REPORT

Part A – Context Analysis Fraser Coast Bushfire Risk Assessment

PREPARED FOR
FRASER COAST REGIONAL COUNCIL

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Meridian Urban

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Member International Association of Wildland Fire
Member Natural Hazard Mitigation Association (USA)
Member Association of Fire Ecology

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Acknowledgement of Country

We acknowledge the Traditional Owners and custodians of the Fraser Coast region which extends through the traditional lands and waters of the Butchulla (Badtjala) and Kabi Kabi (Gubbi Gubbi) people.

We pay respect to Elders past, present and future.

We recognise and honour their ancient cultures, and their connection to land, sea and community. We recognise First Nations continued dedication to the management of healthy Country.

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The client acknowledges and agrees that Meridian Urban has not created or contributed to the creation or existence of this hazard and the Client indemnifies Meridian Urban for claims arising out of or resulting from a bushfire event except to the extent attributable to the negligence of Meridian Urban.

The Client agrees that the Consultant shall have no liability in respect of any damage or loss incurred as a result of bushfire.

Fraser Coast Regional council

Part A – Context Analysis Fraser Coast Bushfire Risk Assessment

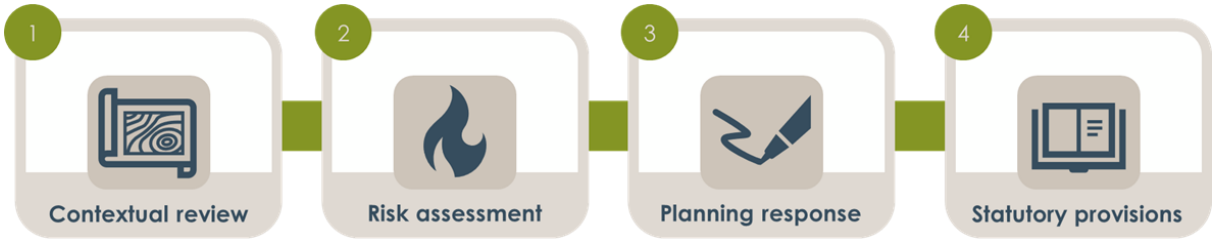
CONTENTS

Project Introduction

This bushfire risk assessment has been commissioned by Fraser Coast Regional Council (herein referred to as 'Council'), to support the review of the Fraser Coast Planning Scheme. The intent of this risk assessment is to examine and understand the potential nature of bushfire risk to people, property, infrastructure, facilities and the environment across the Fraser Coast region both at present and into the future.

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

The Fraser Coast Bushfire Risk Assessment project comprises four component reports:



This approach seeks to inform the policy position, strategic planning and statutory (planning instrument) response as part of a revised Fraser Coast Planning Scheme, adopting a risk-informed evidence base upon which to consider potential strategic and statutory land use planning provisions.

It achieves this by adopting risk-based principles to determine the appropriateness of zoning and other planning controls and provisions from a risk-informed perspective.

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 National Emergency Risk Assessment Guideline (NERAG) and in accordance with AS/NZS ISO 31000 – Risk Management, having regard to the Queensland Emergency Risk Management Framework (QERMF) and in 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.

1 Contextual Review

Pursuant to NERAG and AS/NZS ISO 31000, 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).

This contextual review focusses on the demographic, physical and meteorological characteristics of the Fraser Coast region, the current policy environment, recent bushfire inquiries and cutting-edge research.

Part A of the Bushfire Risk Assessment therefore considers the following:

Section 2
The location and locality context of the Fraser Coast Region

Section 3
Understanding bushfire as a hazard

Section 4
The bushfire policy and regulatory context, relevant to land use planning

Section 5
The Fraser Coast Region bushfire hazard context

Section 6
A summary of the landscape fire hazard

2 Fraser Coast region overview

2.1 Regional context

The Fraser Coast region is located within the broader Wide Bay Burnett region, approximately 250 kilometres north of Brisbane and 120 kilometres south of Bundaberg. The region encompasses the regionally significant townships of Hervey Bay and Maryborough as well as the World Heritage listed K'gari (Fraser Island), the world's largest sand island.

The region spans an area of 7,105 square kilometres and is bound by the Bundaberg local government area (LGA) to the north, Gympie LGA to the south, and North Burnett LGA to the west.

The region is urbanised in the east incorporating the regional centres of Hervey Bay and Maryborough. There are several industrial precincts within the region, these are predominately concentrated around Maryborough such as the proposed Moonaboola Industrial Estate. The area to the north and south of Maryborough is heavily vegetated comprising the Tuan and Wongi State forests. To the west, the region encompasses rural, agricultural and specialised uses as well as some small townships including, Tiaro, Bauple and Gundiah.

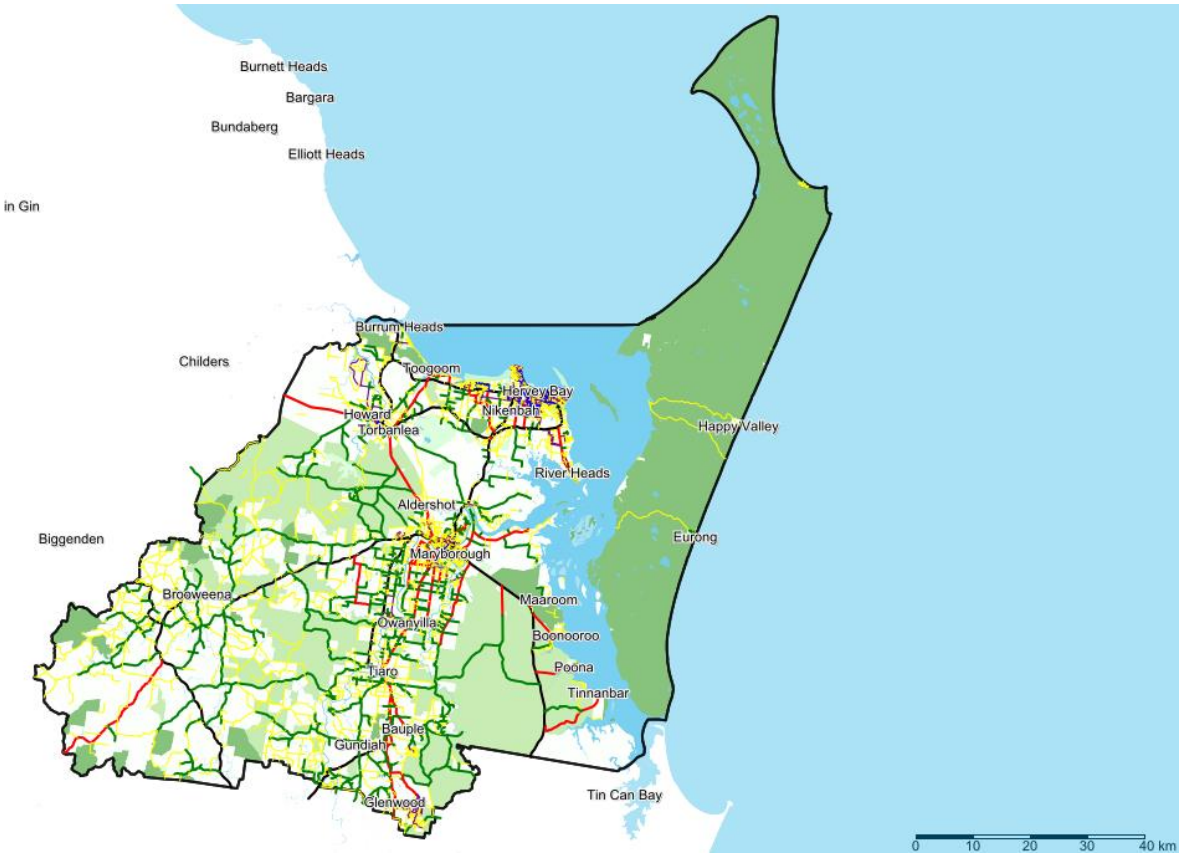


Figure 2-1 - Map of the Fraser Coast region (Source: Fraser Coast Regional Council, 2021)

The small townships that are located across the west of the region are comprised of primarily rural residential land uses. Surrounding land uses vary between rural, community facilities and open space. Low to medium impact industries are dispersed across the region and are particularly concentrated in the main and rural townships. High impact industries are present within the region and are particularly concentrated in Maryborough comprising of large warehouse and logistic activities. Additionally, there is a munitions factory situated in Maryborough, as well as waste and recycling facilities located in Nikenbah, Maryborough, Granville, and Tinana.

Other significant centres in the region include Tiaro which acts as a regional service centre and to a lesser extent, Glenwood, which is an outer township providing local conveniences. Traversing the region is also the Bruce Highway, which acts an important logistical route for the transportation of goods and services to not only the region, but Queensland as a whole.

The Great Sandy Strait communities are a collection of small, isolated towns in the region's south east in an area along the mainland coast. These communities include Boonooroo, Maaroom, Poona, Tinnanbar and Tuan and are situated along the coast that comprise a more remotely inhabited part of the Fraser Coast Region. These communities are also characterised by their isolation and limited access, commonly with a single vehicular access and egress. The Great Sandy Strait encompasses several small islands that represent cultural significance to First Nations people and attract camping enthusiasts.

Land uses within rural and agricultural areas incorporate primary production activities including horticulture, cattle grazing, orchards, poultry farms, hobby farms as well as rural and rural residential communities. Some quarries and other extractive industries are also located within the region.

There are a total of 43,927 occupied private residential dwellings (as at 30 June 2021) within the region with an average household size of 2.3 people. This is lower than the state average of 2.5 people per household.

There are a number of regionally significant facilities across the Fraser Coast including:

- Hervey Bay Airport
- Maryborough Speedway
- University of the Sunshine Coast Fraser Coast Campus
- Wide Bay Institute of TAFE (Hervey Bay and Maryborough Campuses)
- Maryborough Correctional Centre.

2.2 Demographic and socio-economic context

In terms of loss of life and injuries, in Australia bushfire registers as the second highest disaster cause after heatwave and greater than flood and storm (Deloitte Access Economics, 2017). The national cost of bushfire losses are anticipated to double in the period to 2060 (Deloitte Access Economics, 2021). It is therefore important to understand the demographic and socio-economic context of the region when considering bushfire hazard, from a vulnerability perspective.

The estimated resident population of the Fraser Coast region is 112,078 (as at 30 June 2021) with an average annual growth rate of 1.7 per cent between 2016 – 2021 (where the population grew from 102,962) (QGSO, 2022). Notably, the Fraser Coast region has been subject to a marginally higher rate of population growth than other areas of the State (the average annual growth rate across Queensland for the same period was 1.5 per cent).

As indicated in the demographic and socio-economic snapshot provided in Table 1 below, the demographic profile of the Fraser Coast region indicates a statistically significant older population compared with that of Queensland. A substantially higher proportion of seniors (aged 65 and over) and a lower proportion of youth (aged 14 and under) results in an older median age by approximately 12 years compared to the state.

Table 1 – Demographic and socio-economic snapshot of the Fraser Coast region (QGSO, 2021)

Demographic characteristic	Fraser Coast region	Queensland
Median age	49.8	37.8

Demographic characteristic	Fraser Coast region	Queensland
14 years and under	16.4%	19.3%
65 years and older	28.6%	16.1%
Indigenous population	5.1%	4.6%
Persons with a profound or severe disability requiring assistance	10.8%	6.0%
Private residential dwellings	43,927	1,869,462
Average household size	2.3	2.5
Proportion of pre-1980 residential buildings	41.91%	N/A
Dwellings without a vehicle	5.8%	5.7%
Residents who speak English not well or not at all	0.3%	1.8%

Having regard to the above demographic and socio-economic analysis, generally the population of the Fraser Coast region does exhibit some statistically-significant differences from the Queensland state-wide averages. This is particularly noted within a larger portion of the population living with disabilities requiring assistance. A marginally lower proportion of the population cannot speak English well or not all compared to that of the State and there is a slightly higher proportion of Indigenous population. It is also noted that approximately 40 per cent of the region's building stock was constructed prior to the introduction of Australian Standard AS 3959 building standards.

3 Understanding bushfire hazard

Bushfire is a hazard which is commonplace across Queensland and Australia. While land and fire management efforts seek to reduce fuels across managed estates such as national parks, reserves, conservation areas and other public bushland areas, fire is endemic to the Australian landscape and will continue to occur.

