod (3)	High (4)	Extr (5)
	INSIGNIFICANT (1)	VL1	VL2	VL3	L4	L5	VL2	VL3	L4	L5	L6	VL3	L4	L5	L6	M7	L4	L5	L6	M7	M8	L5	L6	M7	M8	H9
	MINOR (2)	VL2	VL3	L4	L5	L6	VL3	L4	L5	L6	M7	L4	L5	L6	M7	M8	L5	L6	M7	M8	H9	L6	M7	M8	H9	H10
	MODERATE (3)	VL3	L4	L5	L6	M7	L4	L5	L6	M7	M8	L5	L6	M7	M8	H9	L6	M7	M8	H9	H10	M7	M8	H9	H10	H11
	MAJOR (4)	L4	L5	L6	M7	M8	L5	L6	M7	M8	H9	L6	M7	M8	H9	H10	M7	M8	H9	H10	H11	M8	H9	H10	H11	E12
	CATASTROPHIC (5)	L5	L6	M7	M8	H9	L6	M7	M8	H9	H10	M7	M8	H9	H10	H11	M8	H9	H10	H11	E12	H9	H10	H11	E12	E13

Key: V.L = Very low; L = Low; M = Medium; H = High; E = Extreme

Scale: 1 (lowest) to 13 (highest)

Table 3 - Risk Matrix

Figure 6-3: Risk matrix as per Appendix 4 of the QERMF

Having regard to the assessment of likelihood (of impact) and consequence for each reporting Locality, the overall risk levels for the Townsville local government area is outlined below. It is noted that H9 is at the lower end of the 'High' category.

Table 6-4: Assessment of risk level in accordance with the risk matrix at Appendix 4 of the QERMF

Spatial context	Bushfire risk level
Townsville LGA	High (H9)

This risk assessment focusses on bushfire risk for land use planning and relates to matters of planning, settlement and building policy and strategy. The risk analysis has not been prepared for the purposes of disaster management and does not represent an appraisal of asset based vulnerability or exposure.

Likelihood and consequence of course varies across Townsville. From a land use planning perspective, it is thus important to consider the risk profile of each local area, in order to provide a clearer picture of the land use planning risks relating to different locations of the Townsville region.

6.2 Reporting locality analysis

The reporting localities referenced in Section 3.7 were used as the basis for the localised risk analysis to provide a more granular appraisal of the nature of bushfire hazard and risk as it manifests across the Townsville local government area.

The reporting Locality-based risk analysis relied broadly upon the methodology set out by AS5334 and its exposure and sensitivity matrices (adjusted specifically for bushfire) and probability derived from a 2050 climate-adjusted scenario adopted to prepare 2014 BPA Mapping.

For each reporting Locality, a mixed methods approach was adopted across a series of risk elements in order to derive a risk rating for land use planning consideration, in accordance with the exposure and sensitivity methodology of AS5334. These include:

- Fuel hazard
 - Hazard extent (total extent of land mapped as potential bushfire hazard)
 - Hazard category (relative to intensity class and extent)
- Assets and exposure

- Residential
- Employment lands
- Vulnerable facilities
- Community Infrastructure
- Access and egress

In relation to the above elements, fuel hazard criteria were derived from the 2014 BPA mapping while assets and exposure criteria were derived from the elements of exposure utilised in the city-wide risk identification relevant to each reporting locality.

Using this approach, a risk ranking specifically for land use planning consideration was identified for each reporting locality, as per map and risk dashboard table provided in Figure 6-4. A detailed summary of each reporting Locality is provided in section 7.2.

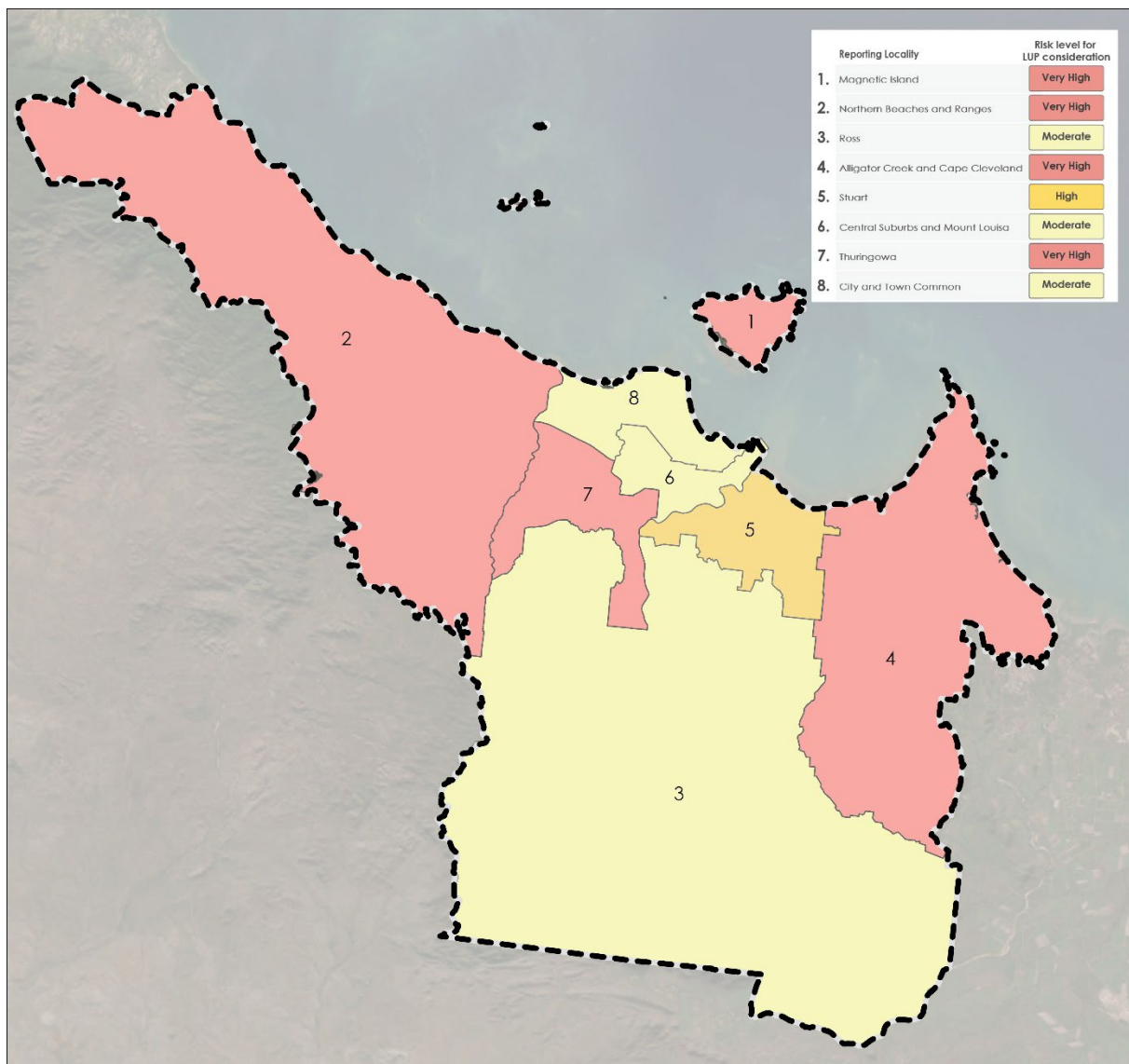


Figure 6-4: Results of land use planning risk analysis by reporting locality



7 Bushfire risk evaluation

The following evaluation of risk relevant to the Townsville local government area is explored in two contexts:

1. City wide strategic risks; and
2. Local area risk, aligned with the reporting localities.

7.1 City wide strategic risk evaluation

As outlined at Section 5, a number of city/region relevant strategic risk factors are identified, relative to land use planning. This section evaluates the context of these issues at the city wide scale whilst the following section provides detailed reporting locality risk profiles.

7.1.1 Population and property exposure

Identified risk: Approximately one tenth of the existing population and residential dwelling stock is exposed to potential bushfire hazard. This equates to around 9,638 residential dwellings experiencing some level of exposure. While exposure across the LGA is considered relatively low, there are a number of locations where exposure is concentrated. Exposure is generally observed within rural residential localities and within urban-bushland interface areas.

Exposure is expected to increase cumulatively in the future due to existing use rights and the current and proposed settlement strategy for the city.

Type of risk: Human and Social; Build environment

A proportion of the city's existing neighbourhoods and communities are, to some extent, exposed to potential bushfire hazard. Outside of the city's planned growth areas, some places may still see more development over time. This could happen because minimum lot size provisions allow further reconfiguration of existing (largely rural residential) allotments over time, or because the way the land is used might change.

65 per cent of the city is mapped as potential bushfire hazard, with a further 11 per cent of the city within the 100 metre potential impact buffer. As such, 76 per cent of the Townsville LGA is subject to potential bushfire hazard.

Cumulatively, it is anticipated the quantum of exposure will continue to grow as the city's urban interface with bushfire hazard expands, as is currently the case. This is discussed in further detail in the following section.

Exposure of persons and property to bushfire hazard is not unique to Townsville. However, for some locations in the city the nature of exposure has the potential to exacerbate existing demand and burden on emergency services, and land managers. Planning tools (of varying strength) can be deployed to improve outcomes.

Aside from potential risk to life, from a human and social (community) perspective the risk to property is a significant consideration, and protection of property and assets as residual risk is transferred to end users.

The Insurance Council of Australia identifies that approximately 1 in 20 properties across Australia are not insured, approximately 70 per cent of properties are under-insured and about two-thirds of renters do not have contents insurance (Wynne, 2017).

One of the critical issues in this regard is that 'insured value' should not just cover the construction or purchase price, but must take into account current building standards, demolition, potential asbestos removal and site clean-up. The recent 2019-20 New South Wales Bushfire Inquiry identified that costs to re-build to new standards could be as high as an additional \$100,000 (Owens & O'Kane, 2020). Many policy holders do not take this into account. In a recent inquiry directed by the Commonwealth Government, the Australian

Competition and Consumer Commission (ACCC) (2020) established that as disaster events continue, insurers are using more refined data and sophisticated pricing techniques which can result in insurance unaffordability for some consumers, over time. It also found that reforms to land use planning and building standards can help reduce risks and costs over the longer term.

7.1.2 Residential dwelling exposure and construction

Identified risk: It is plausible that a number of residential dwellings that are exposed to potential bushfire hazard have not been constructed in accordance with the provisions contained within AS3959 due to the disconnect between the Bushfire hazard overlay mapping (which the planning scheme designates as bushfire prone land for the purposes of triggering AS3959) and the latest available 2014 SPP BPA mapping.

Therefore, it is possible that a proportion of the exposed residential building stock, may not be constructed to meet contemporary fire safety standards.

Type of risk: Human and Social; Build environment

Section 32(a) of the Building Act 1975 and Section 7 of the Building Regulation 2021 allows a local government, via its Planning Scheme, to designate areas as designated bushfire prone areas for the purposes of the Building Code of Australia or Queensland Development Code. Where adopted, this triggers assessment (for Class 1, 2 and 3 and associated Class 10a) against the Australian Standard for construction of buildings in bushfire prone areas (AS3959:2018) for buildings within designated bushfire prone areas.

However, the current bushfire hazard overlay mapping in Townsville's planning scheme does not reflect the State Planning Policy (SPP) 2014 BPA mapping. Most notably, it only includes two hazard categories (medium and high) rather than the three categories used in the SPP and does not incorporate the 100 meter potential impact buffer. It is likely that the current overlay was prepared using the methodology in place under the former SPP 1/03.

In this instance, the state-wide BPA mapping supporting the SPP prevails over local planning overlays for planning purposes to the extent of any inconsistency. However, for building purposes, Council's planning scheme overlay mapping remains the applicable trigger for BPA designation under the Building Act.

There is currently no legislative requirement for existing buildings to comply with these standards, and retrospective application is not possible. However, updating BPA designations in the planning scheme will ensure that future residential development is assessed against the current bushfire construction standards.

The Bushfire hazard overlay in planning schemes is typically based on datasets available at the time of adoption. In contrast, this assessment has utilised the 2014 BPA mapping released by the Queensland Government, which includes three bushfire intensity classes (medium, high, very high) and associated 100 m buffers. A disconnect has emerged between the SPP-IMS BPA overlay and areas that have since been approved or developed for residential use. While it is acknowledged that the spatial extent of the 2014 BPA mapping is generally more refined than Council's overlay (at the time this report was prepared), it remains plausible that there are areas subject to potential bushfire hazard under the 2014 BPA mapping that are not mapped within Council's overlay. Therefore it is possible that residential development may have occurred on areas exposed to potential bushfire hazard that do not require assessment against AS3959 or bushfire protection requirements under the Building Regulation 2006.

At the time of writing, Council was in the process of integrating the 2014 BPA mapping into the planning scheme via Package 1 Major Amendment which will assist in addressing the disconnect between the scheme Bushfire hazard overlay mapping and the 2014 BPA mapping for building purposes.

7.1.3 Rural residential dwelling exposure

Identified risk: Over half of dwellings within Rural residential zoned land are exposed to potential bushfire hazard. Larger rural residential allotments are generally of a scale that limits ability for private landholders to effectively manage fuel loads outside of asset protection areas, and landholding fragmentation introduces challenges for tenure-blind management.

Type of risk: Human and Social; Build environment

Approximately 9 per cent (6635 dwellings) of the residential stock within the Townsville LGA are within Rural residential zoned communities. Despite this, almost one quarter (23 per cent) of the total residential exposure emanates from this zone. This equates to a third of all Rural residential zoned dwellings (34 per cent, 2,252 dwellings).

Rural residential settings represent a challenging environment for which bushfire is to be managed. Typically, lot sizes range from 2ha to 6ha. At this scale, the ability for private landholders to manage fuel loads outside of asset protection areas is diminished as lot sizes are generally too small to facilitate hazard reduction burns however, are too large for most landholders to maintain in their entirety. Across the region, 1,273 rural residential lots are larger than 8,000 square metres and may be eligible for subdivision under current planning provisions. Of these, over half are exposed to potential bushfire hazard. The management of bushfire risk at the landscape scale is also challenging for authorities due to land fragmentation and the resulting complexity of working across multiple tenures.

A review of rural residential communities across the LGA identified numerous locations where heightened bushfire risk was observed. In many cases, this risk was further exacerbated by the local road network, which included a number of single access routes. These routes pose significant challenges for evacuation and emergency response.

The ongoing consideration of rural residential communities from a land use planning perspective is important to maintain. There may be opportunities to consider minimum lot size provisions in specific locations to limit future exposure in high risk environments.

7.1.4 Exposure of Growth areas

Identified risk: Two thirds of land zoned for or capable of accommodating future growth is exposed to potential bushfire hazard.