Ignition factors can vary and include natural ignitions from lightning strikes, as well as human-caused ignitions. These ignitions can be accidental, occurring from the use of power tools, campfires which have not been appropriately extinguished, heavy equipment and farming machinery, and in some cases, they can be caused by electricity infrastructure. They can also be deliberately lit.

There are several factors, beyond ignition, which contribute to bushfire hazard. These include:

A hazard is different to risk. A hazard is the presence of factors which may give rise to an event. A risk is the consideration of likelihood and consequence of an event, as well as factors of exposure, vulnerability and tolerability.

Part B of the Bushfire Risk Assessment will contemplate these aspects across the Fraser Coast region in detail.

There are also different types of fire:

- ground (including grass fires)
- surface
- crown (or canopy).

Crown or canopy fires generally produce the highest output of energy and thus, are the most severe form of bushfire. Crown fires typically occur when bushfire hazard conditions deteriorate, and fire danger is increased. Crown fires also rely strongly on vertical fuel continuity, and as such, the surface layer of fuels (the understorey) is key. This is where most land and fire management efforts are focussed.

3.1 Elements of bushfire hazard

This extent of annual fire seasons can vary year-on-year due to macro-climatic conditions.

Other fire weather conditions must also be contemplated such as preceding weather conditions (such as low rainfall or drought), air temperature and relative humidity. If the area has been subject to drought or low rainfall for a period of time, vegetation health tends to deteriorate with increased leaf drop, curing and drying. This contributes to increased ground fuel loads and general ignition susceptibility. Prolonged dry periods also reduce soil moisture content.

The Forest Fire Danger Index (FFDI) is a commonly used method to readily advise the community of the likely ability of fire suppression based on fire weather and fuel type (specifically forest), which is used to inform the Fire Danger Rating (FDR) System which guides the communication of bushfire warnings across Australia, refer to the following figure.

It is noted, the FDR system has been revised to the new FDR seen below and has been reflected across Australia as of 2022.

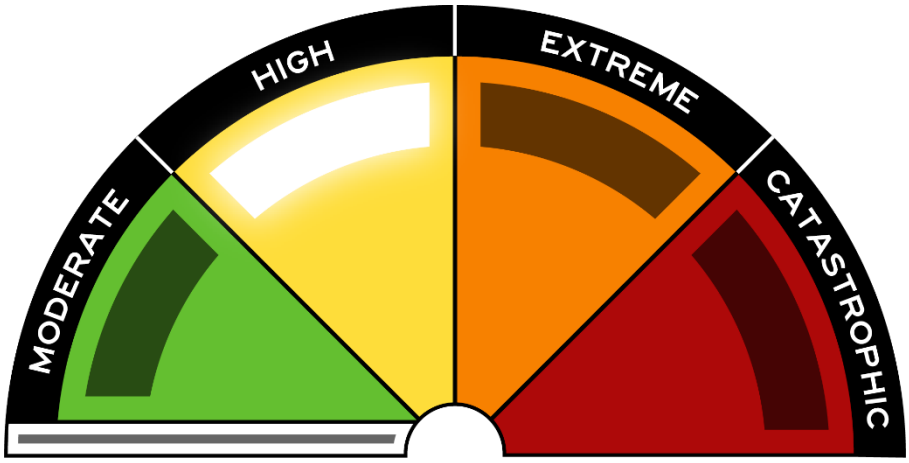


Figure 3-1 – Fire danger ratings and corresponding FFDI values

3.1.1 Climate drivers and influences

There are a number of climate influences which can give rise to more severe periods of increased fire danger for parts of Australia and influence seasonal fire weather. The Indian Ocean Dipole (IOD) is one of the key drivers of Australia's climate, producing dryer conditions in positive phases, and wetter conditions in negative phases (BoM, 2020).

Another profound influence is the El Nino Southern Oscillation (ENSO), which is the oscillation between El Niño and La Niña conditions. El Niño conditions generally result in below average rainfall for much of eastern Australia (BoM, 2020). When El Niño coincides with a positive IOD, the two phenomena can reinforce their dry effects (BoM, 2020). El Niño conditions generally result in more frequent and dangerous fire weather days (Abram et al, 2021).

Other influences can also contribute to drier and warmer conditions, including the Southern Annular Mode (SAM).

In 2020 the Bureau of Meteorology issued a Special Climate Statement detailing the climatic factors which contributed to dangerous fire weather conditions in the 2019-20 fire season, confirming large areas of Australia had their highest accumulated FFDI for December in 2019. It also notes 2019 had the highest December accumulated FFDI for Australia as a whole, continuing the pattern seen in the spring period. Interestingly, the ENSO in 2019 was neutral as classified by BoM and instead, the variability of the IOD and SAM were important in driving the dry and hot conditions that elevated the fire risk during the Black Summer fire season of 2019-20 (Abram et al, 2021).

Climate change is largely associated with anthropogenically forced climate trends as a result of greenhouse gas emissions. Over time, fire weather conditions across large parts of Australia will continue to deteriorate as a result of increased temperatures, lower rainfall, hotter nights, lower soil and biomass moisture content and accumulation and changes to fuel loads more broadly (Abram et al, 2021).

3.1.2 Vegetation and fuels

Fuel load, arrangement and connectivity (or conversely, fragmentation) represents a considerable component in dictating the behaviour of fire in terms of intensity, rate of spread

and flame height. Different vegetation groups yield different fire behaviour and intensities by virtue of their characteristics such as density, arrangement, fuel loads and other characteristics.

Vertical and horizontal continuity of fuels is also a considerable factor. Vegetation characteristics guide estimates on how quickly fire might spread and the likely fire behaviour and intensity which may occur.

3.1.3 Topography

Topography and to a lesser degree, aspect, also influence fire behaviour and intensity. Topography can have a drastic affect, with the rate of speed of which a fire spreads doubling for every 10 degrees of upslope and slowing by half for every 10 degrees of downslope, as a general rule.

Aspect can also affect bushfire behaviour, where areas with northerly or westerly aspects experience a higher level of solar access than those areas with a southern or eastern aspect. Notwithstanding, in times of drought and below average rainfall moisture levels in soil and vegetation in more sheltered areas with southerly and easterly aspects can also decrease substantially giving rise to significantly higher fuel abundance where the preceding fire regime has been less frequent or intense.

Aspect is also important in terms of understanding key fire runs or fire paths, being those tracts of the landscape which may 'convey' fire.

Effective slope is the term used for the slope of land beneath hazardous vegetation.

Site slope represents the topography between a building or receptor and the hazardous vegetation.

3.2 How bushfires move across the landscape

How bushfires transition across the landscape is a function of the factors listed above, and can be considered at both the micro and macro levels.

At the micro level, ignitions are initially carried by leaf litter or tree trunks which are projected forward on the prevailing localised wind. Fire will spread along the ground and also vertically, into surface-level (understory) vegetation, as flame height grows. This can preheat tree canopy vegetation which may also ignite under certain conditions. Bushfire will produce ember attack which will be blown ahead of the fire front, causing spot ignitions and spot fires. The fire will also emit radiant heat.

These are known as 'bushfire attack mechanisms' and are a particular focus of land use planning and building provisions, given their threat to people, property, infrastructure and the environment. Further details on bushfire attack mechanisms follows.

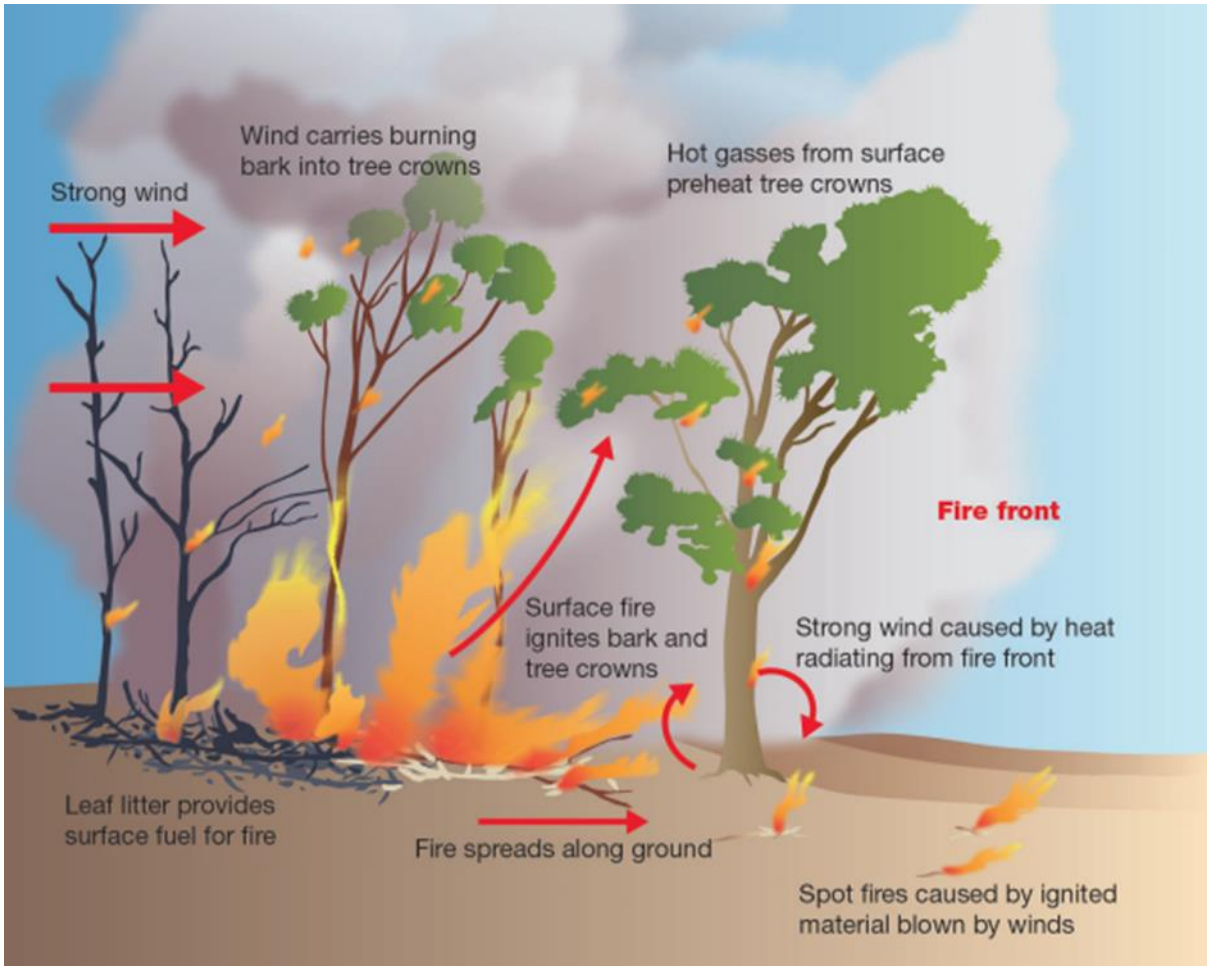


Figure 3-2 – Movement of fire across the landscape (Source: GTANSW)

At the macro level, various atmospheric influences also play a role in the transition of fire across the landscape and this is particularly relevant in larger events where fire produce pyrocumulonimbus clouds.

Smoke plumes of hot air will rise over the fire ground, forming a convection column which cools in the atmosphere, before transitioning into cloud form. In some instances this can produce thunderstorms and lightning, which can lead to further ignitions and spot fires ahead of the fire front.

3.3 Bushfire attack mechanisms

This section provides a brief overview of the bushfire attack mechanisms which may impact upon life, property and the environment.

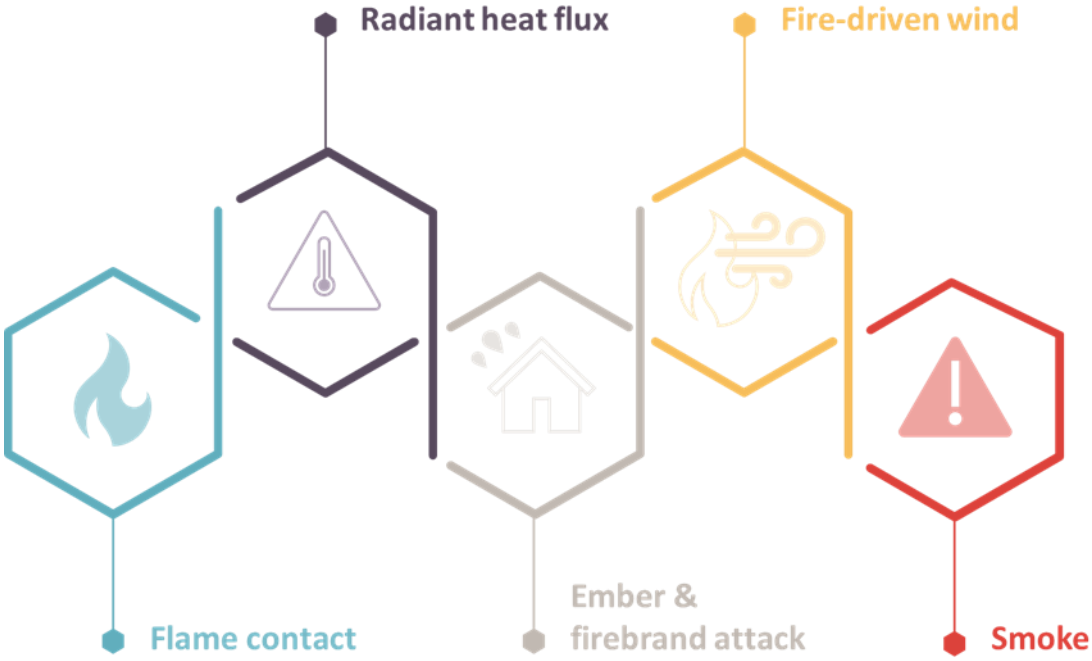


Figure 3-3 – Bushfire attack mechanisms

3.3.1 Flame contact

Flame contact refers to flame contact from fire, where the flame which engulfs burning vegetation comes in to contact with buildings, assets or people. It is estimated that between 10 to 20 per cent of buildings lost to bushfire occur as a direct result of flame attack (CSIRO, 2014).

3.3.2 Radiant heat flux

Radiant heat flux is the heat energy released from the fire front which radiates to the surrounding environment. It remains one of the leading causes of fatalities due to bushfire. In terms of impacts on buildings, radiant heat can pre-heat materials making them susceptible to ignition, can cause non-piloted ignition to certain materials at specific temperatures and can severely damage and melt materials Radiant heat can also damage building materials such as window glazing, allowing openings into a building through which embers may enter. Radiant heat impact is an especially important factor in building-to-building ignition. The figure below outlines the observed effects of radiant heat exposure for persons and buildings.

Table 2 – The effects of radiant heat (Source: NSW RFS, 2006)

Radiant heat flux (kW/m^2)	Observed effect
1	Maximum for indefinite skin exposure
3	Hazardous conditions, firefighters expected to operate for a short period (10 minutes)
4.7	Extreme conditions, firefighters in protective clothing will feel pain after 60 seconds of exposure
6.4	Pain after 8 seconds of skin exposure
7	Likely to be fatal to unprotected person after exposure for several minutes

Radiant heat flux (kW/m²)	Observed effect
10	Critical conditions, firefighters not expected to operate in these conditions although they may be encountered. Considered to be life threatening in less than 60 seconds in protective equipment. Fabrics inside a building could ignite spontaneously with long exposure.
12.5 (BAL-12.5)	Volatiles from wood may be ignited by pilot after prolonged exposure. Standard float glass could fail during the passage of a bushfire.
16	Blistering of skin after 5 seconds.
19 (BAL-19)	Screened float glass could fail during the passage of a bushfire.
29 (BAL-29)	Ignition of most timbers without piloted ignition (3 minutes of exposure) during the passage of a bushfire. Toughened glass could fail.
40+	Flame zone – exposure to direct flame contact from fire front.

3.3.3 Ember and firebrand attack

Ember and firebrand attack relates to the convective forces of bushfire which raises burning embers into the atmosphere on prevailing winds, depositing them to the ground ahead of the fire front to spark spot fires (also referred to as spotting). Firebrands are typically larger items of burning material such as bark which can also stay alight for some time, and can be more dangerous to humans. Ember attack will usually occur ahead of the arrival of the fire front. Embers attack the vulnerabilities of buildings and is estimated to cause between 80 and 90 per cent of building loss as a result of bushfire (CSIRO, 2014).

3.3.4 Fire-driven wind

The convective forces of bushfire typically result in strong to gale force fire driven winds which can, on occasion, lead to building damage. The typical effects of fire driven wind include the conveyance of embers, damage from branches and debris hitting the building and breaking windows.

3.3.5 Smoke

Smoke emission remains a secondary effect of bushfire and is one which is typically not addressed by bushfire assessments but is a relevant aspects of risk assessment. This is for two reasons, the first relates to the potentially severe impact of smoke emission on the human respiratory system. Toxic smoke emission can occur, particularly where buildings, furnishings, materials and the insides of vehicles are ignited or exposed to extreme radiant heat (i.e. materials start to melt). Secondly. It can reduce visibility which can result in challenging evacuation conditions.

3.4 Understanding life and property loss

The purpose of the Bushfire Risk Assessment is to understand the potential quantum of risk that bushfire hazard poses to life, property and the environment with specific regard to the role of land use planning. It is intended this work will underpin and provide the evidence base upon which locally-specific land use planning controls, from strategic to statutory, can be deployed to limit and reduce exposure of people and property to bushfire threat.

Several seminal bodies of research have been compiled which provide insight into various aspects of life and property loss, in particular:

Understanding life loss in bushfire events

In 2012, the CSIRO in conjunction with the former Bushfire Corporative Research Centre undertook a comprehensive study into matters of both life and house loss across utilising over 110 years (1901-2011) of data across 260 bushfire events (Blanchi et al. 2012). Over this period, a total of 825 known civilian and firefighter fatalities have occurred (Blanchi et al. 2012).

Important findings of this seminal research are as follows:

- It is evident that fire weather and proximity to forest are very strong contextual drivers for defining the potential for fatalities to occur.
- 85 per cent of fatalities occur within 100m of bushland.
- 50 per cent of all recorded facilities have occurred on days exceeding FFDI 100 (most fatalities occur as a result of infrequent but high magnitude events).
- Late evacuation is the most common activity persons were engaged in at time of death (30.3 per cent) followed by sheltering inside a structure (24.8 per cent) and defending a property outside (22.4 per cent).
- For those instances where sufficient data is available with respect to fatalities occurring during the act of evacuation, most were trapped on roads by either fallen trees or become bogged, the remainder having run off the road due to poor visibility as a result of smoke conditions.
- In terms of location of fatal exposure, 50 per cent occurred out in the open (including persons found outside structures and outside vehicles), 28 per cent occurred inside structures and in events where FFDI exceeded 100, fatalities within structures represented over 75 per cent of life loss.
- The percentage of fatalities within structures appears to be increasing over time, mostly attributed to the 2009 Victorian Bushfires where 118 of the 173 fatalities occurred inside a structure.
- During the 2009 Victorian Bushfires, findings demonstrate that most of those persons who lost their lives 'could not respond appropriately to the risk the bushfire presented' on that day.
- Increasing percentages of fatalities occurring within structures in later fires (1965-2011) were persons aged 65 and over, as well as those with physical and / or mental disability.
- Most fatalities occur between the hours of 3pm and 9pm – when FFDI is at its peak (3pm) and when summer cool-change winds occur. 90 per cent of fatalities occur immediately after afternoon wind changes.
- 41.9 per cent of fatalities which occurred from 1965 to 2011 'were aware of the fire with enough time to save their lives; had a fire plan and were following intended actions which were ineffective', with 21.8 per cent who also had enough time to save their lives but either had no fire plan or that plan was not followed, and includes persons who were 'waiting to see'. 10.9 per cent were unaware of a fire and only realised when it was too late, and a further 10.7 per cent were either children or adults following the instructions of another person. 6.1 per cent were either physically or mentally incapable of implementing an effective survival strategy (Blanchi et al. 2012).

Understanding risk to property

The CSIRO, in conjunction with the Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC), remain among the leading property loss research agencies in Australia,

having produced a multitude of reports, studies and tools to assist in developing a solid evidence base to support policy-level decision-making.

With respect to property loss, CSIRO studies have found that approximately 98 per cent of all building loss has been found to occur on days when the FFDI exceeded 45 (Blanchi & Lucas, 2010). In events where the FFDI exceeds 50, fire suppression at any part of a fire line is virtually impossible due to the intensity and unpredictable behaviour of a fire (Leonard & Blanchi, 2012).

Land use planning, building design, fuel management, strategic intervention of fire brigades and community preparedness are the only effective defence mechanisms available once the FFDI has exceeded 50 (Blanchi & Lucas, 2010; Leonard & Blanchi, 2012).

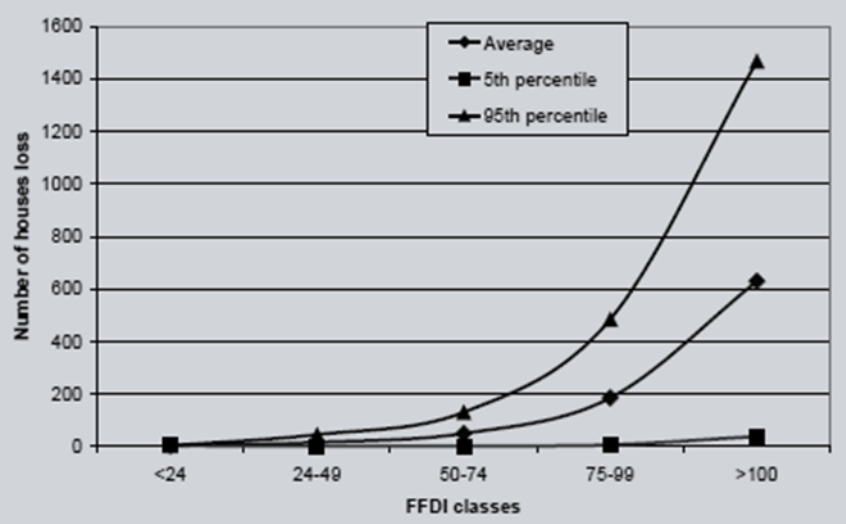


Figure 3-4 – Average house losses for different FFDI classes (Source: Leonard & Blanchi, 2012)

Extensive property loss research reveals that approximately 80 per cent of property loss occurs within 100m of the bushland interface, with the full extent of loss typically occurring 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 events across the world which have penetrated urban areas.

The 2020 Royal Commission into National Natural Disaster Arrangements and the NSW Bushfire Inquiry noted the loss and damage of properties beyond 100m of bushland and in un-mapped areas from the 2019/20 Black Summer Bushfires. However, it is understood the extent of this occurrence was consistent with the observations above.

4 Policy and regulatory context

This section provides an overview of the policy and regulatory context and frameworks relating to bushfire protection in Queensland, as relevant to this review and the broader bushfire risk analysis for the Fraser Coast region.

These key instruments demonstrate a 'line of sight' with respect to the cascading relevance from legislation and regulation, to national best practices instruments, previous inquiries, risk assessments and studies as well as leading Australian and international fire and risk research.

4.1 National policy settings and guidance materials

The national policy landscape relating to natural hazard risk management maintains a strong focus on implementation of the United Nations' ***Sendai Framework*** through improving the understanding of risk across all sectors and all levels of government, stakeholders and the community through a shared responsibility for building resilient communities. In particular:

- Given the alignment with the Sendai Framework, there is naturally a focus on understanding risk, sharing risk information and using improved technologies to understand risk.
- There is a focus on understanding risks to the social, built, economic and natural environments.
- There is a strong focus on building 'disaster resilient communities' by improving the community's understanding of risk and their vulnerabilities, and taking a shared responsibility approach in building resilience to natural hazards such as bushfire.
- Planning is presented in the ***National Strategy for Disaster Resilience*** as an important element of shaping disaster resilient communities.
- Efforts and resources should be targeted to priority disaster risks and mitigation opportunities, and exposure to unreasonable risks from hazards avoided or suitable arrangements to minimise risks implemented.
- With regards to recovery and rebuilding, there is a focus on considering the appropriateness of rebuilding in the same location, or rebuilding to a more resilient standard to reduce future risks.
- Many of the ***National Disaster Risk Reduction Framework*** strategies apply to the planning sector.
- The ***National Climate Resilience and Adaptation Strategy*** not only aligns with the premise that resilience building is a shared responsibility and that there is a need for an evidence-base, risk management approach, but also identifies the importance of factoring climate change into decisions through collaborative and values-based choices and the need to revisit decisions and outcomes regularly.
- ***Profiling Australia's Vulnerability*** brings to the forefront the importance of understanding the relationship between community values and vulnerabilities, including the vulnerabilities of systems that communities rely on, to strengthen resilience. It identifies that trade-offs need to be made between social, built, economic and natural environment factors at the local level when making decisions, and that incentives need to be embedded to guide decision making.
- The ***National Emergency Risk Assessment Guidelines (NERAG) Handbook*** produced by the Australian Institute for Disaster Resilience provides a nationally consistent approach to risk assessment and prioritisation to support the implementation of strategy. It provides a contextualised, emergency-related risk

assessment methodology consistent with ***AS/NZS ISO 31000: 2018 Risk management – principles and guidelines***.