Type of risk: Human and Social; Build environment

The Townsville LGA includes several growth areas located on the urban fringe, including Mount Low, Deeragun, Shaw, Mt Louisa and Rosslea. These areas are earmarked for future development and are expected to accommodate significant population and residential growth over time. With this growth comes an increase in potential exposure to bushfire hazards. The State Planning Policy (SPP) mandates that intolerable risk be avoided and that other risks are managed to a tolerable or acceptable level. This risk-based approach is embedded within planning frameworks to ensure future urban expansion does not occur in areas of unmanageable hazard.

Land zoned as Emerging community represents areas identified for longer term investigation and potential future urban zoning. However, not all land within this zone will be suitable for development, particularly where bushfire risk is high. This assessment found that approximately 65 per cent of land zoned Emerging community is exposed to potential bushfire hazard. In some instances this risk is expected to reduce as development progresses and vegetation is cleared, provided that appropriate development controls, such as bushfire resilient subdivision layout and design particularly at the urban and hazard interface, are implemented. Notwithstanding, despite vegetation clearing to facilitate development, bushfire risk may remain due to the broader considerations, such as landscape scale bushfire risk in the locality or proximity to evacuation routes and capacity of the road network.

7.1.5 Grassfire hazard

Identified risk: Risk from grassfire (including on rural land and agricultural cropping lands), and short, sharp interface fire events, are prevalent in the city and likely to remain so.

Type of risk: Human and Social; Build environment

Grassfire events can lead to property loss in locations which are not subject to the state-wide BPA mapping. This is because, from a policy perspective, grassfire is not deemed to be a planning consideration in Queensland given its lower fireline intensity and limited ability to generate ember attack of a level likely to pose a risk to property. As grassfire hazard is not mapped, it also does not trigger assessment of AS3959 or the application of building measures.

However, grassfire can be very fast moving, with significant rate of spread. These events can generate short, sharp emergencies and which can be destructive.

The continuity of grassland fuels where it adjoins woodlands or bushland can give rise to the ability for fire to run across paddocks and rural lands. Under more severe weather conditions, even paddock stubble can burn and carry fire.

Community education campaigns may assist to ensure grassfire events are reported quickly to emergency services, ensuring residents and primary producers remain vigilant to the threat of potential grassfire in the region.

7.1.6 Competing policy interests

Identified risk: Policy tensions between bushfire hazard protection, as a factor of growth and development, and environmental values have and are likely to continue to generate conflict at the urban bushland interface.

Type of risk: Human and Social; Build environment

The consideration of bushfire hazard in a planning context is often required on balance with other planning interests which include vegetation management (including vegetation clearing), protection of biodiversity and ecosystem rehabilitation.

In the first instance, clear policy positions can assist development assessment processes where vegetation removal is required. In particular, clarity in relation to environmental values and assets which require protection and retention. This may include matters of local and state environmental significance or protected vegetation. Uncertainty can arise where development applications seek clearing for the purpose of bushfire protection. Policy tension can arise between the objectives of bushfire protection and those of biodiversity protection where competing values are present.

Noting the exposure of potential growth areas in the existing planning scheme, this policy tension is likely to arise. For incremental development in existing rural residential areas, for example, processes are in place under the State Development Assessment Guidelines to support the navigation of these issues during the development assessment phase, at least for Matters of State Environmental Significance. A suite of tools can be implemented by Council to address Matters of Local Environmental Significance via strategic planning processes. It is understood that Council is looking to advance a biodiversity study and update the Natural Assets Overlay code in the future. This can also assist in identifying and balancing the protection of Matters of Local Environmental Significance and bushfire hazard protection measures.

7.1.7 Exposure of employment generating land

Identified risk: Portions of the city's employment generating zoned land are exposed to potential bushfire hazard, particularly Industrial zone.

Type of risk: Economic

Industrial and commercial lands are impacted to varying degrees by environmental risks, with 31 percent of industrial land and 34 percent of commercial land exposed to potential bushfire hazard. In the Townsville LGA, 12,833 registered businesses operate (Australian Bureau of Statistics, 2021), contributing an estimated \$14.32 billion to the local economy.

Agricultural losses from bushfires in Queensland and across Australia more broadly continue to grow. These losses have far reaching socio-economic impacts that extend community recovery timeframes and can lead to devastating consequences for agricultural businesses, which are often family owned enterprises.

Furthermore, the impact on agricultural enterprises triggers significant cascading effects on related industries such as transport, logistics, and manufacturing, as well as other dependent sectors. According to the Australian Disaster Resilience Index, many primary production districts across Australia are overexposed to economic risk due to disasters. This increased vulnerability is largely attributable to limited economic diversity and the predominance of agricultural activities.

Regulatory exemptions exist for certain vegetation management practices that primary producers can implement without requiring approval. Beyond agricultural production, large portions of industrial zoned land face potential bushfire hazards. In cases where facilities store or manufacture hazardous materials or operate heavy machinery which are activities that could heighten fire risk; additional planning provisions should be put in place to ensure the safe storage and manufacture of materials and operation of machinery.

7.1.8 Rural Land Exposure

Identified risk: A high portion of rural zoned land is exposed to potential bushfire hazard across the city much of which is used for livestock and horticultural purposes.

Type of risk: Economic

Approximately 78 per cent of rural lands and 34 per cent of rural living lands is exposed to potential bushfire hazard. High levels of exposure across these zones is to be expected however, the potential impacts cannot be discounted. Much of the rural zoned lands is also income generating land, contributing to the economic vitality and diversity of the region. It is also employment-generating lands, helping to support the socio-economic wellbeing of the region's population. Rural living lands are an extension of this however, the nature of risk is more focussed on property loss and potential for life loss.

The relationship with on-property land management in these cases is critical, noting such lands remain in private ownership where fuel management is the responsibility of property owners but for which support can be derived through local rural fire brigades.

7.1.9 Exposure of the recreation and open space network

Identified risk: Parts of the recreation and open space network are exposed to potential bushfire hazard across the city.

Type of risk: Human and Social

Council assets including recreation and open space networks are exposed, which similar to rural zoned lands, is to be expected. Where these lands include bushfire hazard, Council maintain detail bushfire management plans and practices to manage fuel loads and interface locations. The majority of recreation and open space areas are maintained by Council under a regular maintenance schedule, which reduces bushfire risk. Council may however benefit from a synthesised and coordinated approach to the fire management of its lands, pursuant to risk.

Public assets in these locations may include community infrastructure, playground equipment and other recreational assets. Cost recovery for reconstruction of some assets in these areas may be constrained under the current Disaster Recovery Funding Arrangements.

7.1.10 Vulnerable facilities and occupants

Identified risk: Some vulnerable facilities are identified as being subject to potential bushfire hazard.

Type of risk: Human and Social; Build environment

The historical settlement policy of the city appears to have largely avoided the proliferation of potentially vulnerable facilities within bushfire prone areas. Those that do appear within bushfire prone areas are dominated by educational facilities, child care centres, residential care facilities and some retirement facilities.

The location of facilities of this nature is, as outlined by the State interest policy, intended to be avoided in hazard exposed locations.

This aspect must form an area of policy focus as part of the formulation of the new planning instrument.

7.1.11 Essential community infrastructure exposure

Identified risk: A portion of essential community infrastructure is exposed to potential bushfire hazard particularly across the electricity, water and sewerage networks.

Type of risk: Human and Social; Build environment

A number of essential infrastructure assets are identified in the bushfire prone area, dominated largely by electricity, water and sewerage networks, many items of which are not under Council's jurisdiction. Exposure of selected water pump stations, coupled with exposure of some electrical substations in the city, may eventuate in cascading impacts during a fire event where power and water supply fail in certain areas. Whilst this remains a disaster management issue, planning controls can support the reliability of essential infrastructure by adopting a policy position, in the first instance, of avoiding such critical assets in bushfire prone areas. This is the expectation of the SPP and State interest for bushfire, and Council has options available to satisfy the SPP requirements in relation to essential infrastructure.

7.1.12 Risks to the evacuation network

Identified risk: Parts of the evacuation network may be compromised in a fire event and may impact the ability to evacuate in certain locations, under certain conditions.

Type of risk: Human and Social; Build environment

Planning for bushfire evacuation is an immensely difficult task. Unlike flood and other events, bushfire events are not a 'known quantity'. There is no surety in when or where an ignition may occur, the direction it may spread, the extent of possible ember attack, etc.

The impact of smoke and limited visibility in emergency situations, coupled with wind impact, can lead to issues on the road network as residents attempt to evacuate. The exposure of motorists to potential flame contact and radiant heat are also key considerations.

The extent of warning time and ability to evacuate to safety (including the aspects of access and egress) represent the most fundamental characteristics which determine risk to life in a land use planning context.

There are three key elements of relevance to land use planning:

1. The extent of warning time available (window of evacuation opportunity);
2. How the settlement pattern supports or enables:
 - a. separation from hazard sources;

- b. urban intrusion of fire by built form;
 - c. the act of community evacuation (processes); and
3. Evacuation destinations (designated evacuation centre or Neighbourhood Safer Place [NSP]).

AIDR Handbook 4: Evacuation Planning provides guidelines and considerations for developing community evacuation plans underpinned by an all-hazards approach. It uses the nationally recognised five stages of the evacuation process as a framework for planning an evacuation (AIDR, 2017).

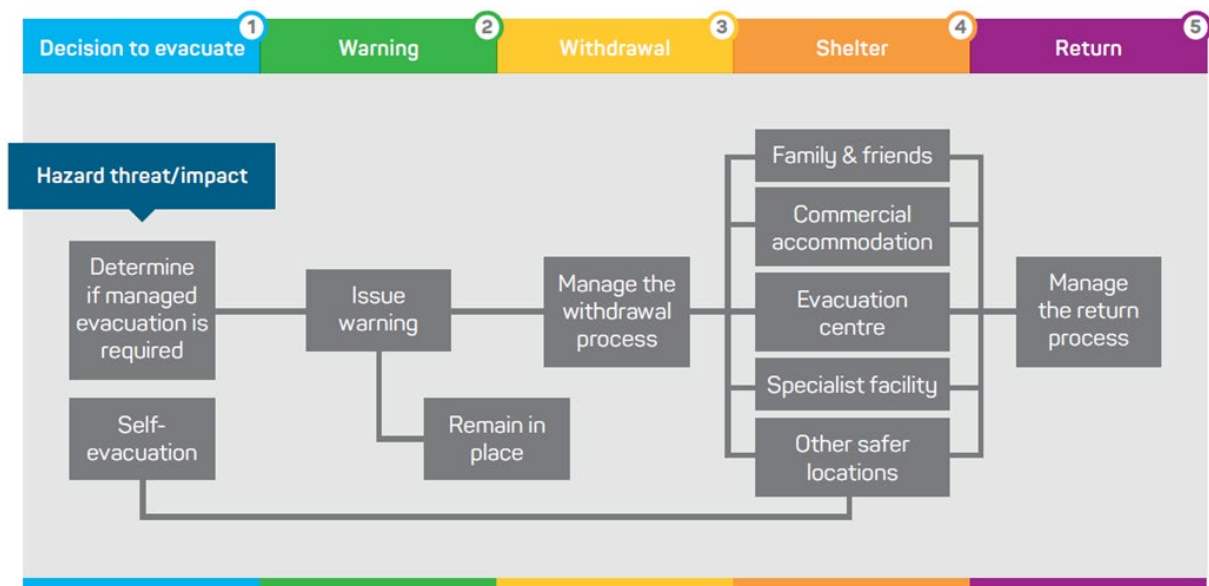


Figure 7-1 - The five stage evacuation process (Source: AIDR, 2017)

This risk assessment does not seek to determine specific evacuation windows for any event scenarios. Rather, the focus of this work is to examine the potential exposure of the higher order evacuation route network to inform potential Council decisions in relation to settlement policy and potential growth locations.

Current planning instruments and materials in Queensland do not, at this time, adequately articulate the characteristics of an effective and efficient evacuation network in relation to bushfire hazard. This risk assessment defines an evacuation network as including the following attributes (as a minimum):

- a network with capacity to support surge demand during evacuation (i.e. many residents leaving at once, with multiple vehicles departing from each household);
- a network which provides and support multiple egress options, in the event that one or more routes become non-trafficable;
- potential bottlenecks and pinch points in an emergency situation are identified via strategic processes and able to be mitigated; and
- roads at the interface are sufficiently wide to enable fire appliances to stand on the pavement and be operational (i.e. doors open and equipment deployed), and continue to allow for passing vehicles which may be leaving the area.

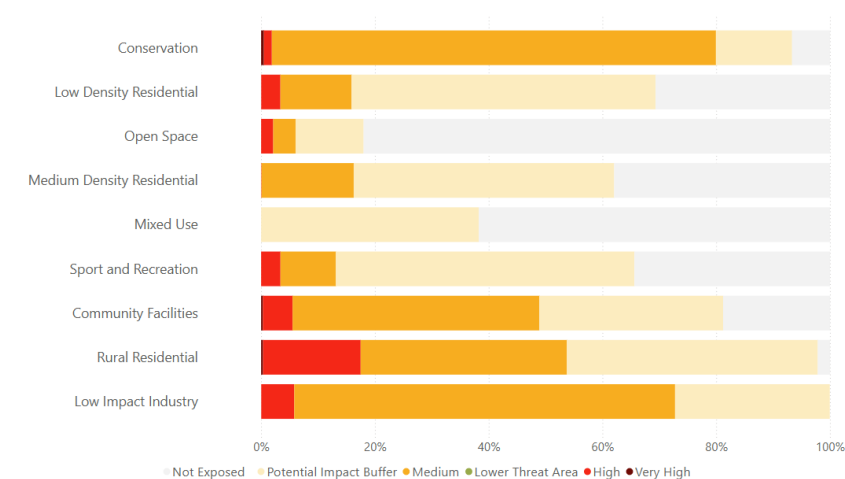
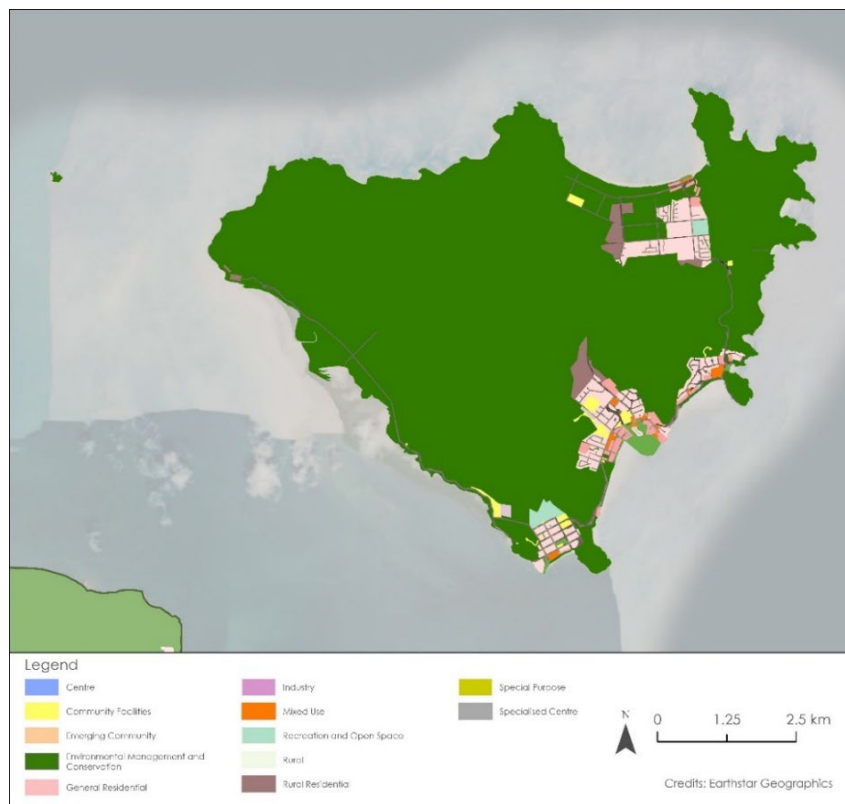
Regard for the above in advance of development growth enables the road network to appropriately support emergency evacuation, and mitigate potential risk to life to a tolerable level.