- Pursuant to the ***National Construction Code*** and the ***Building Code of Australia***, development on land within a designated Bushfire Prone Area is required to be assessed against and comply with the construction requirements of ***Australian Standard AS3959-2018 – Construction of Buildings in Bushfire Prone Areas***. A designated Bushfire Prone Area is established by the Bushfire Hazard Overlay map within a planning instrument, or pursuant to Part 1.6 of a planning scheme or a bushfire hazard overlay code.
- Of particular relevance in the incorporation of natural hazards and risk into planning processes, the Australian Institute for Disaster Resilience ***Land Use Planning for Disaster Resilient Communities Handbook*** provides a summary of regulatory instruments, spatial instruments and assessment processes and their role in disaster resilience, aligned with the Planning Institute of Australia's ***National Land Use Planning Guidelines for Disaster Resilient Communities***.
- the ***Evacuation Planning Handbook*** prepared by the Australian Institute for Disaster Resilience provides a suite of considerations for evacuation planning, using the five nationally-recognised stages of the evacuation process. The Handbook articulates the relevant aspects of community-level evacuation planning which are to be considered as part of evacuation planning processes.

4.2 State-based policy and regulation

The state-wide policy and regulatory environment relating to natural hazard risk management and bushfire protection maintains a strong focus on protection of life, property and the environment. This is aligned with the state's commitment to secure a liveable, sustainable and prosperous Queensland. Those aspects of the state-wide policy and regulatory framework which contribute to this includes:

- Recognising, equipping, integrating and collaborating to drive towards an innovative and resilient Queensland that manages the risks and harnesses the opportunities of a changing climate through the ***Queensland Climate Adaptation Strategy 2017-2030 – Pathways to a climate resilient Queensland*** and its subsequent ***sector adaptation plans***.
- The four objectives of the ***Queensland Strategy for Disaster Resilience*** and its implementation plan, ***Resilient Queensland 2018-2021***.
- The emergency management principles under the ***Queensland State Disaster Management Plan*** align with national approaches, including those related to adopting a comprehensive approach, understanding an all-hazards approach, building local disaster management capacity and supporting the ***Queensland Disaster Management Arrangements*** (QDMA) pursuant to the ***Disaster Management Act 2003***.
- The ***Queensland Bushfire Plan 2020*** articulates the principles and priorities for bushfire risk management in Queensland through prevention, preparedness, response and recovery. Risk-based land use planning and building and construction provisions are identified as key prevention and mitigation measures for bushfire disaster risk reduction in Queensland. It also articulates the QDMA provisions, roles and responsibilities specifically relevant to bushfire hazard in Queensland.
- The ***Queensland Emergency Risk Management Framework*** (QERMF) promotes opportunities for collaboration and communication between Government, industry stakeholders and the community across the three disaster management

levels (Local, District and State) in Queensland. It also promotes the need for identification and communication of residual risk across these levels.

- The ***Changes to Fire Weather in Queensland 2019*** by the Australian Bureau of Meteorology notes a general trend towards warming and greater number of days with a higher fire danger rating, including for the Fraser Coast region.
- The ***Queensland State Natural Hazard Risk Assessment 2017*** identifies the vital role of the state and local governments in planning for and managing sustainable development through, in part, increasing the resilience of communities through prevention and mitigation with improved land use planning provisions for avoidance, mitigation, and response and recovery.
- The ***State Infrastructure Plan*** includes a strategic objective for improving the sustainability and resilience of Queensland's infrastructure.
- The ***Planning Act 2016*** regulates planning in Queensland and provides strategic guidance for planning for bushfire resilience. This includes regulating the relationship between planning and building, regional planning approaches, compliance with the SPP and the regulation of development application processes.
- The Act also includes provisions for Councils to prepare strategic planning frameworks which articulate the long-term vision for land use in local areas.
- The ***Fire and Emergency Services Act 1990*** outlines the responsibilities to extinguish or control fires in Queensland.
- The ***State Planning Policy*** (SPP) establishes the strategic and statutory planning requirements which are relevant to the State interest of natural hazards, risk and resilience, which includes bushfire hazard and risk. It requires strategic planning processes to consider the nature of potential bushfire risk and key strategic issues, to determine if development is appropriate in its risk context.
- The ***Integrating state interests into planning schemes – guidance for local governments*** document was released in 2021 and provides non-statutory guidance for local government in integrating the State interest for bushfire into local planning instruments and processes. This includes guidance on the preparation of fit-for-purpose risk assessments.
- A compendium State interest guidance material document, ***Bushfire resilient communities – technical reference guide for the State planning policy State interest 'Natural Hazards, Risk and Resilience – Bushfire'*** was released in 2019. Prepared by QFES, this guidance material provides further detail with regard for local planning processes and the preparation of bushfire hazard assessments.
- Regional-level planning instruments further guide the strategic planning approaches adopted by local governments in the Wide Bay Burnett, including ***Wide Bay Burnett Regional Plan 2011***.
    - It is noted that the regional plan is currently being revised and due for release in 2022.
- The ***Bushfire Resilient Building Guidance for Queensland Homes*** document is a guide released by the Queensland Reconstruction Authority in conjunction with the CSIRO which provides information about improving the bushfire resilience of new and existing Queensland homes. It incorporates retrofitting information for existing homeowners, as well as tips for new building and renovation design.

4.2.1 SPP state interests for natural hazards, risk and resilience

The SPP identifies natural hazards, risk and resilience as a state interest and seeks to 'ensure natural hazards are properly considered in all levels of the planning system'. In relation to

bushfire hazard and risk, the SPP identifies how the state interest can be appropriately integrated into local planning instruments, as summarised in the table below:

Table 3 – Natural hazards State interests

Mapping	In support of the SPP state interest, state-wide bushfire prone area mapping has been developed. The mapping identifies three potential bushfire intensity classes being very high, high and medium. A potential impact buffer surrounds all areas. The SPP identifies that the bushfire prone area mapping must be appropriately integrated and can be locally refined by a local government in a local planning instrument (subject to approval by the Planning Minister), in a way that achieves the state interest policy.
Fir-for-purpose risk assessment	In order to appropriately integrate with the SPP, a fit-for-purpose risk assessment is required to be undertaken to support the provisions of a planning scheme relating to bushfire risk. The purpose of a fit-for-purpose risk assessment is to 'understand the likelihood, severity and potential consequences of a bushfire event for existing and proposed communities, property and infrastructure.'
Planning provisions	The fit-for-purpose risk assessment informs the provisions of a local planning instrument. These provisions should, for existing and new development in bushfire prone areas, seek to achieve an acceptable or tolerable level of risk.

Where undertaking a fit-for-purpose risk assessment, the objective will be to comply with the following policy positions as established in the technical reference guide for the SPP, 'Bushfire Resilient Communities, October 2019' prepared by QFES:

Table 4 – QFES policy positions outlined in the 'Bushfire Resilience Communities' technical reference guide

Policy 1 – Mapping is robust and locally relevant.	As a minimum, the State Planning Policy Interactive Mapping System (SPP IMS) bushfire prone area mapping must be identified and applied to local government planning schemes. Local governments should refine the SPP IMS bushfire prone area mapping, using the refinement process outlined in this document, and then adopt the refined mapping in their specific planning scheme. QFES may be able to assist local governments with limited resources in this process.
Policy 2 – 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.	Local governments should undertake a risk assessment when making or amending a planning scheme. To understand the consequences of a potential bushfire event, the risk assessment should consider the exposure, vulnerability and resilience of communities and their assets to a bushfire as a first step in proposing a planning response. A risk assessment is a methodical assessment, considering the specific circumstances of the local government area. Preferably, the risk assessment:

	• will be consistent with AS/NZS ISO 31000:2018 Risk Management – Principles and Guidelines1 • is undertaken by a suitably qualified person (further detailed in Section 10). A comprehensive risk assessment may not be required for every planning scheme amendment, depending on the scope of the proposed instrument and whether an assessment has been previously undertaken. QFES can provide advice to local governments early in the planning process to scope a risk assessment that is suited to the nature of the proposed scheme amendments (i.e. a risk assessment that is fit-for-purpose).
Policy 3 – 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.	The outcomes of the risk assessment should inform the drafting of the local planning strategic framework and assessment benchmarks to ensure a clear approach to managing bushfire risk. Avoidance of the risk would include a local government minimising the expansion or increased density of existing development in mapped bushfire prone areas, particularly: • vulnerable uses • community infrastructure for essential services • materials that are hazardous in the context of bushfire hazard. After this, managing bushfire risk should be based on achieving an acceptable or tolerable level of risk for both existing and new development in bushfire prone areas. An acceptable risk is a level that is sufficiently low to require no new treatments or actions to allow communities to live with the risk without further action. A tolerable risk is low enough to allow the exposure to a natural hazard to continue but high enough to require new treatments or actions to reduce that risk. Communities can live with this level of risk, but as much as is reasonably practical should be done to reduce the risk. This may include planning responses for: • reducing the likelihood of the risk (avoidance) • reducing the consequences of the risk (mitigation and hazard management over time). What constitutes an acceptable or tolerable level of risk will vary among local government areas and community context. If appropriate, community consultation could be undertaken to understand tolerance levels to bushfire risk and identify possible treatment options.
Policy 4 – Disaster management capacity and capabilities are maintained to mitigate the risks to people and property to an	Mitigation involves a local government including provisions in its planning scheme to ensure subdivision layout:

acceptable and tolerable level.	• locates low fuel separation areas, such as roads, managed open spaces and large lots, to separate people from hazard • does not hinder emergency service access and functions through active measures including: • ensuring sufficient access areas (e.g. via perimeter roads or fire trail and working areas) for firefighters and vehicles between assets and vegetation • allowing for vegetation management and wildfire response to provide opportunities to establish control lines from which hazard reduction or back-burning operations can occur • allows safe access and egress routes • ensures water supply in both reticulated and non-reticulated areas. Mitigation also involves local governments including provisions in their planning scheme for Bushfire Management Plans (BMPs) for ongoing vegetation management that maintains identified low fuel separation areas.
Policy 5 – Lot and neighbourhood layout and design mitigates the risks to people and property to an acceptable and tolerable level.	Mitigation involves local governments including provisions in their planning scheme for: • new subdivision design to minimise the interface with bushfire prone areas and facilitate connections to safe evacuation routes • landscape design and management that does not increase the level of bushfire risk or mechanisms of bushfire attack. The key mitigation approach for houses involve a local government defining all or part of its area as a designated bushfire prone area in accordance with section 12 of the Building Regulation 2006. This in turn triggers the requirement for adherence to Australian Standard 3959–2018 Construction of buildings in bushfire-prone areas at the building development application stage.
Policy 6 – 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 not suitable alternative location and site planning can appropriately mitigate the risk.	The local government should include provisions in its planning scheme which articulate this policy position. If located in a bushfire prone area, vulnerable uses maintain disaster management capacity and capabilities, and mitigate the risks to people and property to an acceptable and tolerable level (see Policy 4).
Policy 7 – Revegetation and rehabilitation avoids an	Local governments should include provisions in their planning schemes which articulate this policy position and

increase in the exposure or severity of bushfire hazard.	do not result in an unacceptable level of risk or an increase in the potential bushfire intensity level.
Policy 8 – 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 not suitable alternative location.	The local government should include provisions in its planning scheme which articulate this policy position. If located in a bushfire prone area, the risks to public safety and the environment from the release of these materials during and after a bushfire event must be mitigated by positioning it: • outside any asset protection zone applying to other buildings or structures on the site • as close to the edge of the bushfire prone area as possible. • If located in a bushfire prone area, the storage or manufacture of materials that are hazardous in the context of a bushfire must be managed through: • maintenance of appropriate disaster management capacity and capabilities • mitigation of the risks to people and property to an acceptable and tolerable level (see Policy 4).
Policy 9 – The protective function of vegetation arrangements that can mitigate bushfire risk are maintained.	Local governments should include provisions in their planning schemes to mandate BMPs that uphold the protective function of vegetation arrangements, such as species selection, landscape design and ongoing vegetation management.
Policy 10 – Community infrastructure for essential services are 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 not suitable alternative location, and further, the infrastructure can be demonstrated to function effectively during and immediately after a bushfire event.	Local governments should include provisions in their planning schemes which articulate this policy position. If located in a bushfire prone area, community infrastructure for essential services must be secured by: • maintenance of appropriate disaster management capacity and capabilities • mitigation of the risks to people and property to an acceptable and tolerable level (see Policy 4).

4.3 Royal Commissions and inquiries

Over the years, more than 50 inquiries have been conducted nationally in relation to bushfire, resulting in almost 900 recommendations. This is considerable in comparison to the number of flood-related inquiries over the same period at just 15, yielding 328 recommendations. This includes Royal Commissions, independent, audit, agency, Coronial and Parliamentary inquiries (BNHCRC, 2019).

Aspects relevant to this risk analysis are as follows:

- The ***2020 Royal Commission into National Natural Disaster Arrangements*** was undertaken following the devastating 2019/20 fire season which affected Australia, commonly referred to the 'Black Summer' fires. The Royal Commission noted that state and local governments should be required to consider present and future disaster risk through plan making processes. The Royal Commission also had regard to aspects of mitigation, cultural burning, climate projects and data applications, and building provisions.
- The ***Victorian Bushfires Royal Commission*** (VBRC) which concluded in 2010 after the Black Saturday fires of 7 February 2009 also contemplated the role of land use planning in bushfire disaster risk reduction. Of the 67 recommendations made by the VBRC, 18 recommendations related specifically to land use planning.
- The inclusion of planning-related findings as a result of inquiries dates back to the ***1939 Royal Commission (the Stretton) report*** which identified a clear need to incorporate bushfire risk considerations into policy, including planning.
- Similar observations and findings are made across other Royal Commission and Inquiry reports, over the decades across the country. One of the key challenges for planning in this regard is the continued expansion or encroachment of urban areas into bushland and scrub areas. In 1984, following the Ash Wednesday fires in Victoria and South Australia, two reports identified specific planning-based measures for bushfire risk reduction. Many of these measures continue to form the basis of risk treatment today at the property level.
- The 2012 ***Productivity Commission Inquiry Report on Barriers to Effective Climate Change Adaptation*** identified the prioritised need for land use planning systems across the country to enable risk management approaches to incorporate climate change risks into planning decisions at the state, regional and local government levels.
- The 2014 ***Productivity Commission Inquiry into National Disaster Funding Arrangements*** identified a range of recommendations, with key observations including the governments over-invest in post-disaster reconstruction and under-invest in resilience and mitigation to limit the impact of risk and disaster, and that regulations affecting the built environment have a significant influence on the exposure and vulnerability of communities to natural hazards. While building regulations have generally been effective, there is a need to transparently incorporate disaster risk management into land use planning.
- The Inspector-General Emergency Management (IGEM) has conducted a number of recent reviews into Queensland bushfire events including the ***2018 Queensland Bushfires Review***. Finding 11 of this review identifies scope to emphasis the role of land use planning and to improve education and advice about bushfire risk as complementary mitigation strategies, and that effort should be made to improve land use planning (Finding 17).
- The above review was supported by an independent review of the impacts of heatwave on bushfire risk in Queensland, prepared by the Bushfire and Natural Hazard Cooperative Research Centre (BNHCRC).
- Further reviews have been undertaken by IGEM following the 2019-20 fire season, including the ***Queensland Bushfires Review – Report 2: 2019-20,*** as well as the ***K'gari (Fraser Island) Bushfire Review 2020-21.***

4.4 Queensland Bushfire Reviews

Queensland maintains a long history of bushfire events and impacts. Some seasons, driven by climate patterns like the Indian Ocean Dipole (IOD) and Southern Annular Mode (SAM), see more serious fire weather conditions than others. For example, the fire seasons of 1994, 2018 and 2019-20 saw extreme fire conditions across the state and serious bushfire events.

Over recent years in particular, a number of major bushfire events have occurred across the state and have been the subject of several Inspector-General of Emergency Management (IGEM) reviews.

4.4.1 2018 Queensland bushfires

In 2018, drought and heatwave conditions primed Central Queensland for a number of serious bushfire ignitions. By late November, over 165 bushfires were active across Queensland. Serious events occurred in Eungella, Deepwater, Gracemere, Stanwell, Kabra, The Caves, Mount Larcom, Minjerribah, Sarina Beach and Campwin Beach and Carnarvon National Park (IGEM, 2018). The Bureau of Meteorology (BoM) issued a 'Catastrophic' fire weather warning for the Rockhampton District.

The IGEM Review following the 2018 bushfire seasons culminated in 23 recommendations across the realms of:

- Heatwave
- Science and risk
- Mitigation – engagement, compliance, authorisation processes, and effectiveness
- Intelligence and technology
- Public information and warnings – warnings about catastrophic conditions, Education, Roles and responsibilities, and Effectiveness of warnings
- Coordination structures and inter-agency cooperation – hazard specific planning, coordination, liaison officers, evacuation and interstate and Commonwealth support

A key insight from the 2018 Queensland bushfires was the management of fuels across landholdings, including the responsibilities of state agencies as well as fuel load management on private lands and the various challenges associated with each. Changes to clarify and streamline fuel hazard management across tenures has been a continued focus since this event.

The three key opportunities identified by the 2018 IGEM Review were bushfire mitigation, community education and warnings, and where primary agency response runs in parallel with disaster management arrangements.

4.4.2 2019-20 Black Summer Bushfires

The 2019-20 Black Summer Bushfires was Australia's worst fire season on record and again, saw a number of major bushfire emergencies across Queensland owing to continued persistent drought conditions, high temperatures and an early-onset fire season. At its peak, QFES was dealing with more than 90 bushfires burning at the one time (Queensland Reconstruction Authority, 2020).

The 2019 IGEM Review Report focused on the consideration and refinements of recommendations made in the 2018 Review, identifying four (4) immediate recommendations and the remaining 19 as timely.

4.4.3 2020 K'gari (Fraser Island) bushfire

In October 2020, the Bureau of Meteorology reported above average mean maximum and minimum temperatures in the east of the state.

On 14 October 2020, a vegetation fire was reported following an illegal campfire near Orange Creek, at the north-east of K'gari.

Several factors contributed to the fire spreading, including high temperatures, strong dry northerly winds, complex vegetation structures and types, difficult terrain and remote and limited access constrained by dry, loose sand tracks.

In response to the K'gari bushfire, a review into the effectiveness of preparedness activities and the response to the bushfire was undertaken. The Office of the Inspector-General Emergency Management (IGEM) was officially tasked by the Minister for Police and Corrective Services and Minister for Fire and Emergency Services (the Minister) to undertake the review on 4 December 2020.

The Review made 38 recommendations to address opportunities for improvement across the areas of preparedness, response and community engagement. Key points included that mapping should be easily understandable for community, and an enhanced focus on risk. References to the State-wide Bushfire Prone Area mapping is included, suggesting it contemplates risk however, it must be acknowledged the State-wide Bushfire Prone Area mapping is hazard mapping rather than risk mapping. Further, it was recommended that evacuation planning from Fraser Island be developed by the Maryborough District and Fraser Coast Local Disaster Management Groups, as well as regularly exercising and review once the evacuation plan has been developed. Notwithstanding this, IGEM identifies that community members are unlikely to utilise town planning-related information to understand potential risk during an emergency and the need for risk-based mapping to exist outside of the planning system (as well as for the planning system).

4.5 Bushfire risk and land use planning research

An extensive evidence-base of academic research is available in Australia which informs policy approaches as well as operational approaches. A considerable base of land use planning and bushfire specific research has been conducted, particularly following Black Saturday in 2009, as well as events which have occurred over recent years including the Wye River and Tathra fires.

Key bodies of research include:

- The ***Community Preparedness and Responses to the 2017 New South Wales Bushfires*** research paper reviewed the reactions of the NSW community when faced with threat from a bushfire emergency. The research revealed that even when notified, the at-risk community tends to remain where they are to observe the bushfire for themselves, adopting a 'wait and see' approach. Despite a change in focus on warning messaging since the 2009 Black Saturday fires for catastrophic events, most people still do not intend to leave before there is a fire on such days (Whittaker & Taylor, 2018).
- ***Planning and Bushfire Risk in a Changing Climate*** examines the role of urban and regional planning in relation to bushfire risk in Australia. The research provides a deeper understanding of the contribution of urban and regional planning to managing fire risk throughout Australia. Differing perceptions of fire and various planning responses by States and Territories provide a rich policy environment for multiple sectors to consider. Added to this complexity are expanding urban areas across Australia and the challenges of continuing urban development in regions that are already experiencing environmental change and predictions of an even hotter environment and an increased potential for fire risk. A key finding is the need

for a more integrated approach to planning for fire risk that better connects planners with emergency management (Norman et al. 2014).

- The Australian Business Roundtable for Disaster Resilience and Safer Communities, together with Deloitte Access Economics, released the report ***Building Resilience to Natural Disasters in our States and Territories*** in 2017. At 2017, the total cost of disasters across Queensland was an average of $11bn per year. This is forecast to escalate to $18bn per year by 2050 having regard to direct and indirect tangible costs as well as intangible costs. Over the past decade, Queensland has borne 60 per cent of the total economic costs of disasters in Australia. Mainstreaming resilience into planning, land use and building requirements is identified as a key strategy in embedding resilience in decision-making but noting also that land use planning systems are yet to fully embrace their role in mitigating the risks to loss of life, property damage and destruction of vital infrastructure arising from natural hazards (Deloitte Access Economics, 2017).
- The 2020 report ***Integrated Urban Planning for Natural Hazard Mitigation*** identifies that risk modelling for urban edge development remains relatively limited in Australia, and that it is common for future growth area identification processes to progress significantly, well before adequate risk assessment. The inclusion of critical decision criteria, requirements for scenario testing, allocation of roles and establishment of suitable forums can significantly improve future growth risk assessments. The report identifies a suite of findings to assist in frontload risk considerations into strategic planning activities (March et al. 2020).
- The 2019 paper entitled ***Future Risk Framework: Understanding tomorrow's risk and what we can do to reduce it*** notes the continuous increases over time in disaster risk due to factors such as climate change, population growth, economic development and an ageing population. The paper presents a risk framework comprising four main steps to quantify future risk. These steps include the exploration of drivers of future risk, development of plausible future scenarios, parameterisation of scenarios and simulation of impact of scenarios to develop an increased understanding of future risk. This progresses assessment from a primarily qualitative approach to one which is more quantitative in nature (Riddell et al. 2019).
- In 2019 the Bureau of Meteorology (BoM) partnered with QFES to deliver the report ***Changes in fire weather in Queensland***, identifying a rise in maximum temperatures, a fall in annual rainfall and increased annual accumulated forest fire danger index (FFDI) of 51 per cent in South East Queensland. The report also identifies an earlier start to the annual bushfire season is occurring in South East Queensland.
- The BoM has released a series of ***Special Climate Statements*** in relation to recent fire weather in Queensland and eastern Australia, including SCS 68 – Widespread heatwaves during December 2018 and January 2019; SCS 72 – Dangerous bushfire weather and heat in Spring 2019; and SCS 73 – Extreme heat and fire weather in December 2019 and January 2020.

4.6 Local policy, regulation and strategies

4.6.1 Fraser Coast Planning Scheme

The ***Fraser Coast Planning Scheme*** (Planning Scheme) commenced in January 2014 and is the current statutory local planning instrument for the region. The Planning Scheme was prepared in accordance with the (now repealed) *Sustainable Planning Act 2009* (SPA). The Planning Scheme regulates development within the region including how development must consider bushfire hazard and risk. The Planning Scheme seeks to manage bushfire risk via an avoid or mitigate approach.

The Planning Scheme addresses bushfire hazard and risk within the Strategic Framework, Tables of Assessment, Development Codes, Neighbourhood Centre Zone Code and through the Bushfire Hazard Overlay which is supported by mapping and assessment benchmarks, against which development applications require assessment. The following provides a summary of the relevant aspects of the Planning Scheme with regards to bushfire hazard and risk.

Strategic Framework

The Strategic Framework summarises the overall effect of the Planning Scheme. Broadly, the Strategic Framework seeks to avoid or mitigate bushfire risk areas to ensure protection of people, property, economic activities and the environment.