7.2 Reporting locality risk evaluation profiles

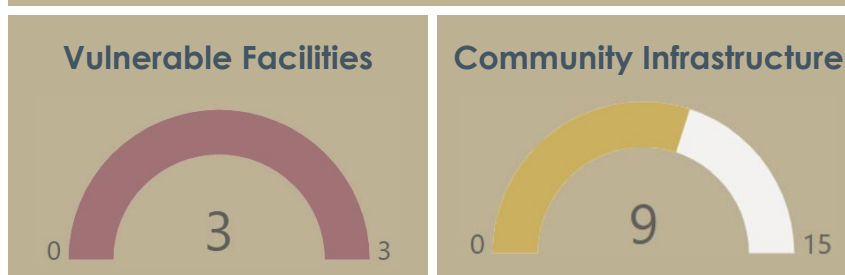
A detailed analysis of the 8 reporting localities has been undertaken and summaries for each is provided below.

7.2.1 Magnetic Island

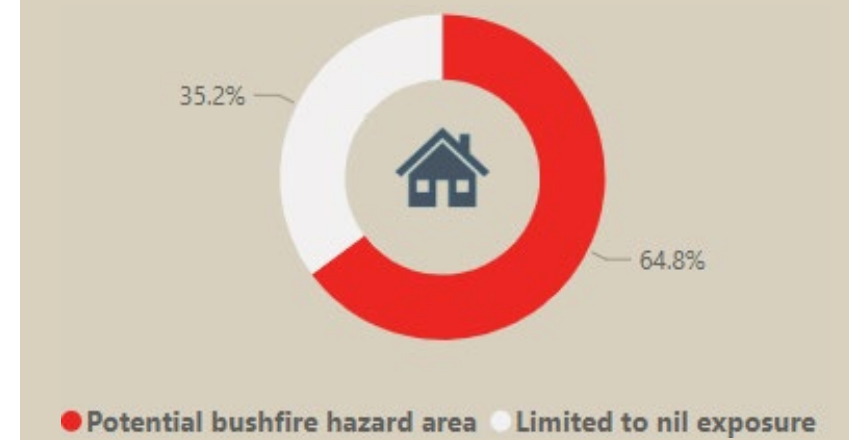
Zone Exposure



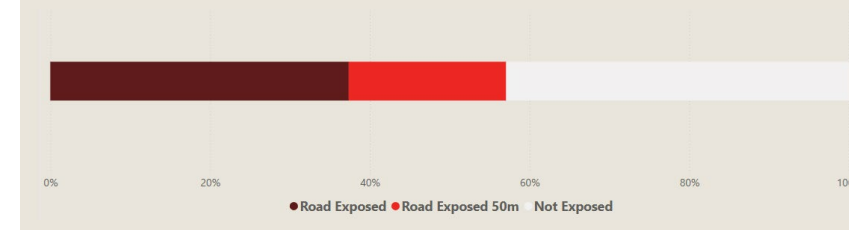
Existing bushfire exposure metrics



Residential Exposure



Road Exposure



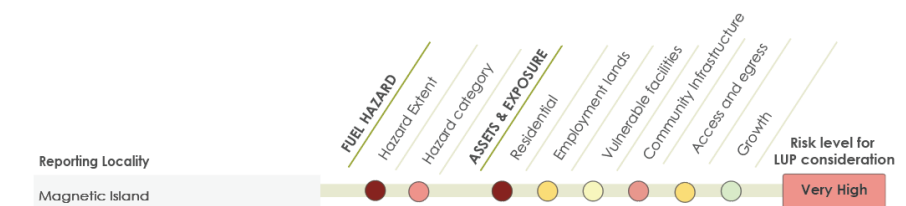
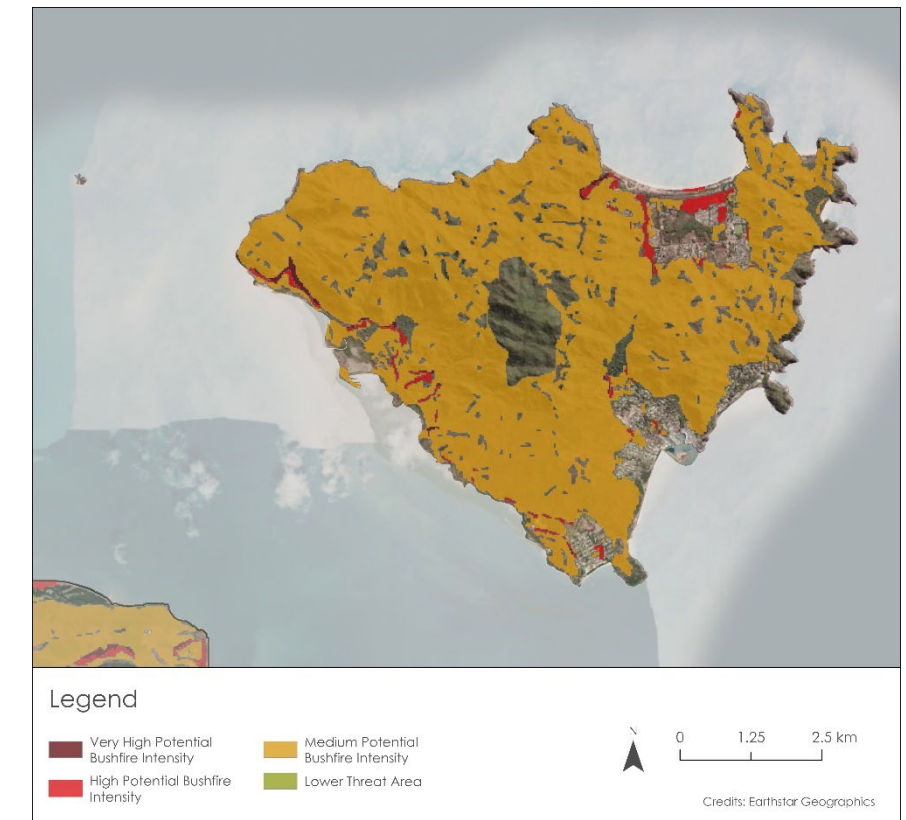
Exposure Summary

The Magnetic Island reporting locality includes significant vegetated areas that result in largely consistent hazard connectivity across the majority of the reporting locality. The primary urban settlements of Horseshoe Bay, Arcadia, and Nelly Bay are situated along the coastline and interface directly with vegetated areas associated with Magnetic Island National Park, which is identified as bushfire prone. This interface contributes to the elevated level of residential exposure, with approximately 60 per cent of dwellings located within the bushfire prone area, primarily within the 100 metre buffer. Notably, there are no perimeter roads, asset protection zones or dedicated fire trails separating dwellings from surrounding vegetation.

The road network within Magnetic Island is also highly exposed, with approximately 60 per cent identified as being at risk from potential bushfire hazard. Key connections between settlements such as Horseshoe Bay Road and Mandalay Avenue traverse vegetated, bushfire prone areas. These roads provide the only vehicular access between communities and to the ferry terminal at Nelly Bay, making them critical for evacuation and emergency response.

A very high proportion of essential community infrastructure within the reporting locality is exposed to potential bushfire hazard, including seven pump stations and two treatment plants. All three vulnerable facilities comprising one educational establishment, one childcare centre and one aged care facility are also identified as exposed. However, it should be noted that the total number of vulnerable facilities is low, and two of the three, the childcare centre

and the aged care facility, are located within the 100 metre potential impact buffer.



Bushfire Risk Summary

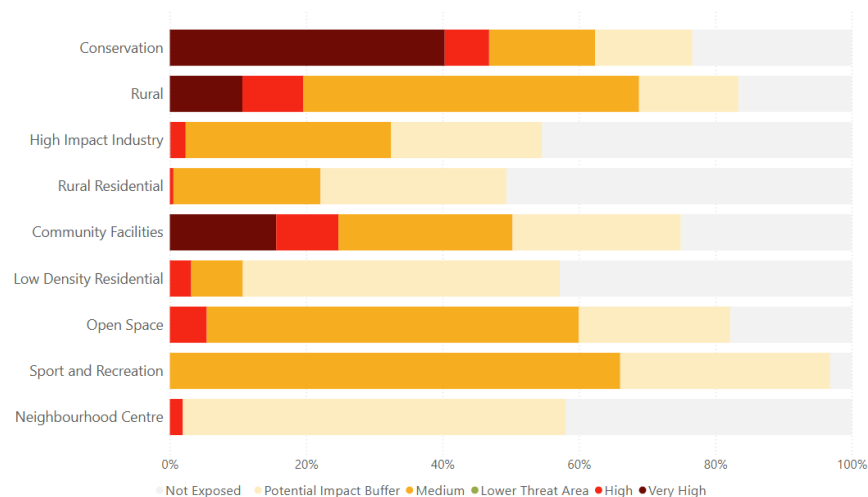
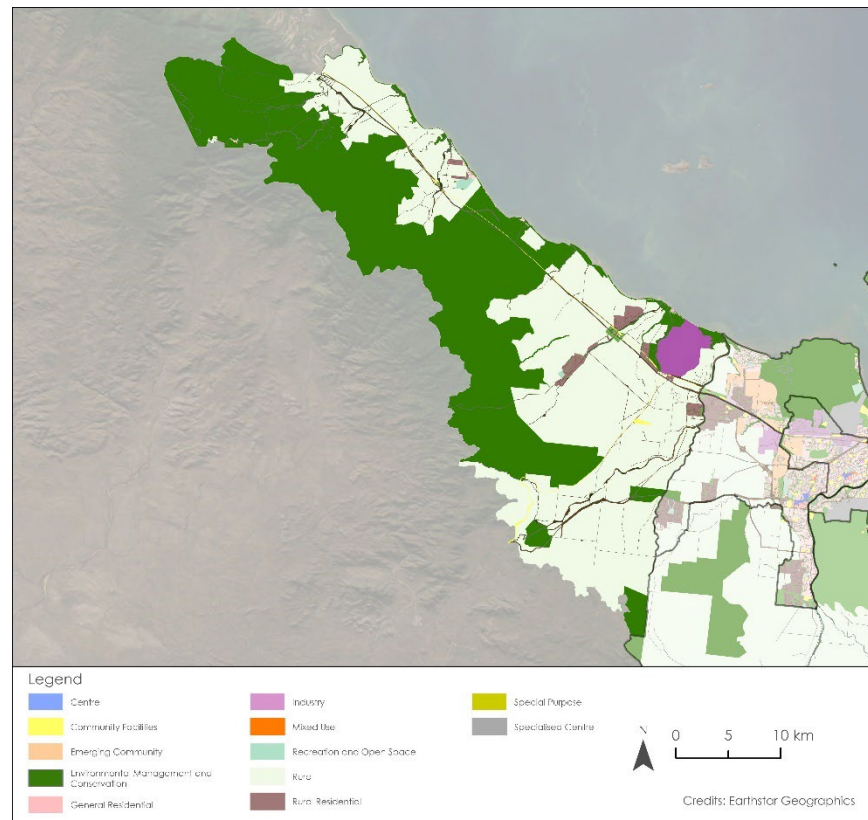
Bushfire risk within the Magnetic Island reporting locality is considered is Very High, primarily due to the island's extensive vegetation coverage and strong connectivity of bushfire prone areas. The hazard is largely continuous across the island, with only minor breaks around developed areas. There is limited presence of natural or constructed buffers, which reduces separation between bushland and development.

This risk is further amplified by exposure across the road network, which provides critical links between communities and the ferry terminal. These routes are vulnerable to disruption during a bushfire event.

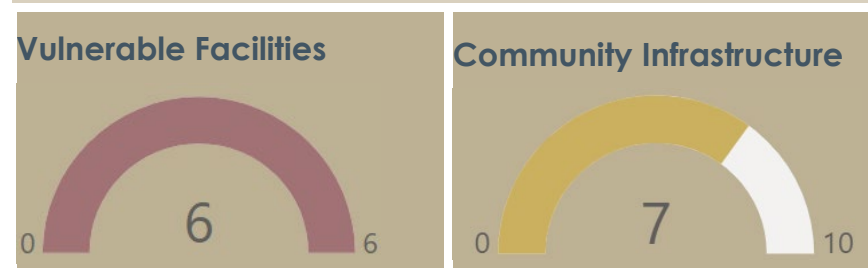
A substantial proportion of residential dwellings are also located within the bushfire prone area, particularly within 100 metres of hazard areas, increasing the potential exposure of life and property.

7.2.2 Northern Beaches and Ranges

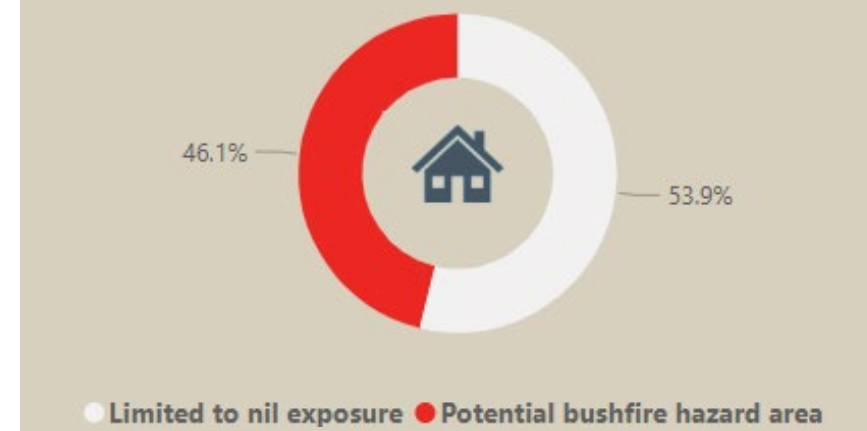
Zone Exposure



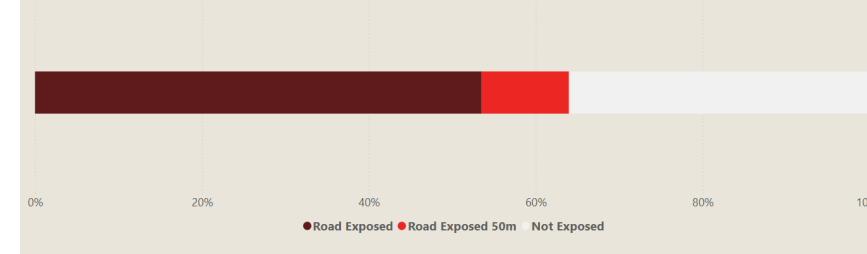
Existing bushfire exposure metrics



Residential Exposure



Road Exposure



Exposure Summary

The reporting locality of Northern Beaches and Ranges is characterised by extensive areas of Very High and High bushfire hazard in the west, where the Paluma Range National Park forms a large, continuous expanse of hazard. This transitions into rural areas primarily classified as Medium bushfire hazard, resulting in widespread exposure across the locality, including residential zones.

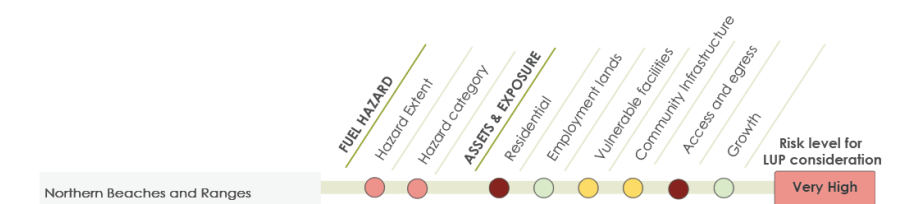
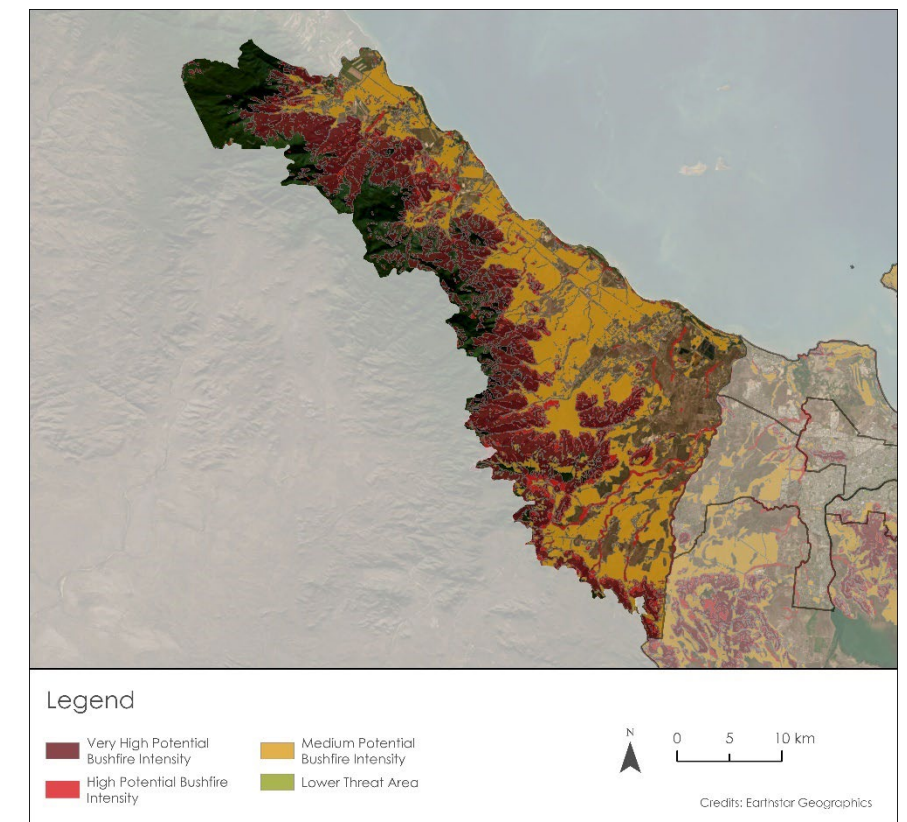
Residential exposure is significant, with almost half of all dwellings located within the bushfire prone area. This is primarily because these small coastal residential communities directly interface with vegetation. The majority of this exposure is associated with the 100 metre potential impact buffer. There are limited perimeter roads, asset protection zones, or dedicated fire trails separating residential areas from surrounding vegetation, leading to direct interface and increased bushfire vulnerability. Residential communities such as Balgal Beach, Toomulla, Bluewater, and Toolakea are notably affected.

Many of these small coastal communities have limited access and egress options, heightening their vulnerability to bushfire risk. Over two thirds of the road network is exposed, with key access routes such as Toomulla Beach Road, Forestry Road, Saunders Beach Road, Toolakea Beach Road, and Balgal Beach Road all traversing bushfire-prone vegetation and serving as the sole points of entry and exit for their respective communities. This level of exposure, including a key segment of the Bruce Highway, presents a risk to connectivity

and emergency response, especially in areas with limited alternative access routes.

All vulnerable facilities identified within the reporting locality are exposed to potential bushfire hazard. This includes two child care centres and four educational establishments. Notably, both Rollingstone State School and Mangalla Silver Lining School are located within areas classified as High Bushfire Hazard.

Essential community infrastructure is also significantly impacted, with over a third of facilities exposed. This includes two zone substations, two treatment plants, and three substations.

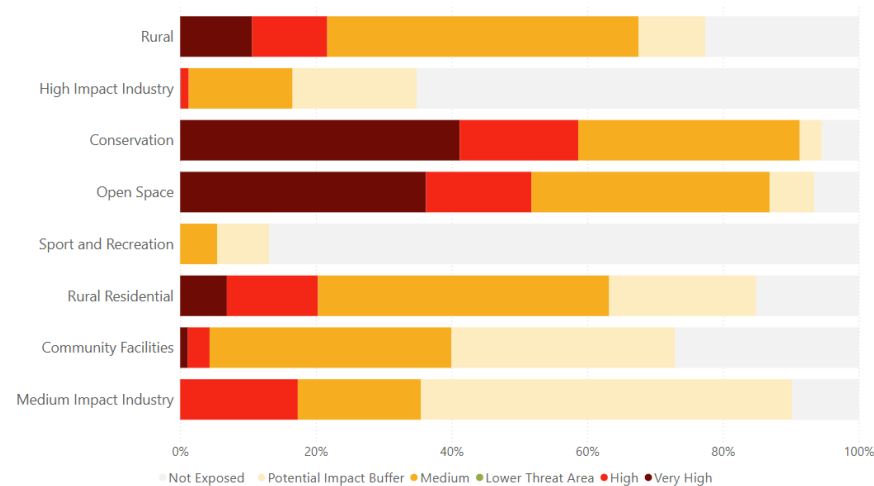
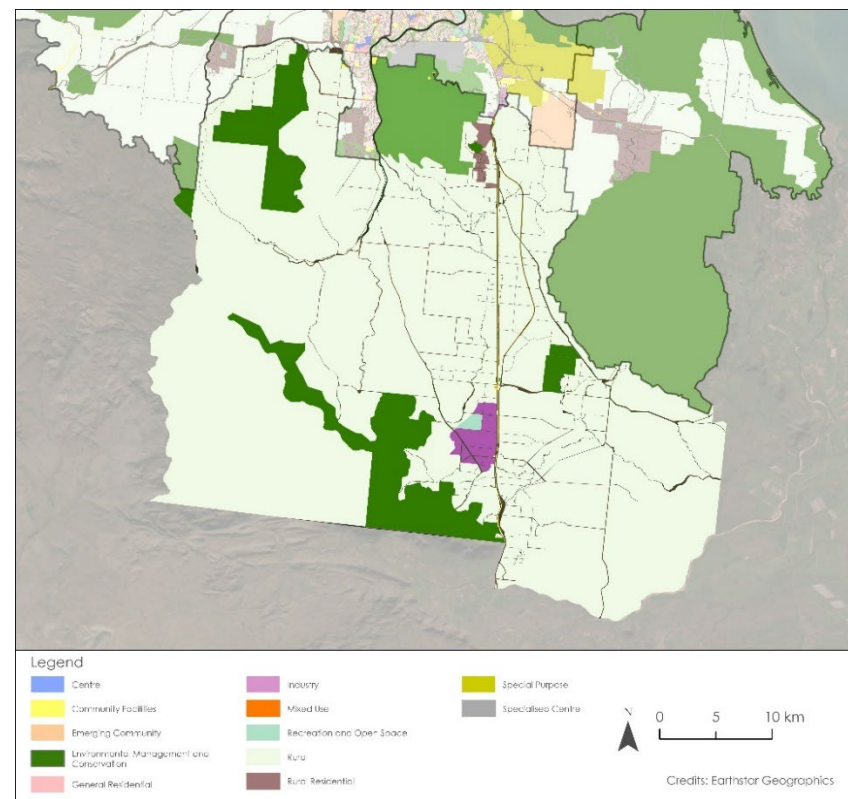


Bushfire Risk Summary

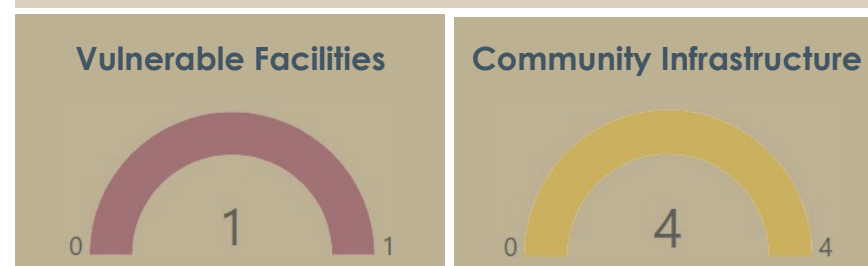
Bushfire risk within the reporting locality is assessed as Very High primarily driven by significant vegetation coverage and the proximity of residential settlements. The risk is further heightened by the exposure of residential dwellings, which is considered high. Access and egress challenges due to the considerable extent of road network exposed to potential bushfire also contribute to the isolation risk in the area.

7.2.3 Ross

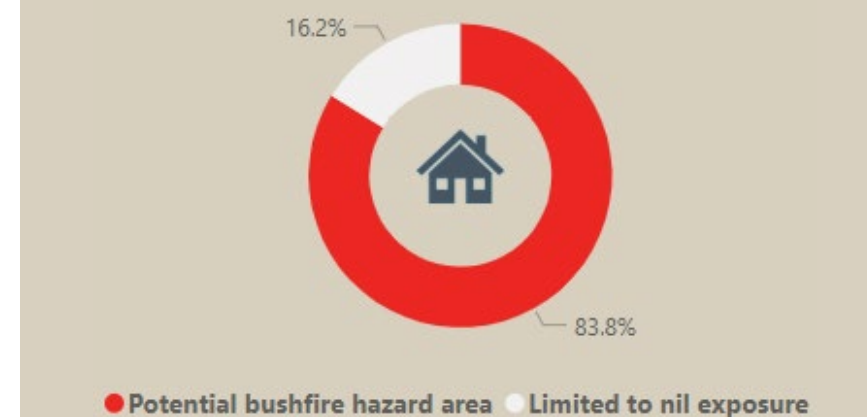
Zone Exposure



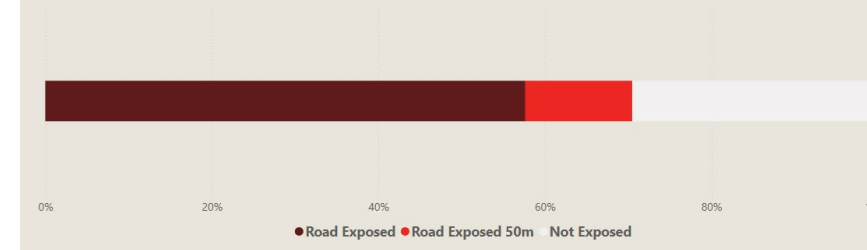
Existing bushfire exposure metrics



Residential Exposure



Road Exposure



Exposure Summary

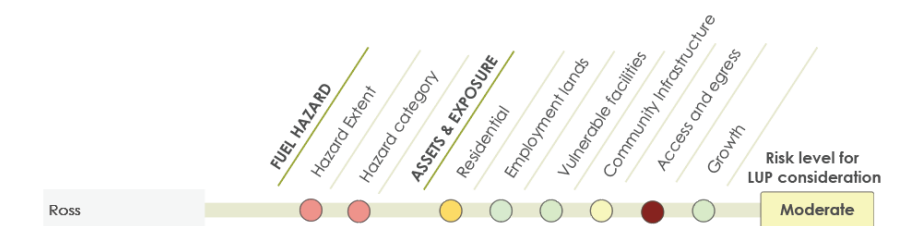
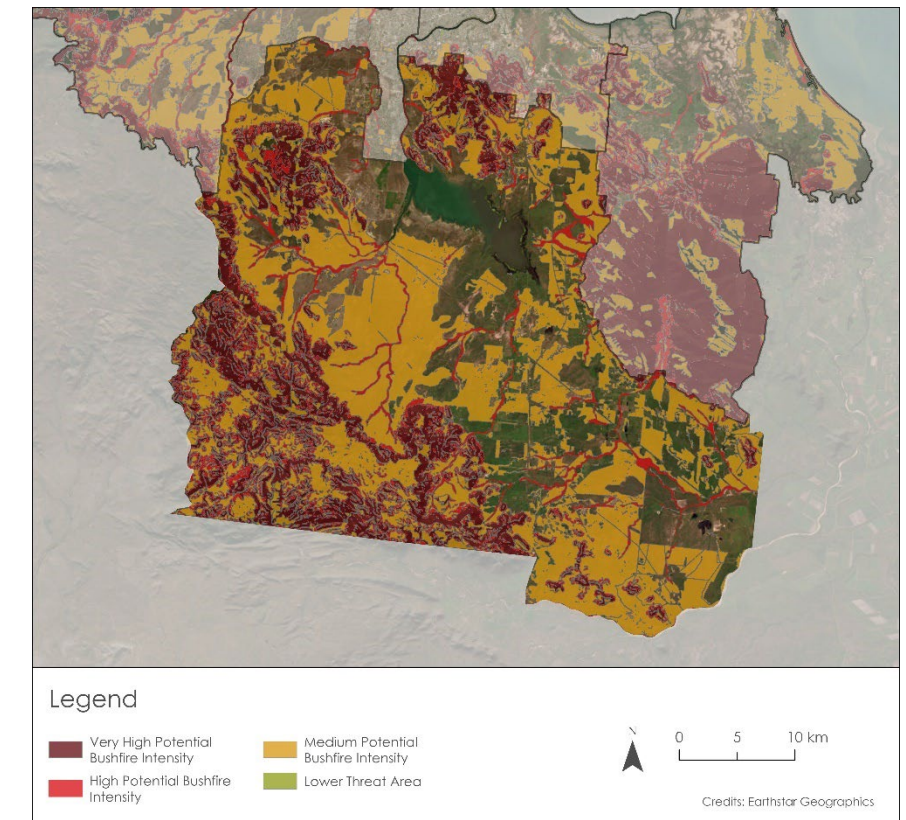
The reporting locality of Ross is characterised by considerable areas of high and medium potential bushfire intensity, primarily in the western part of the locality due to the presence of Mingela State Forest. The majority of the reporting locality is zoned as rural land.