Bushfire Hazard Overlay Map

Schedule 2 of the Overlay Mapping adopts the State Planning Policy 2014 Bushfire Prone Areas mapping. There are three categories of bushfire risk being Very High, High and Medium Bushfire Hazard Area, with the inclusion of the Bushfire Hazard Potential Impact Buffer.

State Interests

The Planning Scheme has indicated in section 2.1 that aspects of the SPP (SPP 2014) have been appropriately reflected within the scheme. This includes natural hazards, risk and resilience (includes bushfire).

Building Work

For Building Work regulated under the Planning Scheme, the 'bushfire prone area' is designated under Section 1.6 in accordance with section 32(a) of the *Building Act 1975* and section 7 of the *Building Regulation 2021* for the purposes of triggering assessment against AS3959:2018.

The 'bushfire prone area' is cited as being areas identified as medium hazard, high hazard, or very high hazard on the Bushfire hazard overlay maps in schedule 2. It is noted that the designated 'bushfire prone area' does not include the potential impact buffer area.

Categories of Development and Assessment

The assessment categories for Material Change of Use (MCU) as specified in Table 5.10.1 makes no changes to Categories of development and assessment for all development located within the Bushfire Hazard Overlay Map.

Bushfire Hazard Overlay Code

The purpose and overall outcomes of the Bushfire Hazard Overlays seek to ensure the siting, design and construction of development 'avoids, or mitigates the potential adverse impacts of bushfire on people, property, economic activity and the environment'.

The assessment benchmarks establish the requirements for achieving the overall outcomes. The Acceptable outcomes include:

- Development is connected to Council's reticulated water supply and water supply outlets are readily available, or an on-site water storage system is provided.
- A site-specific bushfire hazard assessment and management plan, created in accordance with the Planning scheme policy for information that Council may require, confirms the level of bushfire hazard depicted on a bushfire hazard overlay map.
- Development involving vulnerable or difficult to evacuate uses (such as child care centres, educational establishments, retirement facilities and tourist parks) is not located or intensified in medium, high or very high bushfire hazard areas (including potential impact buffers)

- Development is not located in medium, high or very high bushfire hazard areas (including potential impact buffers) where it would materially increase the number of people living or congregating on the premises.
- Community infrastructure is not located on land subject to medium, high or very high bushfire hazard.
- Development provides 'through roads' and avoids cul-de-sac unless a perimeter road is provided.

4.6.2 Fraser Coast Planning Scheme Review Project

Fraser Coast Regional Council is currently undertaking a review of the current Planning Scheme. The review comprises eight stages and commenced in 2019. There are seven key themes identified for improving the planning scheme, one of which refers to natural hazards. This theme seeks to 'improve our resilience to natural hazards', which includes bushfire.

4.6.3 Local disaster management

An **Area Fire Management Group** (AFMG) is established for the North Coast, which encompasses the Fraser Coast region, pursuant to the Queensland Bushfire Plan. Representatives from Council, as well as major landholders and land managers, community groups, industry groups, other regional councils, as well as all relevant combat agencies and support agencies and services. The focus of this committee is on the development of a Bushfire Risk Management Plan for the relevant local government areas, detail mitigation activities to be undertaken along with applicable residual risk, and the prevention of, response to and recovery of emergencies potentially impacting the region.

A ***Local Disaster Management Group*** (LDMG) is established for the Fraser Coast region, pursuant to the QDMA with representations from Council as well as all relevant combat agencies and support agencies and services. The focus of this committee is on the prevention of, preparation for, response to and recovery from emergencies which impact the local community.

The ***Local Disaster Management Plan*** (LDMP) was endorsed in 2019 with the last revision of the plan being undertaken in 2020. The LDMP sets out to detail the arrangements for the coordination and management of resources, to ensure and maintain safe communities within the region prior to, during and after a disaster. The LDMP identifies the wildfire threat period as primarily being between September to February and notes that seasonal conditions can increase risk of bushfire hazard. The LDMP identifies risk from bushfire amongst the highest prioritised risks for the region.

The LDMP sets out a range of objectives which are centred upon the Prevention, Preparation, Response and Recovery (PPRR) cycle. The LDMP includes a community profile which articulates the demographic, topographical, climate and weather, economic and social characteristics of the Fraser Coast region, as well as key infrastructure assets, community facilities, essential services and major events. The LDMP also articulates the range of existing and ongoing risk assessment and treatment approaches which are adopted by Council, and the roles and responsibilities in preparedness, response and recovery. The LDMP also includes a number of Sub Plans to significant natural hazards posing a risk to the area, which includes Wildfire.

The LDMP recognises the importance of land use planning in reducing risks associated with natural hazards, including bushfire. The LDMP identifies a number of sites, assets and facilities that are relevant to this risk assessment (Table 5).

Table 5 – Summary of critical infrastructure within Fraser Coast region (Source: Fraser Coast Regional Council, 2021)

Category	Name / location of site, asset or facility
Authorised airports and landing areas	Hervey Bay Airport, Hervey Bay Hospital (helipad), Maryborough Airport, Pacific Haven Airfield, (non-commercial), and Fraser Island Authorised Landing Areas
Hospitals	Hervey Bay Hospital (Public), Maryborough Base Hospital (Public), St Stephen's Private Hospital
Major transport networks	Bruce Highway, North Coast Railway Line
Water supply	Howard / Torbanlea Water Treatment Plant, Takura / Burgowan Water Treatment Plant, Tiaro Water Treatment Plant
Dams / Weirs	Lenthal's Dam, Teddington Weir
Gas supply	LNG is reticulated to Maryborough and Hervey Bay
Wastewater treatment plant	Burrum Heads, Dundowran, Hervey Bay, Howard / Torbanlea, Maryborough, Toogoom
Industrial / manufacturing Facilities	Dundowran Industrial Park, Wide Bay Industrial Estate
Natural bushland	Great Sandy, Grongah, Wongi, Poona, Mount Walsh, Burrum Coast Natural bushland areas not mentioned in the LDMP include Wongi State Forest, Tuan State Forest, St Mary State Forest, Bauple State Forest, Glenbar State Forest, and Mount Walsh National Park

5 Fraser Coast region disaster resilience context

Disaster resilience is the capacity to prepare for, absorb and recover from natural hazards, and to learn, adapt and transform in ways that enhance these capacities in the face of future events. Disaster resilience arises from many social, economic and institutional capacities and the mix of these capacities in a community conveys how well it is positioned to absorb and adapt to natural hazards.

In 2020 the Bushfire and Natural Hazard Cooperative Research Centre (BNHRCR) released the Australian Disaster Resilience Index which assesses disaster resilience using factors that encapsulate the resources and abilities to prepare for, absorb and recover from natural hazards (coping capacity), or that enable learning, adaptation and problem solving (adaptive capacity).

The Australian Disaster Resilience Index applies a top-down assessment approach, using data derived from secondary sources and a formative measurement model (see below). In combination with the capacities approach, the Australian Disaster Resilience Index therefore assesses the capacities for disaster resilience that emerge from structural settings. Understanding the Australian Disaster Resilience Index as the capacity for disaster resilience is vital to interpreting the index and comparing among different places in Australia (BNHCRC, 2020).

The Australian Disaster Resilience Index provides a nationally standardised assessment of the capacities for disaster resilience across the entire country. While the index covers the whole country, the spatial resolution for reporting is a Statistical Area Level 2 (SA2) level (BNHCRC, 2020).

Figure 5-1 – Diagram of the formative measurement model which underpins the Australian Disaster Resilience Index (Source: BNHCRC, 2020)

The capacities for disaster resilience are made up of eight themes that capture dimensions of disaster resilience:

- Social character
- Economic capital
- Emergency services
- Planning and the built environment
- Community capital
- Information access
- Social and community engagement
- Governance and leadership.

The SA2s which comprise the Fraser Coast local government area generally rank as 'Low' on the BNHCRC disaster resilience index scale. The index describes moderate resilience as follows:

> *'Communities in areas of low disaster resilience may be limited in their capacity to use available resources to cope with adverse events, and are limited in their capacity to adjust to change through learning, adaptation and transformation.*
>
> *Limitations to disaster resilience may be contributed by entrenched social and economic disadvantage, less access to or provision of resources and services, lower community cohesion and limited opportunities for adaptive learning and problem solving' (BNHCRC, 2020).*

It is noted that two areas of the region skew towards a classification of 'Moderate' resilience including Craignish-Dundowran Beach, and Tinana. 'Moderate' is described by the index as follows:

> *'Communities in areas of moderate disaster resilience have some capacity to use available resources to cope with adverse events, and some capacity to adjust to change through learning, adaptation and transformation.*
>
> *Moderate disaster resilience is generally contributed by moderate levels of coping and adaptive capacity, which in turn are associated with moderate levels of economic capital, moderate provision of and access to services, moderate community cohesion and variable encouragement for adaptive learning and problem solving' (BNHCRC, 2020).*

In the context of reviewing the current planning scheme for the Fraser Coast region, the role of strategic planning extends beyond mere land use provision and built environment considerations. It also has regard to matters of employment generation, industry diversification and economic prosperity, and community and social cohesion.

Thus, there remains the opportunity following the review of the Planning Scheme to drive enhanced resilience outcomes, including for bushfire resilience, through multiple avenues.

5.1 Disaster resilience factors

The eight themes or factors of disaster resilience which are contemplated by the Index are outlined in the table below.

Table 6 – Disaster resilience factors (Source: BNHCRC, 2020)

Disaster resilience factor		Description
	**Social character**	The social and demographic characteristics of the community. Factors such as household and family composition, age, sex, education, employment, disability, language, and length of residence have well-known influences on capacity to prepare for, respond to and recover from natural hazards.
	**Economic capital**	The economic characteristics of the community. Economic capital can contribute to the reduction of losses from natural hazard events through improved mitigation and risk management, individual flexibility and adaptation, enhanced recovery, market continuity and business continuity.
	**Emergency services**	The presence and resourcing of emergency services. Emergency management is a core government service and is integral to natural hazard preparation, response and recovery. Emergency services undertake a range of activities to assist communities before, during and after natural hazards.
	**Planning and the built environment**	The presence of legislation, plans, structures or codes to protect communities and their built environment. Land use planning articulates and regulates relationships between development and hazards. Planning reduces current and future risk and enhances the readiness and capacity of organisations to respond to events.
	**Community capacity**	The cohesion and connectedness of the community. Social capital is a resource that facilitates collective action for mutual benefit. Sense of community fosters participation, community competency, pro-social behaviour and preparedness through working with others to solve shared local problems
	**Information access**	The potential for communities to engage with natural hazard information. Telecommunication and internet access is vital to information sharing before, during and after natural hazard events. Community engagement activities benefit communities through capacity building, social connectedness, self-reliance, training, awareness of risk and psycho-social preparation.
	**Governance and leadership**	The capacity within communities to adaptively learn and transform in the face of complex change. Adaptive communities have support and resources to manage complex change and to renew for mutual benefit. Characteristics of adaptive communities include social engagement, trust, cooperation, learning and wellbeing.

Disaster resilience factor		Description
	**Social and community engagement**	The capacity within organisations to adaptively learn, review and adjust policies and procedures, or to transform organisational practices. Adaptive institutions have conditions suited to the development of the skills, knowledge and culture for managing complex change. They have flexibility and can learn from experience, innovate and adjust.

A range of strength factors are evident across the Fraser Coast region, most notably including:

- Social character (with the exception of within the Maryborough, Pialba – Eli Waters, Point Vernon, Torquay - Scarness - Kawungan and Urangan - Wondunna SA2 areas where it is identified as a barrier)
- Community capital (with the exception of within the Maryborough, Pialba – Eli Waters, Point Vernon, Torquay – Scarness – Kawungan, and Urangan – Wondunna SA2 areas where it is identified as a barrier)
- Emergency services (with the exception of within the Booral – River Heads, Burrum - Fraser, Granville, Maryborough Region - South, and Tinana SA2 areas where it is identified as a barrier)
- Planning and the built environment (with the exception of within the Booral – River Heads, Burrum - Fraser, Granville, Maryborough Region - South, and Tinana SA2 areas where it is identified as a barrier)
- Economic capital (with the exception of within the Booral – River Heads, Burrum - Fraser, Granville, Maryborough Region - South, and Tinana SA2 areas where it is identified as a barrier)
- Information access (with the exception of within the Booral – River Heads, Burrum - Fraser, Granville, Maryborough Region - South, and Tinana SA2 areas where it is identified as a barrier)
- Social and community engagement (with the exception of within the Maryborough, Pialba – Eli Waters, Point Vernon, Torquay - Scarness – Kawungan, and Urangan – Wondunna SA2 areas where it is identified as a barrier)
- Governance and leadership (with the exception of within the Booral - River Heads, Burrum – Fraser, Granville, Maryborough Region – South and Tinana SA2 areas where it is identified as a barrier).