Residential dwellings in the reporting locality are limited to the suburb of Oak Valley, where over 80 per cent of properties are exposed to potential bushfire hazards, including areas within the 100 metre buffer. Most assessed dwellings, primarily in Oak Valley, are located within rural residential zones and fall within moderate to high potential impact buffers. This exposure is largely attributed to the rural residential zoning and proximity to unmanaged vegetation.

The Lansdown Eco-Industrial Precinct, located along the Flinders Highway, shows some exposure to bushfire hazard, with over a third of the precinct located within the 100 metre impact buffer, the majority of which falls within areas of medium potential bushfire intensity. It is expected that the level of exposure across the precinct will reduce as the precinct is developed. Although the assessment included only a small number of dwellings, a high level desktop review suggests that some vegetation clearing and buffer zones have been implemented around properties.

The road network within LGA South shows considerable exposure to bushfire hazard. However, exposure along the major roads appears to be fragmented, with risk areas interspersed with lower risk sections. The presence of numerous cul-de-sacs and no-through roads may impede evacuation.

All four community infrastructure facilities assessed were identified as exposed to bushfire hazard. These include a zone substation, a water treatment plant, and a water pump station. The only vulnerable facility within the reporting locality is identified as exposed to potential bushfire hazard is Woodstock State School.

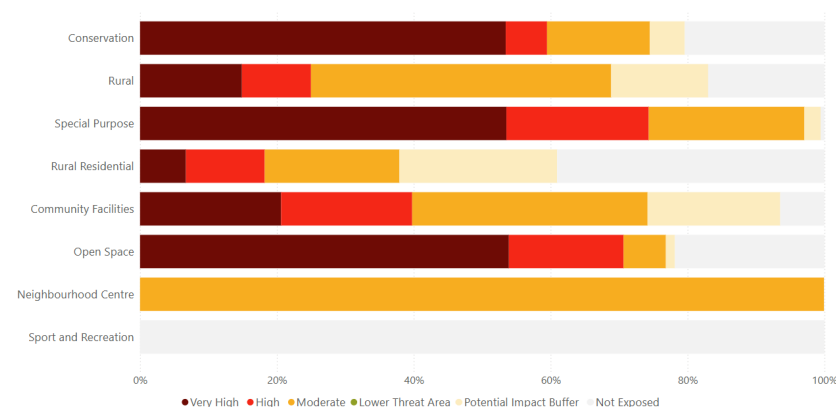
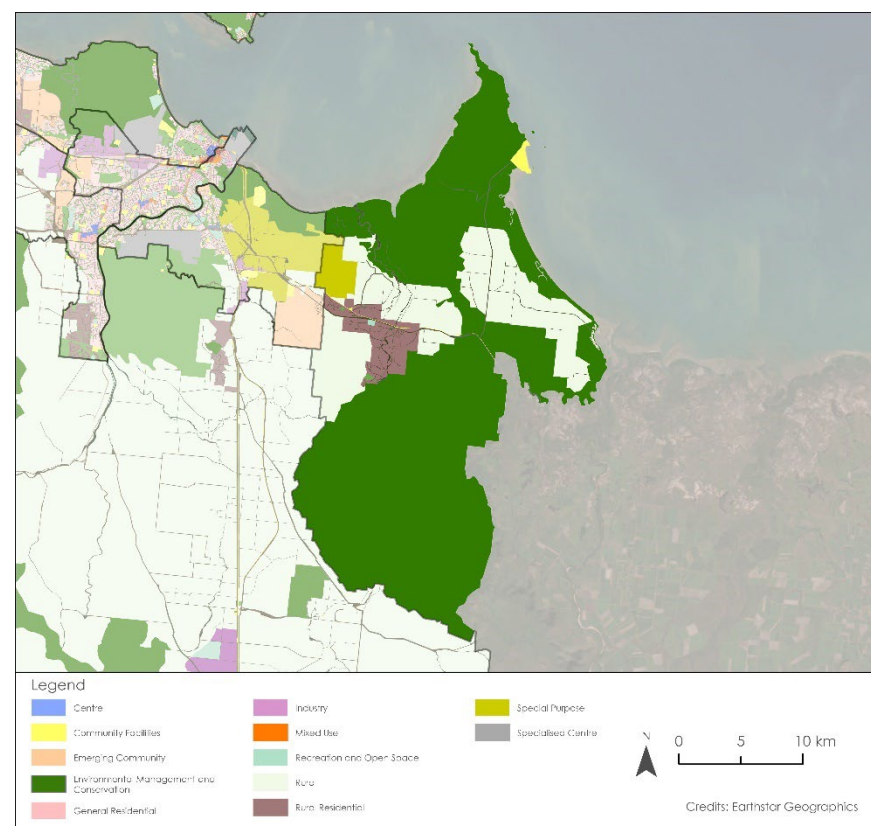


Bushfire Risk Summary

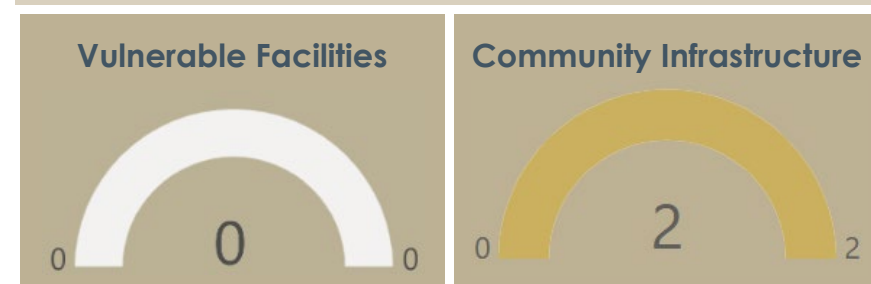
Bushfire risk within the reporting locality is assessed as Moderate, primarily due to the limited number of dwellings, which are highly exposed, and the presence of limited development along with clear access and egress.

7.2.4 Alligator Creek and Cape Cleveland

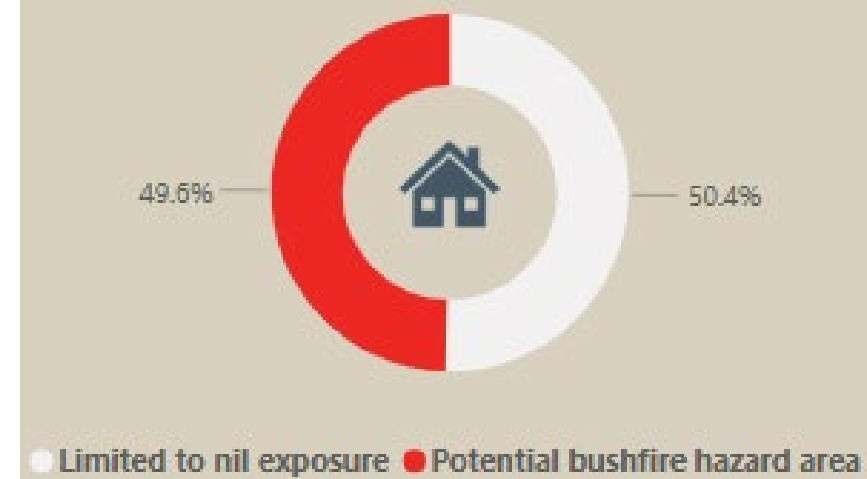
Zone Exposure



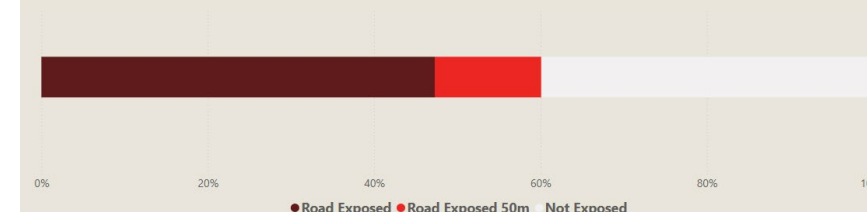
Existing bushfire exposure metrics



Residential Exposure



Road Exposure



Exposure Summary

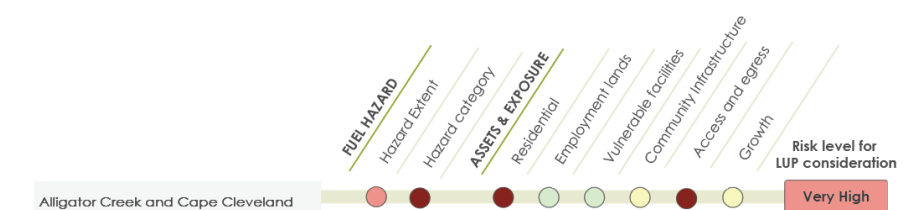
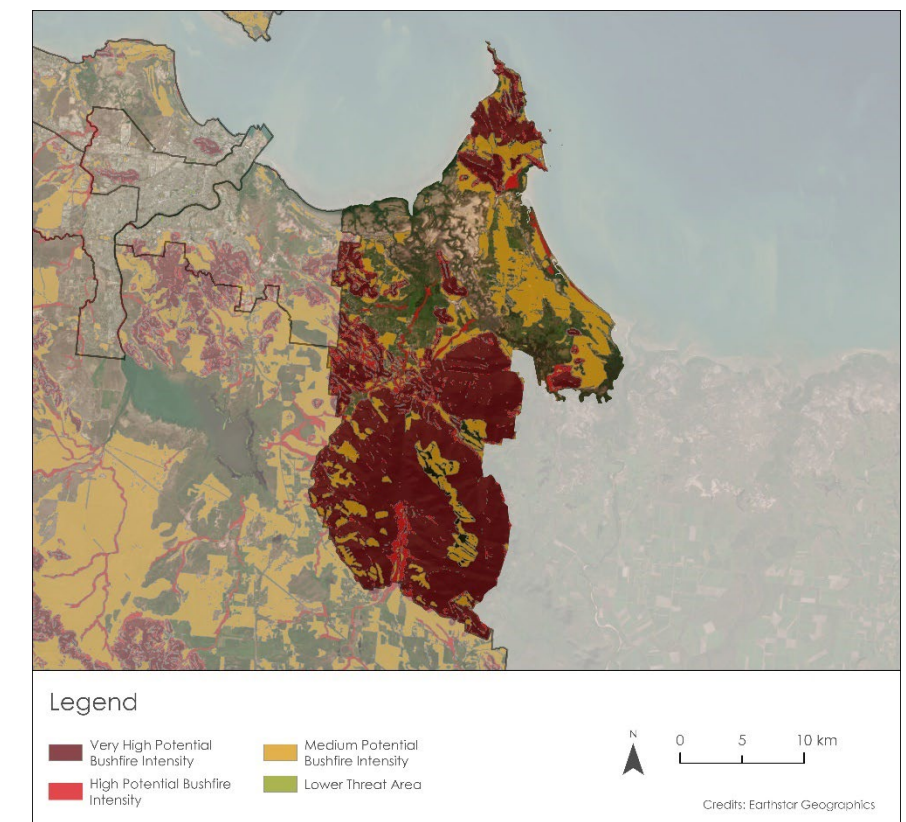
The reporting locality of Alligator Creek and Cape Cleveland has considerable areas of very high potential bushfire intensity, primarily in the southern part of the locality. This is largely driven by Bowling Green Bay National Park and the rural land located to the north west of the reporting locality.

The rural residential suburb of Nome has considerable exposure, with a very high proportion of residential dwellings identified as exposed to potential bushfire hazards. However, most of these dwellings fall within the 100 metre buffer zone and the total number of residential dwellings in the reporting Locality is relatively low. Based on a desktop assessment, significant clearing around the dwellings indicates that some vegetation management has occurred.

The area of Cungulla, while zoned rural, contains dwellings on urban sized allotments that are exposed to potential bushfire hazard. These dwellings primarily fall within the 100 metre potential impact buffer and directly interface with surrounding vegetation. There are no perimeter roads, asset protection zones, or dedicated fire trails in this area, contributing to increased bushfire vulnerability. The presence of numerous cul-de-sacs and no-through roads may further impede evacuation and emergency response efforts. Additionally, Cungulla is solely reliant on Goodsell Road for access, which is itself exposed to bushfire hazard.

Over a third of the road network is exposed to potential bushfire hazard, including two major roads, the Bruce Highway and Flinders Highway. There are no vulnerable facilities exposed to bushfire hazard. Community infrastructure identified as exposed includes one zone substation and one water pump station.

Both community infrastructure facilities in the locality, one zone substation and one water pump station were identified as exposed.

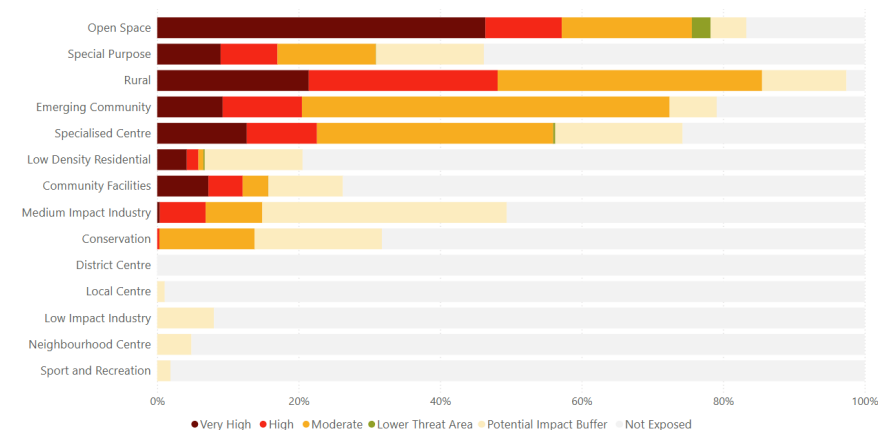
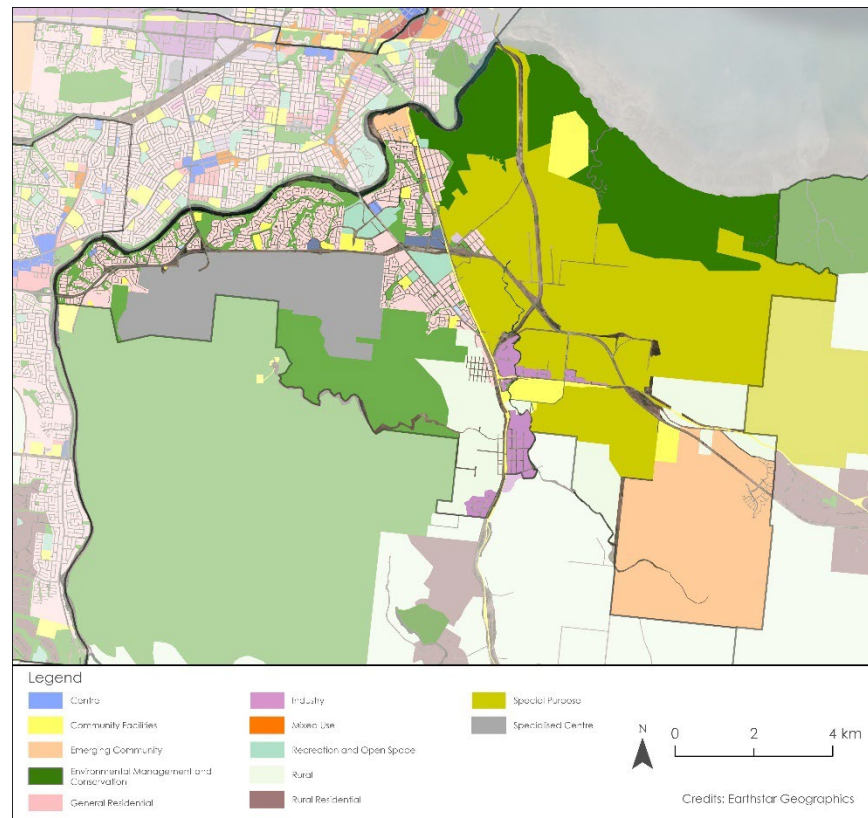


Bushfire risk Summary

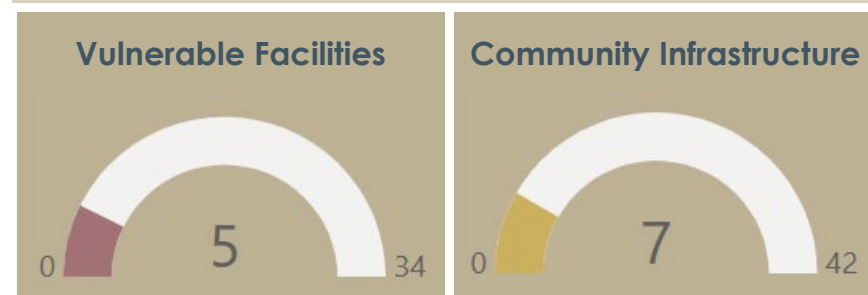
The bushfire risk in Alligator Creek and Cape Cleveland reporting locality is considered very high due to widespread residential exposure, particularly in areas where homes directly interface with surrounding vegetation. Limited bushfire protection measures and constrained evacuation routes further increase vulnerability in some communities. Key transport routes and essential community infrastructure are also exposed to bushfire hazards.

7.2.5 Stuart

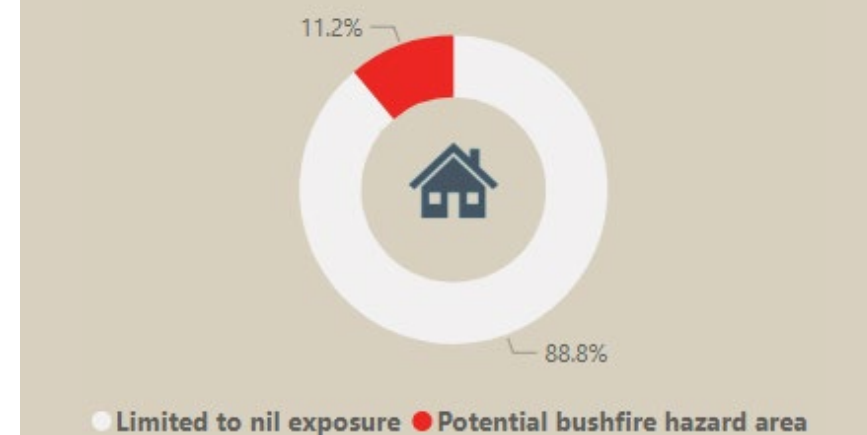
Zone Exposure



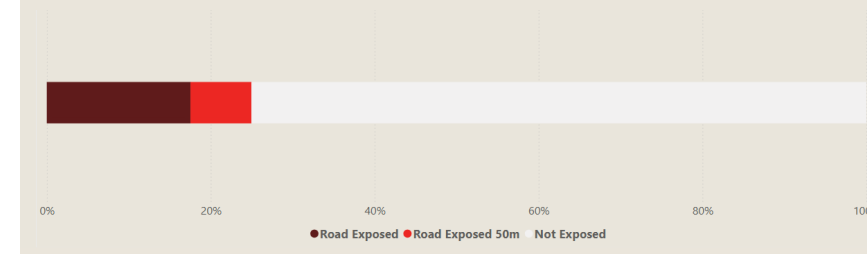
Existing bushfire exposure metrics



Residential Exposure



Road Exposure



Exposure Summary

Exposure in the Stuart reporting locality is primarily driven from the south, where there are considerable patches of high and moderate potential bushfire intensity. Residential exposure is moderate, with dwellings largely clustered in the suburb of Wulguru along the boundary of the Mount Stuart Defence Reserve. These homes directly interface with bushland and are predominantly located within the 100 metre potential impact buffer, heightening their sensitivity to bushfire hazard.

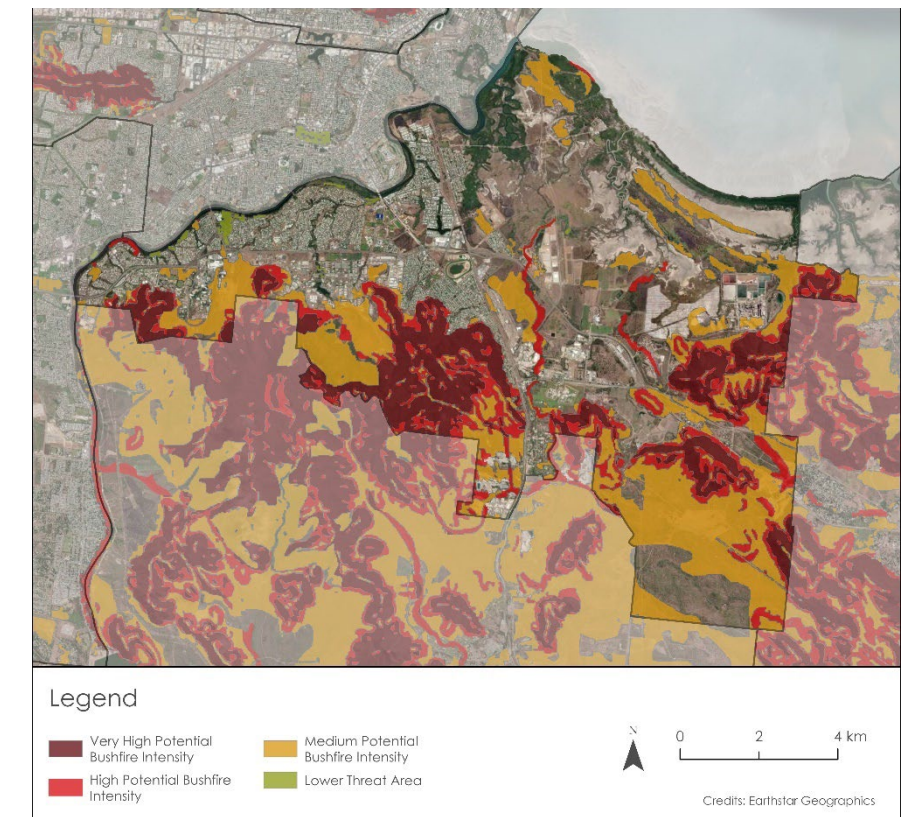
Additional residential exposure is present to the far west of the locality along the Ring Road, where dwellings back onto the James Cook University grounds. This area lacks perimeter roads, asset protection zones, and dedicated fire trails, which increases its bushfire vulnerability. The presence of numerous cul-de-sacs and no-through roads, particularly in the western residential areas, may impede evacuation.

Emerging community areas such as Elliot Springs, located in the southern part of the locality, also contribute to overall exposure. While current development is limited, the full development scenario would likely result in increased exposure. The indicative plan of development shows the northern and southern portions of the estate separated by a ridgeline, with a single access and egress point provided via a mountain overpass, which may present evacuation and access constraints during a bushfire event.

Exposure of vulnerable facilities within the reporting locality is also relatively low. However, it should be noted that both James Cook

University and Townsville University Hospital are identified as exposed to potential bushfire hazard. Community infrastructure exposure is proportionally low, with six exposed water pump stations and one zone substation identified.

Less than one third of the road network within the reporting Locality is exposed to potential bushfire hazard. While overall exposure is limited, maintaining safe and reliable access and evacuation routes remains an important consideration, particularly for critical infrastructure and the residential cluster near Wulguru.

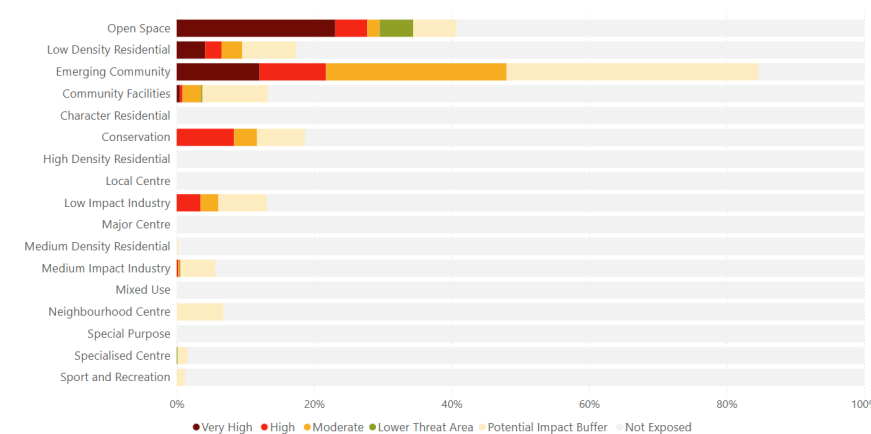
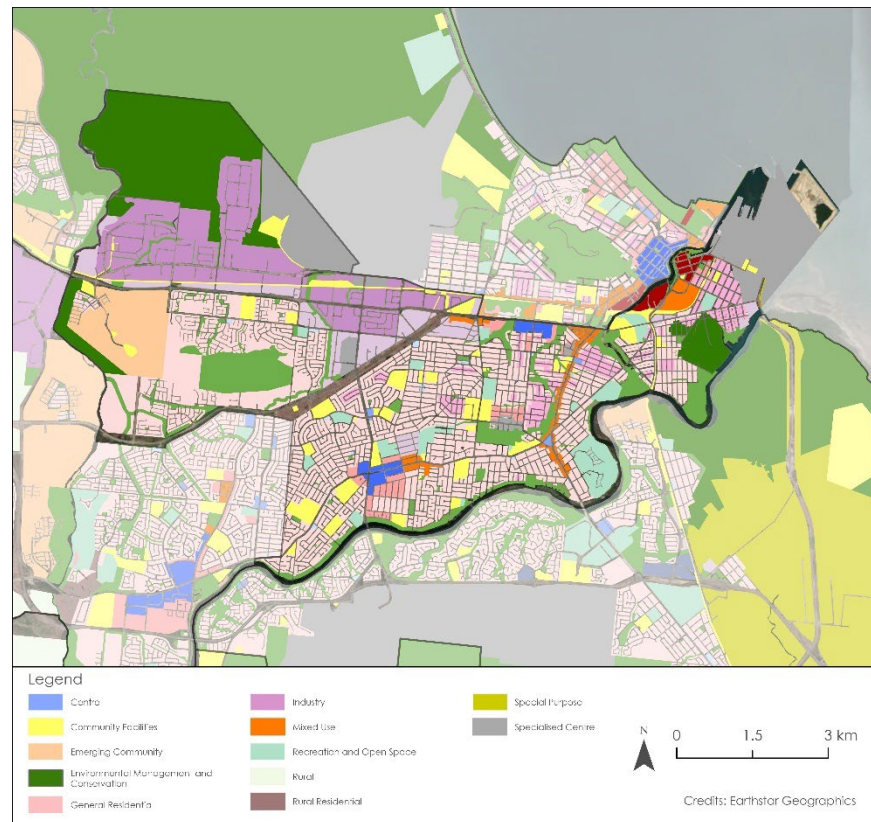


Bushfire Risk Summary

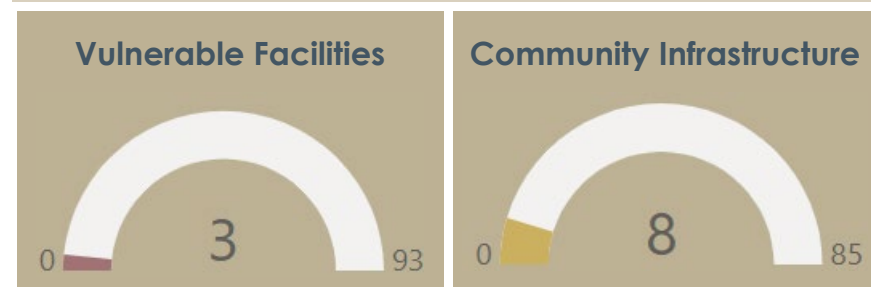
Bushfire risk within the Stuart reporting locality is considered high due to direct residential interfaces with bushland, particularly along the Mount Stuart Defence Reserve. The lack of perimeter roads, asset protection zones, and dedicated fire trails further increases vulnerability, especially in areas with constrained evacuation options. Although broader infrastructure exposure is limited, key facilities such as James Cook University and Townsville University Hospital are potentially at risk.