With specific regard to planning and the built environment, a range of data inputs are used by the index to understand the character of the built environment within each SA2 area. These inputs include the consideration of the percentage of caravan and improvised dwellings, percentage of dwellings constructed prior to and post 1981, commercial dwelling construction post-1981, number of Council staff and new dwellings as a proportion of old dwellings.

5.2 Adaptive and coping capacities

Adaptive capacity across the Fraser Coast region, based on the above, is observed generally as 'Low', which reflects the region's capacity to adjust to change through learning, adaptation and transformation. Notably, coping capacity within the Fraser Coast region is observed to be somewhat higher, particularly within urban areas with both Craignish-Dundowran Beach, and Tinana having 'High' coping capacity.

Overall, the index helps to paint a picture of relevant disaster resilience considerations for the region however, this is a broad assessment and specific consideration of resilience factors can

vary from household to household based on a range of circumstances, personal values and past experiences with disaster events.

6 Fraser Coast region bushfire hazard context

The following sections set out the specific factors relating to the bushfire hazard context for the Fraser Coast region.

6.1 Designated bushfire prone areas

Bushfire Risk Areas are identified on Map OM-005 within the current Planning Scheme. As previously noted, the current bushfire mapping includes three categories of bushfire risk being Very High, High and Medium Bushfire Hazard Area, with the inclusion of the Bushfire Hazard Potential Impact Buffer.

It is understood the current Planning Scheme bushfire risk mapping reflects the State Planning Policy's 2014 Bushfire Prone Area mapping, which was based on the best available data at the time (Figure 6-1). The current overlay mapping includes three categories utilised by the State Planning Policy and incorporates a 100 metre buffer around designated bushfire prone lands which is also subject to potential flame contact and radiant heat exposure.

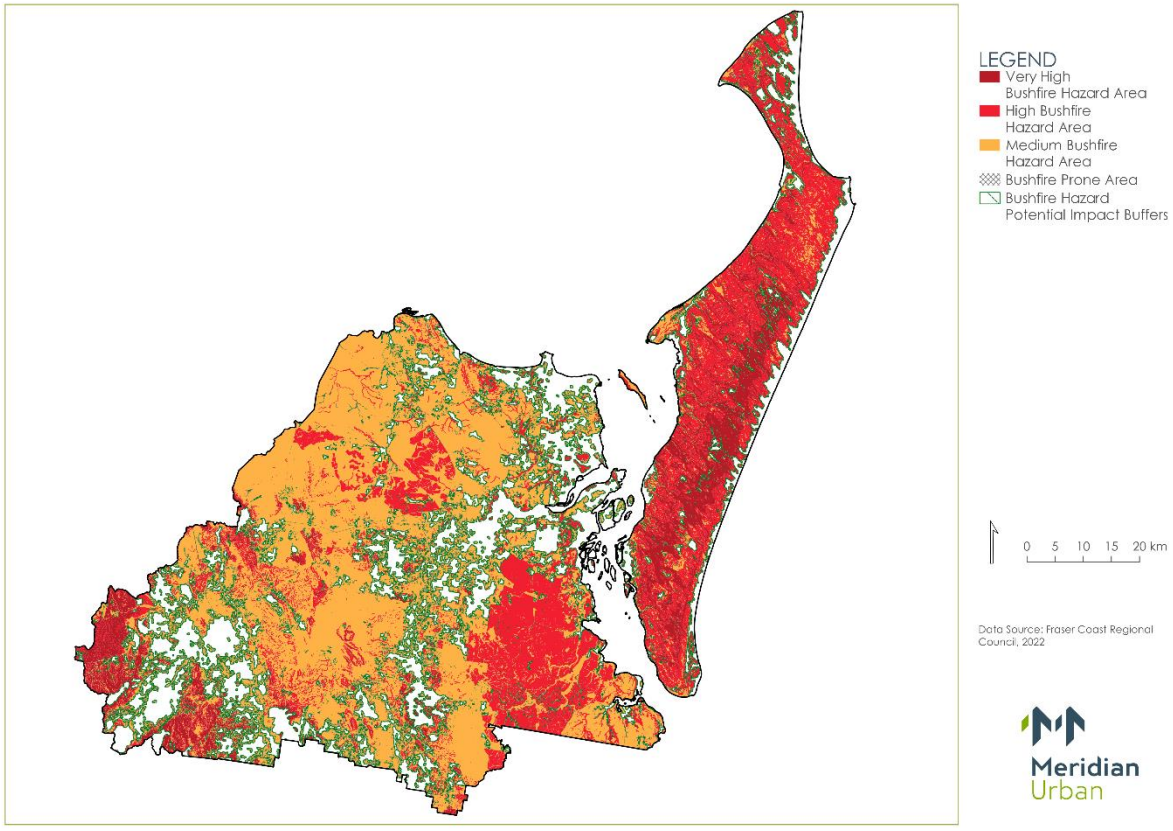


Figure 6-1 – Current Planning Scheme bushfire risk mapping (OM-005 Bushfire Risk Area)

The current overlay mapping represents the latest available state-wide mapping for the region. However, it is noted that the methodology to prepare the mapping was since updated in 2017 to incorporate patch and corridor filtering.

A reliability assessment has been undertaken on the 2014 mapping product. The assessment intended to determine the accuracy and suitability of the state-wide Bushfire Prone Area for land use planning purposes in accordance with the requirements of the State Interest Policy of the Natural hazards, risk and resilience State Interest relating to bushfire hazard. The assessment determined that the state-wide BPA mapping is considered suitable for local government planning scheme preparation and other strategic planning decisions with a reliability of 93.6 per cent.

6.1.1 State-wide bushfire prone area mapping

In 2014, the CSIRO in conjunction with QFES, released the *'New Methodology for State-wide Mapping of Bushfire Prone Areas in Queensland'*. This methodology underpins the fire science which is incorporated into the current SPP mapping. This mapping is also regularly updated. In 2017, the CSIRO released addendum methodological information, *'Estimating the Potential Bushfire Hazard of Vegetation Patches and Corridors: An enhancement of Queensland's methodology for State-wide mapping of bushfire prone areas'*.

The State-wide mapping methodology has been subject to peer review processes and has been found to be highly accurate, yielding an estimated 85 per cent level of accuracy based upon recent innovation in fire science and is considered a substantial advancement in bushfire hazard mapping in Queensland. 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.

It is recognised that depending upon the timeframe of adoption of an amended Fraser Coast Planning Scheme, the current state-wide BPA mapping may not be the version which Council ultimately adopts for the purposes of the bushfire hazard overlay mapping. This may occur where the state-wide BPA mapping is updated / refined / revised before the proposed planning scheme is finalised.

Irrespective, the current state-wide BPA mapping provides an acceptable view of potential bushfire hazard, based on fireline intensity. The state-wide BPA mapping for the Fraser Coast region, as part of Wide Bay Burnett, was last updated in 2014. This product does not reflect the 2017 refinements to the methodology after its original 2014 release.

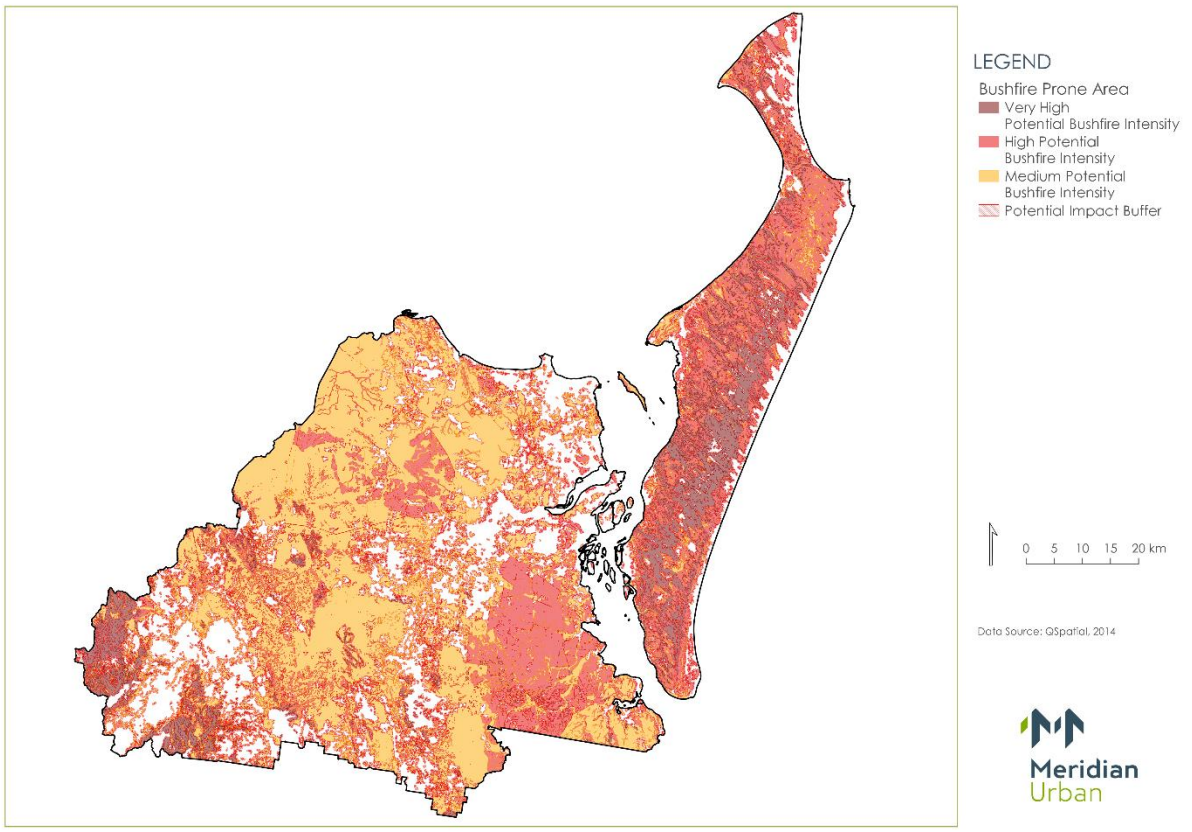


Figure 6-2 – Extract of the state-wide bushfire prone areas mapping for the Fraser Coast region (Source: Queensland Government, 2017)

It is important to note that grassfire hazard is not a category mapped under the current State-wide methodology, given its fireline intensity does not exceed 4,000 kW/m^2. However, grassfire hazard is present across the agricultural and rural areas of the region.

As illustrated by the state-wide bushfire prone areas mapping for the Fraser Coast region, the highest levels of mapped hazard occurs within heavily vegetated areas of the region such as the Great Sandy National Park, Walligan and Tuan State Forest as well as the western part of the region around the Mount Walsh National Park and the Grongah National Park.

Areas of moderate hazard are mapped within the centre of the region around Aramara, stemming into areas of the Wongi State Forest, and Bauple.

Areas of bushfire hazard are also mapped near to urban settlements near Booral, Toogoom, Burrum Heads, and Pacific Haven.

6.1.2 Mapping verification process

Pursuant to the provisions of the *Bushfire Resilient Communities technical reference guide* which constitutes guidance material under the SPP, local verification of the current State-wide BPA mapping has been undertaken for the Fraser Coast region, as part of this risk assessment. This process considers the accuracy of data inputs and resultant bushfire hazard class outputs, ostensibly relating to fireline intensity. A BPA Reliability Assessment was undertaken by Meridian Urban prior to the commencement of this project.

Overall, this risk assessment along with the reliability report identifies the current BPA mapping includes small instances of over-representation of the magnitudes of bushfire hazard in isolated parts of the region, which appears to be associated with how topographical inputs have been weighted as part of mapping development. Notwithstanding these observations, the reliability assessment demonstrates a 90 per cent level of satisfaction across the 180 cells of interest that were examined by geo-spatial processing.

The reliability assessment determines the state-wide BPA mapping is suitable in terms of its level of accuracy across the Fraser Coast region. Accordingly, the state-wide BPA mapping is considered suitable to form the bushfire hazard overlay map of an amended Fraser Coast Planning Scheme.