7.2.6 Central Suburbs and Mount Louisa

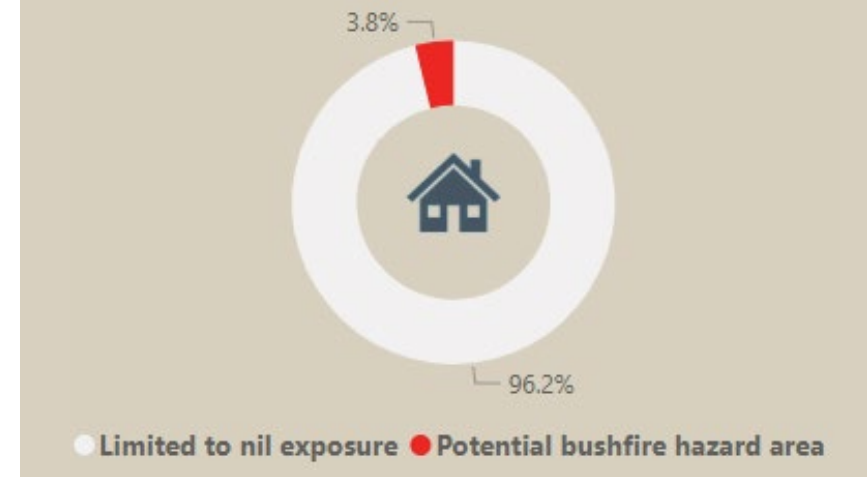
Zone Exposure



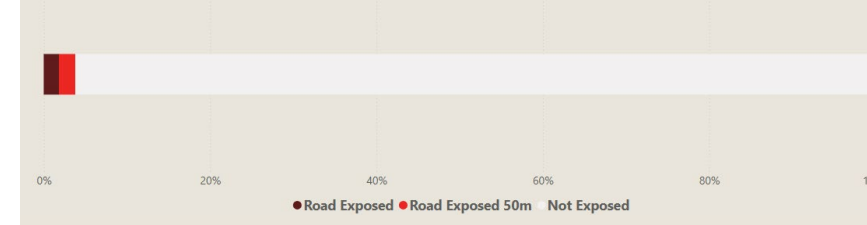
Existing bushfire exposure metrics



Residential Exposure



Road Exposure



Exposure summary

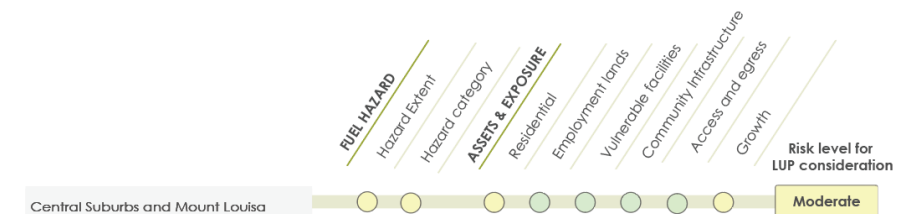
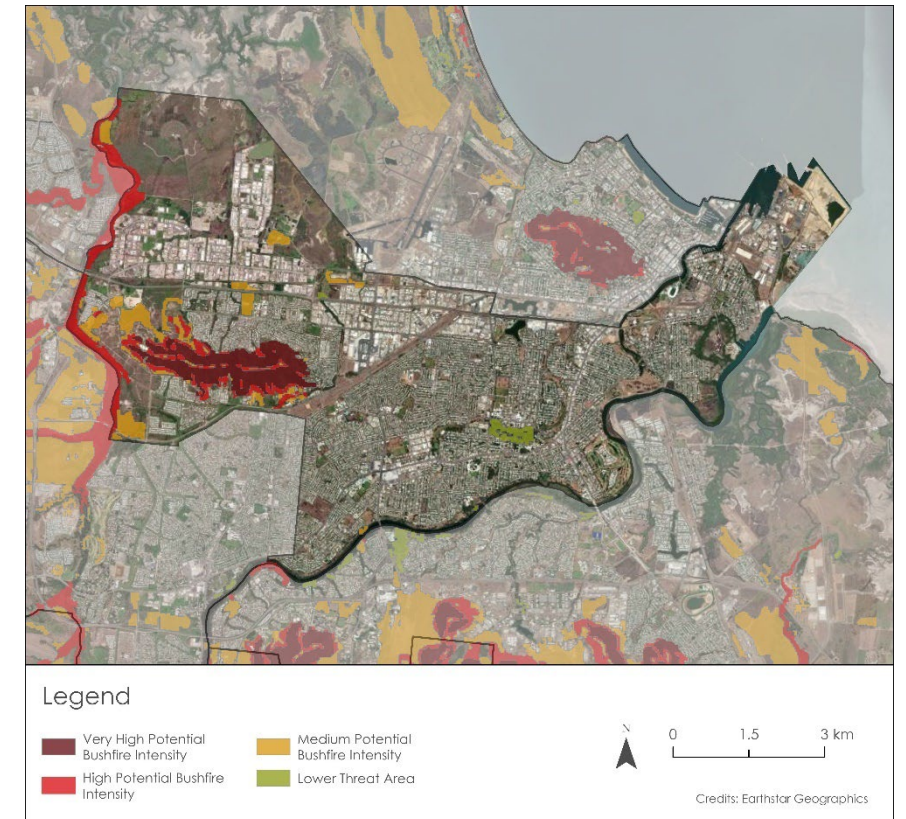
Exposure to potential bushfire hazard in Mt Louisa is constrained to specific area within the reporting locality, due to its largely developed urban environment surrounding Mt Louisa itself.

Exposure is largely identified in the suburbs of Mt Louisa and Cosgrove, where dwellings are primarily located within the 100 metre potential impact buffer and interface directly with the nearby vegetated area. With more than 80 per cent of the emerging community land to the west falling within bushfire hazard areas, future development in this zone could substantially elevate residential exposure.

Due to its urban function, the reporting locality includes a high proportion of vulnerable facilities. However, exposure to these facilities is relatively limited. Two vulnerable facilities are identified as being exposed to potential bushfire hazard within the 100 metre buffer: one childcare centre, one aged care facility, and Calvary Christian College is located within the Medium potential bushfire intensity.

With regard to community infrastructure, exposure is minimal. Two sewer treatment plants and six sewer pump stations are located within the reporting locality and identified as being within the potential bushfire hazard area.

Exposure to the road network is also limited, with less than a third of the network intersecting areas of potential bushfire hazard.

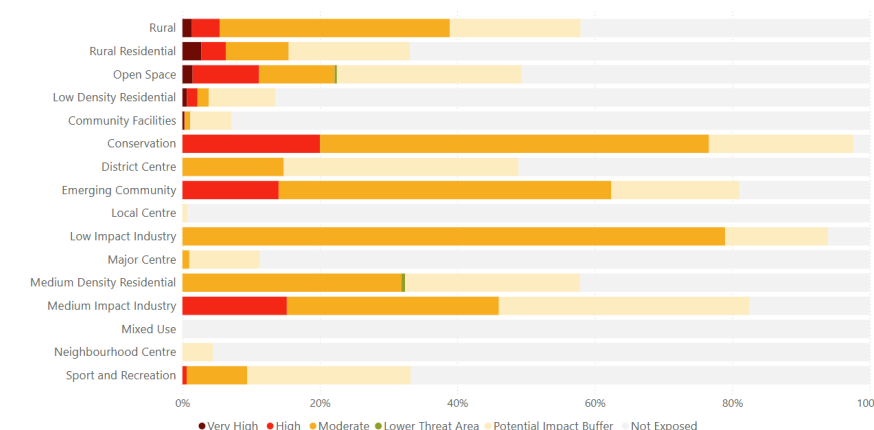
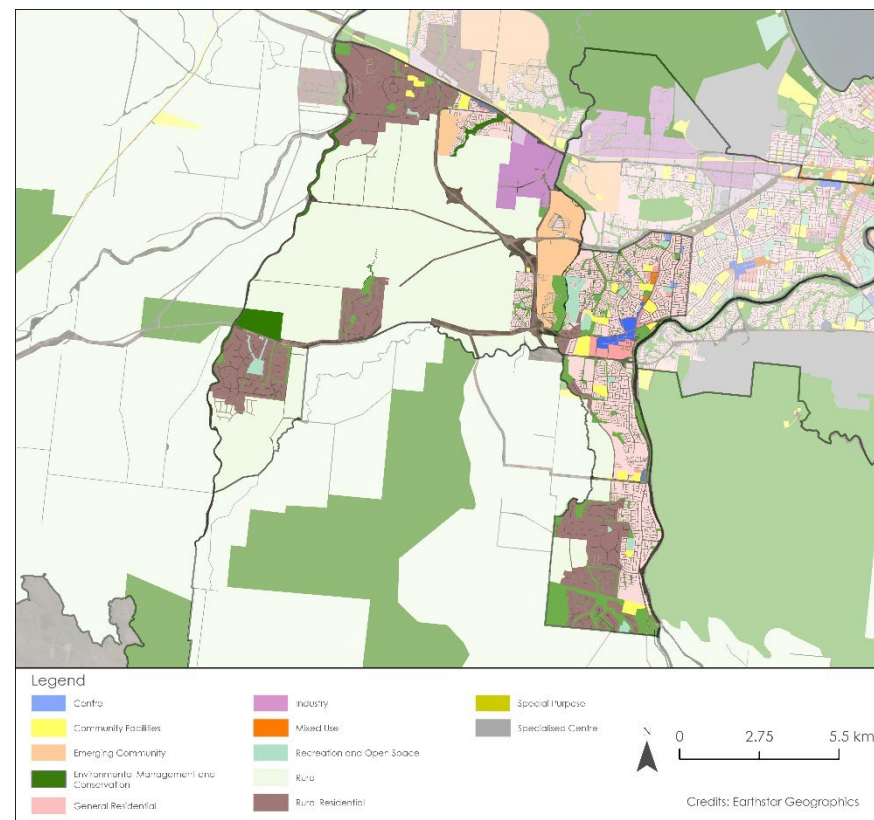


Bushfire risk summary

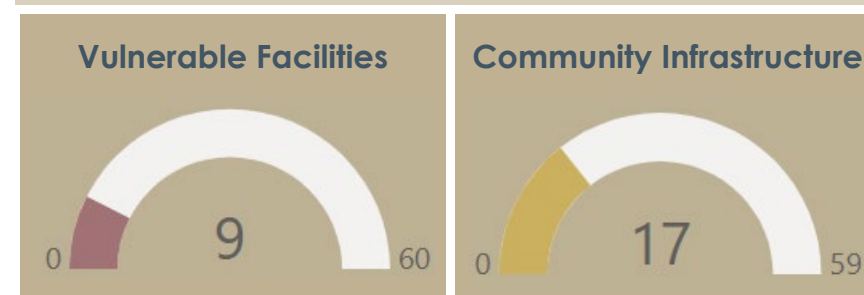
The Central Suburbs and Mt Louisa locality is categorised as moderate risk. While current bushfire exposure is limited due to the established urban environment, residential risk is primarily confined to areas bordering vegetation. However, over 80 per cent of the emerging community land to the west is located within bushfire hazard zones, which could elevate future risk as development occurs. Notably, some of this land may fall outside the current BPA overlay and therefore may not be subject to bushfire construction requirements under existing planning provisions.

7.2.7 Thuringowa & Kelso

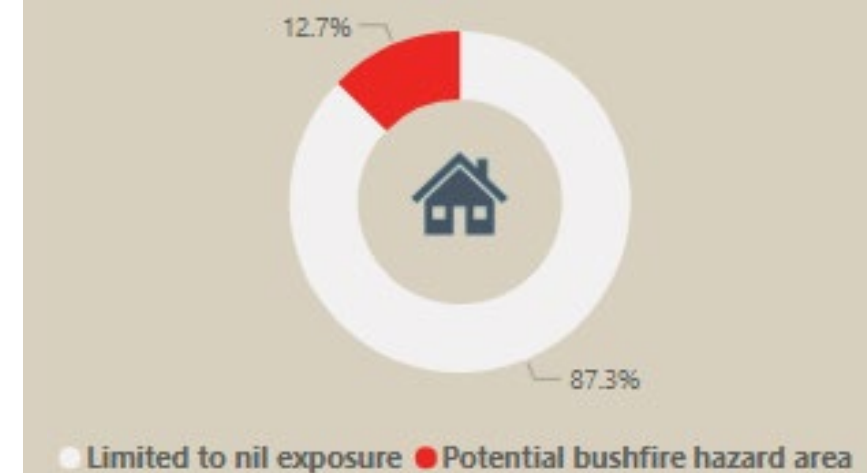
Zone Exposure



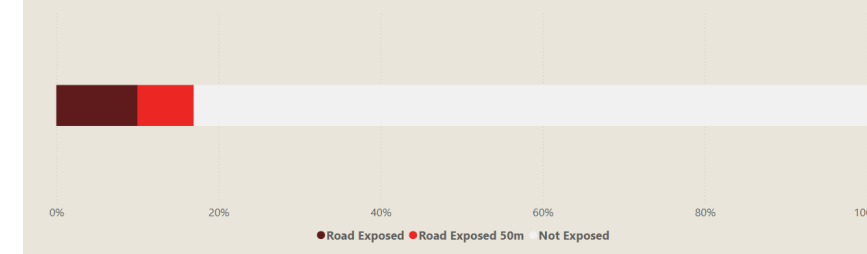
Existing bushfire exposure metrics



Residential Exposure



Road Exposure



Exposure Summary

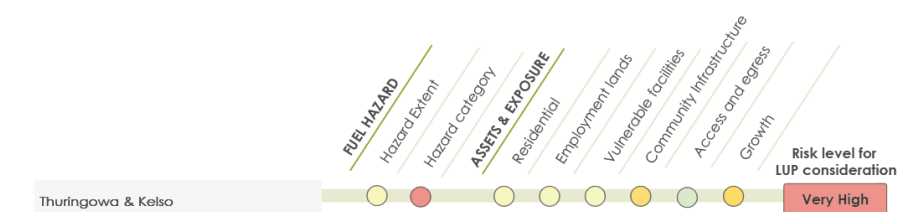
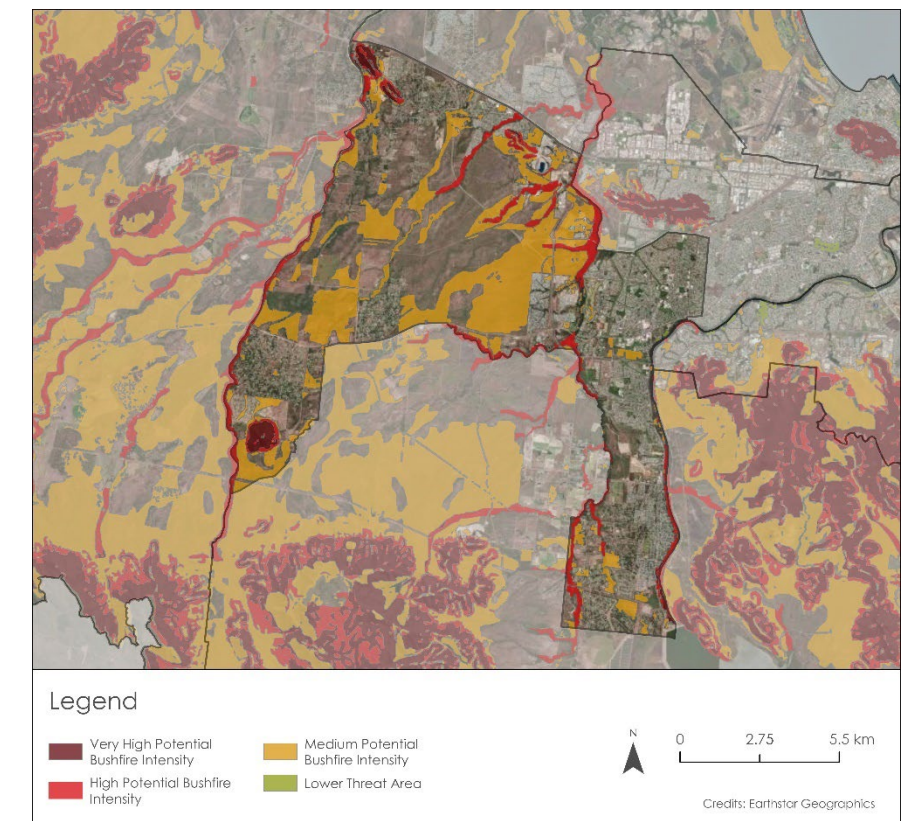
Exposure across the Thuringowa and Kelso reporting locality is significant due to the nature of the bushfire hazard, which primarily follows corridors of dense vegetation through the centre of the locality, combined with the locality's growth potential. The area is characterised by moderate potential bushfire intensity.

Residential exposure is most notable in the suburbs of Deeragun, Shaw, and Bohle Plains, as well as residential communities along the Townsville Ring Road. Many dwellings fall within the 100 metre potential impact buffer, with exposure largely linked to rural residential communities scattered throughout the locality.

Over 80 per cent of the Emerging community zone is identified as exposed to potential bushfire hazard, which is particularly notable as much of this area may accommodate future residential development.

The road network is also affected, including sections of the Bruce Highway, a key evacuation route, which are subject to bushfire exposure. Moderate levels of exposure are recorded across the broader road network.

Additionally, nine vulnerable facilities are identified to be moderately exposed to potential hazard. These include two schools and seven childcare centres. Community infrastructure exposure is high and is primarily associated with sewer pump stations, with one water pump station also affected.

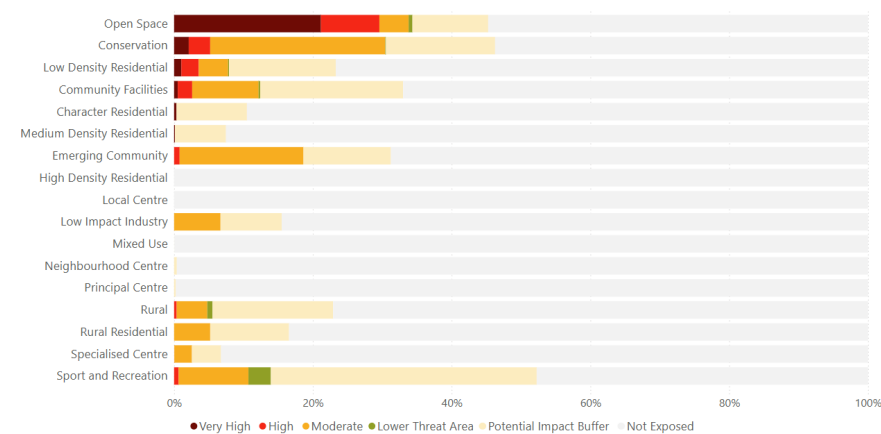
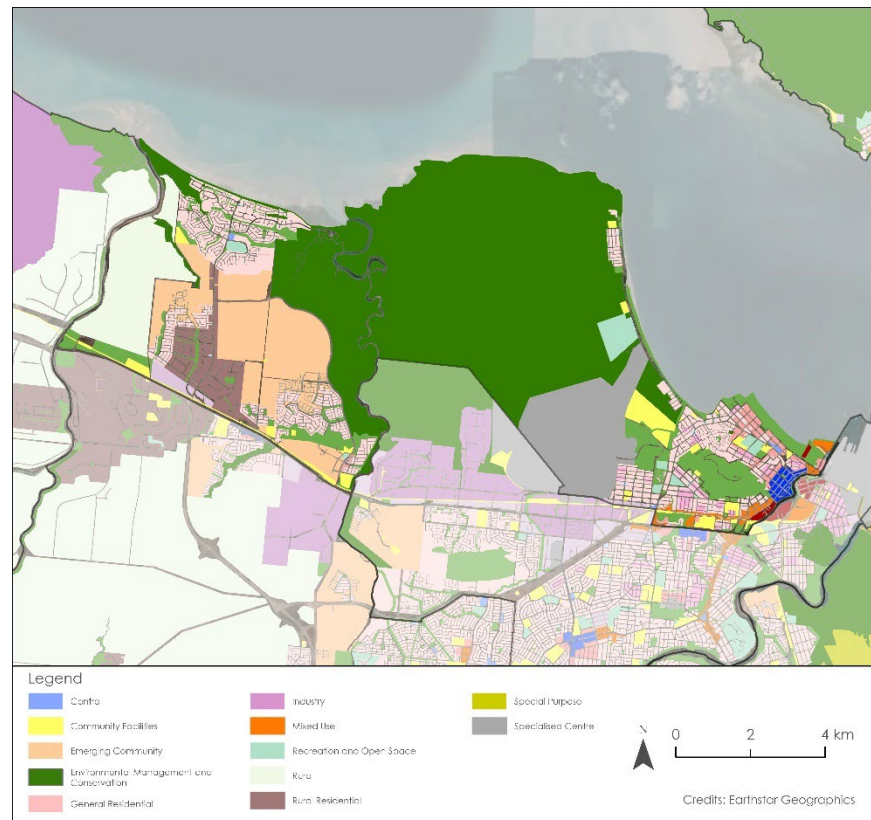


Bushfire Risk Summary

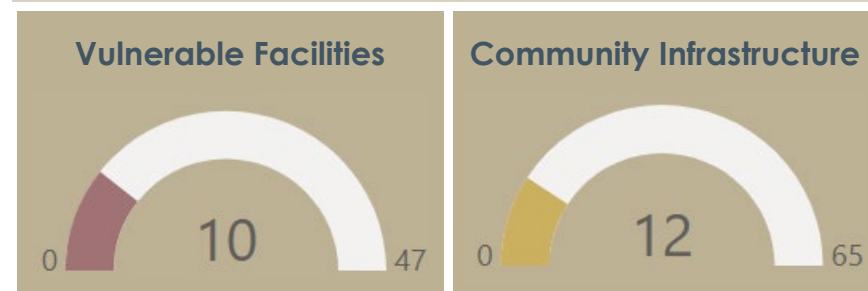
The Thuringowa and Kelso locality is subject to very high bushfire risk. A number of residential areas are subject to bushfire exposure as a result of directly interfacing with vegetated areas. A significant portion of land zoned for emerging community use is also identified to be exposed which may increase future exposure to dwelling as development progresses.

7.2.8 City & Town Common

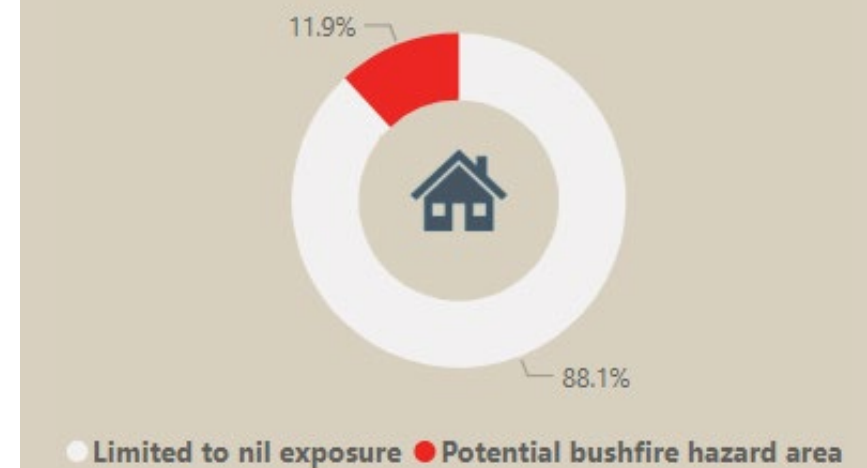
Zone Exposure



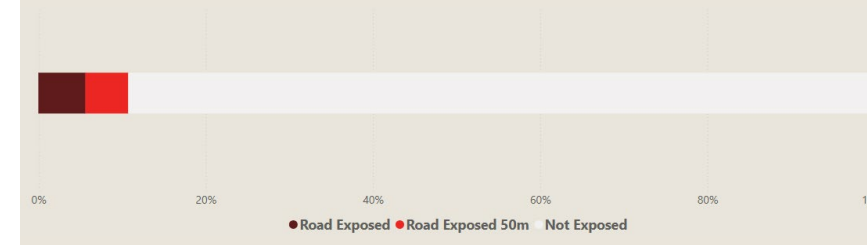
Existing bushfire exposure metrics



Residential Exposure



Road Exposure



Exposure Summary

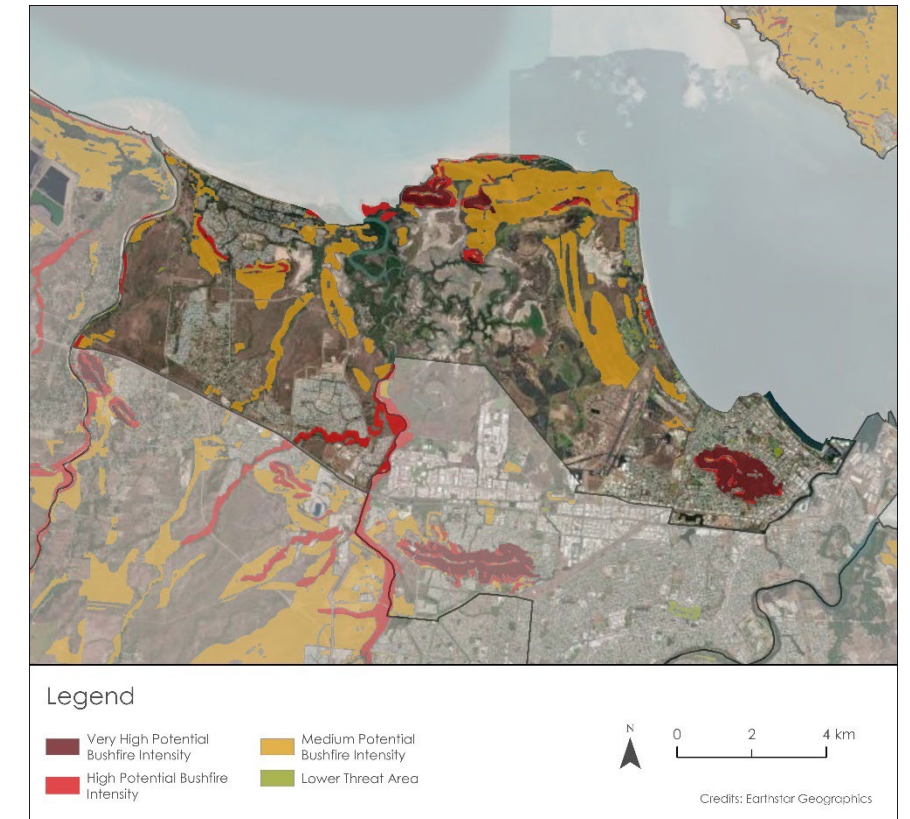
Exposure across the LGA North reporting locality includes medium potential bushfire intensity to the north and a patch of very high potential bushfire intensity to the east of the locality in castle hill.

Dwelling exposure is mainly associated with the Pallarenda residential area, with a notable cluster of dwellings along The Esplanade triggered as very high potential bushfire intensity. This is due to their direct interface with the Townsville Common Conservation Park. This area lacks perimeter roads, asset protection zones, and dedicated fire trails, which increases its bushfire vulnerability. Access and egress issues exist as the one road connecting the community, Cape Pallarenda Road, is subject to potential bushfire hazard. There is also dwelling exposure in Belgian Gardens, where dwellings interface with vegetation linked to a patch of dense vegetation to the east of the locality.

Areas of exposure to the road network are largely limited, with exposure primarily associated with isolated patches to the north of the precinct, including Cape Pallarenda Road.

Community infrastructure has a moderate level of exposure, comprising two water pump stations, two sewer treatment plants and eight sewer pump stations.

A moderate proportion of vulnerable facilities are exposed, including five educational establishments, one correctional facility, and four childcare centres.



Bushfire Risk Summary

The City and Town common is categorised as moderate bushfire risk. Residential dwellings in Pallarenda and Belgian Gardens interface directly with bushfire-prone vegetation, including areas of very high potential bushfire intensity. The single access road to Pallarenda is also subject to hazard, which may impact evacuation. Exposure of community infrastructure and vulnerable facilities contributes further to the overall risk.

8 Risk assessment recommendations

This section summarises the recommendations of this strategic land use planning-based risk assessment. The following table outlines the extent of recommendations identified by this risk assessment for further consideration as part of the preparation of the amended planning scheme.

Table 8-1: Summary of risk assessment recommendations to inform policy, strategic and statutory planning approaches

ID	Recommendation
01	Ensure the designated bushfire prone area (as designated under the <i>Building Act 1975</i> and the <i>Building Regulation 2021</i> in Section 1.6 of the Planning Scheme) applies to all areas subject to latest available BPA mapping. This will ensure that all dwellings within a bushfire prone area would require assessment against AS3959 and comply with modern building standards for the construction of buildings in bushfire prone areas.
03	Ensure zoning and other settlement policy decisions are informed by considerations for evacuation, having regard to: • The existing and potential exposure of the road network to bushfire attack • The ability to provide / retain multiple egress route options • The capacity of the road network to support emergency evacuation • Road network design and construction • Identifying and mitigating potential route bottlenecks during emergency evacuation.
04	Review minimum lot size requirements within existing high and very high risk Rural residential communities to limit the ability for further reconfiguration of lots to add to levels of exposure.
05	Consider the implementation of statutory controls to regulate reconfiguring thresholds relative to the number of evacuation routes to ensure a grassroots approach to evacuation planning can be contemplated at development assessment stage.
06	Consider the integration of statutory controls which focus on mitigating the risk of urban fire intrusion for new settlement at the urban bushland / grassland interface. This include perimeter road provisions within the overlay code to provide separation from the hazard, noting this is a particular mitigation measure of the SPP guidance material.
07	Consider a policy of avoidance of vulnerable facilities within the bushfire prone area across the city. Where such uses are necessary, contemplate the strength of statutory controls which acknowledges these uses rarely require a bushfire building response under AS3959.
08	Explore the opportunity to align the definition of vulnerable uses (defined by the SPP and BRC guidance materials) with that which applies to flood, to aid in consistency.
09	Explore opportunities for statutory planning provisions to appropriately address the bushfire resilience of land uses and activities not subject to AS3959 including commercial uses, industrial activities, hazardous activities, and critical infrastructure where these cannot be avoided in a bushfire prone area.

ID	Recommendation
10	Ensure any future planning scheme appropriately balances the competing planning policy issues of biodiversity and environmental protection with bushfire protection and mitigation.
11	Ensure any future master planning or structure planning process for Emerging community zoned land or other growth areas are undertaken in line with bushfire resilient urban design principles which guide outcomes, on balance with ecological values.
12	Ensure strong and calibrated consideration of bushfire hazard and risk across all parts of the draft planning scheme.

9 Policy development considerations summary

To advance the identification of policy pathways and directions, established by the specific risk profiles established by this risk assessment report, a number of considerations are required. These include:

- The recommendations of this bushfire risk assessment (Part B)
- The legislative and regulatory environment and relevant requirements for plan-making
- The State interests identified by the SPP and its guidance materials, including the Bushfire Resilient Communities technical reference guide and example code. This includes:
 - The 10 policy positions established by the technical reference guide, which support an assessment of risk tolerability
 - Section 13.1.4 approach to plan-drafting under the 'Integrating state interests in a planning scheme' non-statutory guidance material
 - Relevant content contained in the 'Drafting a planning scheme – Guidance for local governments' document.

The above considerations are set out in further detail in Part C of the Bushfire Risk Assessment project reporting.



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