The state-wide BPA mapping is regularly updated by QFES. As such, it may be the case the state-wide BPA mapping is updated following this risk assessment and prior to the adoption of the new planning scheme. Any updates are likely to incorporate the most recent Regional Ecosystem dataset. Having regard to this risk assessment it is considered unlikely that updated mapping (based on the existing methodology) would result in any significant changes to the risk profiles identified by this risk assessment.

To this end, this risk assessment need not be updated in the event that updated mapping is released prior to Council's endorsement of a proposed planning scheme.

A recommendation of this risk assessment is that Council works alongside the State government as part of ongoing updates and amendments processes supporting the state-wide BPA mapping.

6.2 Climate and fire weather

Fraser Coast enjoys a sub-tropical climate along with the majority of the Wide Bay Burnett which is characterised by warm humid summers and mild winters. Rainfall occurs year-round but is highest during Summer months with a mean annual rainfall of 744mm. The region is also subject to seasonal severe storms which can include lightning strikes which are a key form of bushfire ignition (BoM, 2020). July is historically the driest month for the Fraser Coast region.

6.2.1 Projected impacts of climate change

Observations of weather over the last 30 years by the Bureau of Meteorology (BoM) have indicated that annual rainfall across the Wide Bay Burnett Region has been relatively stable however, summer rainfall has decreased in the summer months along the coast. Additionally, there has been a clear increase in the number of hot days (days over 35°C) which is characteristic of current climate change observations which are reflective of a general warming of the Australian climate (BoM, 2019).

Utilising the Queensland Government Queensland Future Climate Dashboard (2021), key climate projections relevant to fire weather in the Fraser Coast region include:

- Annual **precipitation** is projected to remain relatively stable with exceptions along the coastline of Fraser Island however, it is noted that precipitation within the dry season (May – September) is projected to decrease.
- **Mean temperature** is projected to increase by 1.5-2.5°C under a low emissions scenario or 3-4.5°C under high emissions scenario to 2090 with temperature increases most pronounced during Spring months.
- The number of **hot days** (days over 35°C) is projected to increase substantially by 2090. Under a low emissions scenario the number of hot days is projected to increase by between 240 and 1,300 per cent (4-15 days). It is projected to increase by between 2,600 and 6,900 per cent (22-52 days) under a high emissions scenario.
- **Hot nights** (nights where the minimum temperature exceeds 20°C) are also projected to increase by 2090, notably within Autumn and Summer months. Under a low emissions scenario, hot nights in Autumn will increase by 59 to 170 per cent (11-24 nights) and by 31 to 46 per cent (16-23 nights) in summer. Under a high emissions scenario, Autumn hot nights will increase by 160 to 320 per cent (30-42 nights) and Summer hot nights by 52 to 62 per cent (26-30 nights). It is noted that Autumn nights will substantially exceed the number of hot nights in a high emission scenario by 160 to 320 per cent (30-42 nights) by 2090.

The above indicates that irrespective of climate action to reduce greenhouse gas emissions, a degree of climate change is locked in through to 2090. The factors of which speak to a hotter and drier environment for the Fraser Coast region. This is likely to give rise to increased fire frequency and potential consequences across the region.

Hot nights in particular are a critical factor for consideration in fire suppression. To date, reduced temperatures during the night provide a key opportunity for firefighters to supress and contain running fires. During the Black Summer fires, fireground temperatures in the evening were not much less than during the day, eliminating this critical opportunity for fire response.

6.2.2 Influence of climate change on fire weather

The 2018-19 and 2019-20 fire weather seasons were record breaking for Queensland.

In 2020 the Bureau of Meteorology issued a Special Climate Statement detailing the climatic factors which contributed to dangerous fire weather conditions in the 2019-20 fire season, confirming large areas of Australia had their highest accumulated FFDI for December in 2019. It also notes 2019 had the highest December accumulated FFDI for Australia as a whole, continuing the pattern seen in the spring period across Queensland.

The BoM report 'Changes to Fire Weather in Queensland' released in 2019 provides that the time series of annual accumulated FFDI for the South East Coast sub-region from 1950 to 2018 has increased by 51 per cent, the largest sub-regional change in Queensland.

The average annual occurrence of days of FFDI of 50 or higher has increased by 368 per cent over the same period. This is followed closely by the neighbouring Wide Bay Burnett sub-region.

BoM states this data should be used with caution however, FFDI is significant given the associate spike in house loss for events of FFDI 50 or more.

Based on a time-series index, indicators of fire season commencement (FFDI <25) is occurring 18 days earlier and ending 16 days later, demonstrating a lengthened fire season is now occurring in this region compared with previous decades.

The impact of climate change on fire weather is complex. It is not as simple as an elevated FFDI but involves a likely increased frequency of both higher fire danger days, as well as more frequent fire danger days. Longer fire seasons which start earlier and extend over a longer period are projected (Douglas, 2017), with a cascading impact on fuel reduction opportunities in cooler months. BoM identifies there is no current change to beginning of the fire season in the Wide Bay Burnett Queensland than is was several decades ago however, the season is ending 29 days later.

The work of Douglas (2017) which focuses extensively on the impact of climate change on fire weather for land use planning notes **'a trend to more severe fire weather conditions, however the changes range from subtle to pronounced. These results have implications for adaptation in future land use decision making'**.

Catastrophic fire weather events may be rare in nature, and fires in these conditions can be considered as outliers when compared with the frequency of lower FFDI events. However, it remains the responsibility of strategic land use planning to consider the risks associated with higher magnitude and rarer events. In flood risk management this is often referred to as the probable maximum flood.

6.2.3 Wind speed and direction

Wind speed and direction data has been obtained from BoM for five weather stations within and closely bordering the Fraser Coast region. Monthly climate statistics from 'Climate Data Online' provide wind information for the region from the following stations and periods of data:

- Gympie 1965 – 2022
- Hervey Bay Airport 1999 - 2022
- Maryborough 1957 – 2022
- Rainbow Beach 1992 – 2022
- Sandy Cape Lighthouse 1957 – 2022.

The locations of these weather stations are seen below in Figure 6-3.

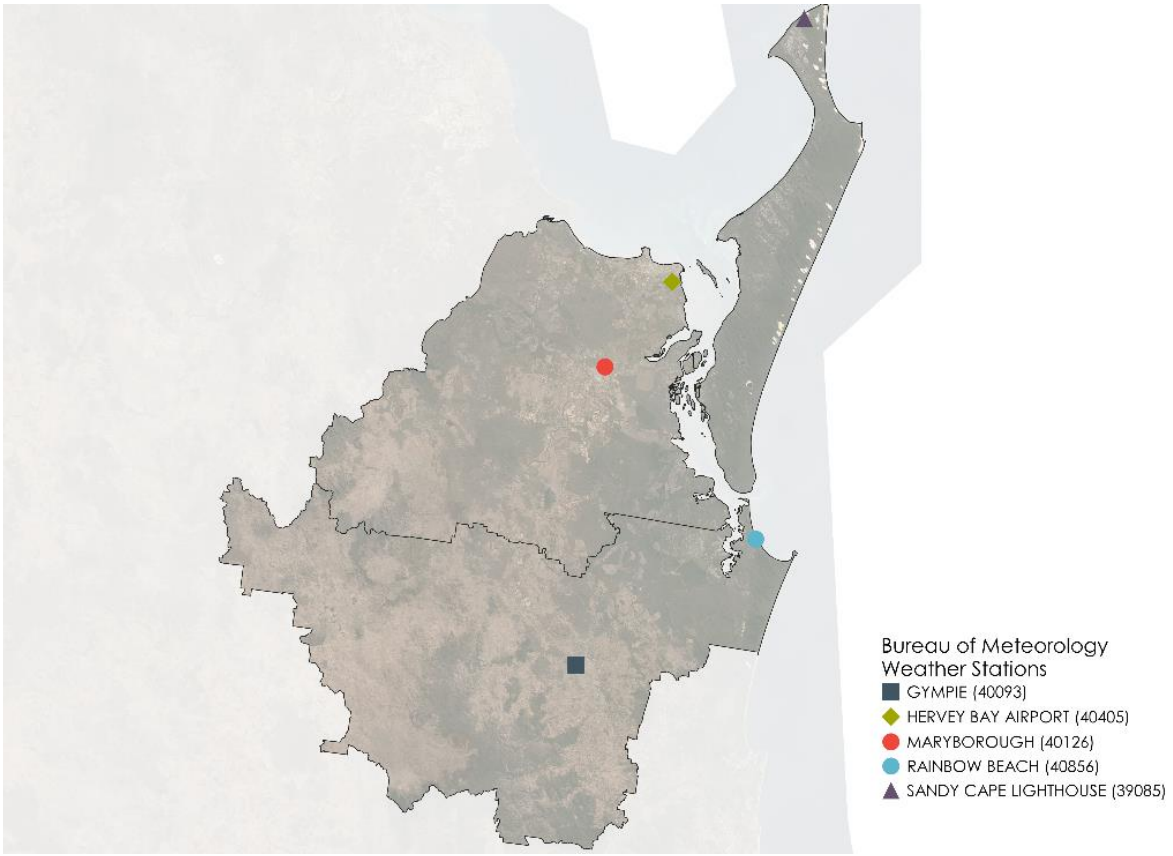


Figure 6-3: Location of Weather Stations

Monthly BoM statistics for the 3pm observations (around the time where FFDI peaks each day) have been considered for each month of the fire season from August to March, and then annually.

Gympie predominately has a prevailing wind deriving from the south east for the months of August, the end of Summer and March, with prevailing winds deriving from the east during Spring and the beginning of Summer. There is an average annual wind speed of 10-20km/h which is consistent through Summer, Spring and the months of August and March. Gympie shares this average annual wind with Rainbow Beach and is relatively consistent with prevailing wind orientation with other weather stations.

The annual average prevailing wind for Hervey Bay predominately derives from the south east. During August, the prevailing wind is from the north of between 10-20km/h. This continues through Spring and the beginning of Summer where wind speeds increase to 20-30km/hr. From January, wind direction shifts to prevail from the south-east which continues through to March. The average annual wind speed is consistent with the other weather stations, with the exception of Gympie and Rainbow Beach.

Maryborough predominately has a prevailing wind deriving from the south east during August, December, February and March. Wind deriving from the north prevail during Spring and easterly winds dominate during January. The annual average wind speed for Maryborough is between 20-30km/h and this is the primary wind speed for August, Spring, Summer and March. Maryborough and Rainbow Beach are the only weather stations with a consistent wind speed.

The annual average prevailing wind for Rainbow Beach predominately derives from the east. During February and March, the prevailing wind is from the south east, while winds prevail from the east during August, Spring, December and January. The annual average wind speed is between 10-20km/hr. This is consistent throughout August, Spring, Summer and March.

Sandy Cape Lighthouse predominately has a prevailing wind deriving from the east. During October and November, the prevailing wind is from the north of between 10-20km/h. The average annual wind speed is between 20-30km/h which continues through Spring, Summer, and March, before shifting to 10-20km/h during August.

Annually, south easterly winds dominate for all stations except for Rainbow Beach and Sandy Cape Lighthouse where an easterly wind dominates. The average annual wind speeds are predominately between 20-30km/hr for all regions except Gympie and Rainbow Beach which have speeds between 10-20km/hr.

Overall, wind direction and speed is observed to change through the year based on season and direction varies between stations. This is particularly observed during Spring where Gympie and Rainbow Beach have a prevailing wind from the east, while Hervey Bay, Maryborough and Sandy Cape Lighthouse have a prevailing wind deriving from the north. The dominant annual average prevailing wind for all stations is from the south east with the exception of Rainbow Beach and Sandy Cape Lighthouse having a prevailing wind from the east. Wind speed also varies between weather stations. The average annual wind speeds are between 10-20km/hr for Gympie and Rainbow Beach, while the other weather stations have speeds between 20-30km/hr.

6.2.4 Rainfall

Mean rainfall data is available via BoM's 'Climate Data Online' facility, with data sourced from five (5) weather stations collected over periods extending from the 1870s to the 1990s (BoM, 2022).

The highest mean rainfall months each year typically occur in January, February and March where the mean rainfall exceeds 140 millimetres in each month. Rainfall decreases significantly between July and September. This places the months of August, September and October (Spring) as the period of increased bushfire hazard, with low soil and biomass moisture contents from the drier winter period combining with rising daytime temperatures, low relative humidity and strong dry easterly and northerly winds.

As identified in Figure 6-4 below, the mean rainfall also decreases during July through to September. It is observed that both Hervey Bay and Maryborough received the lowest mean rainfall during the months between July to September which coincides with the fire risk season.

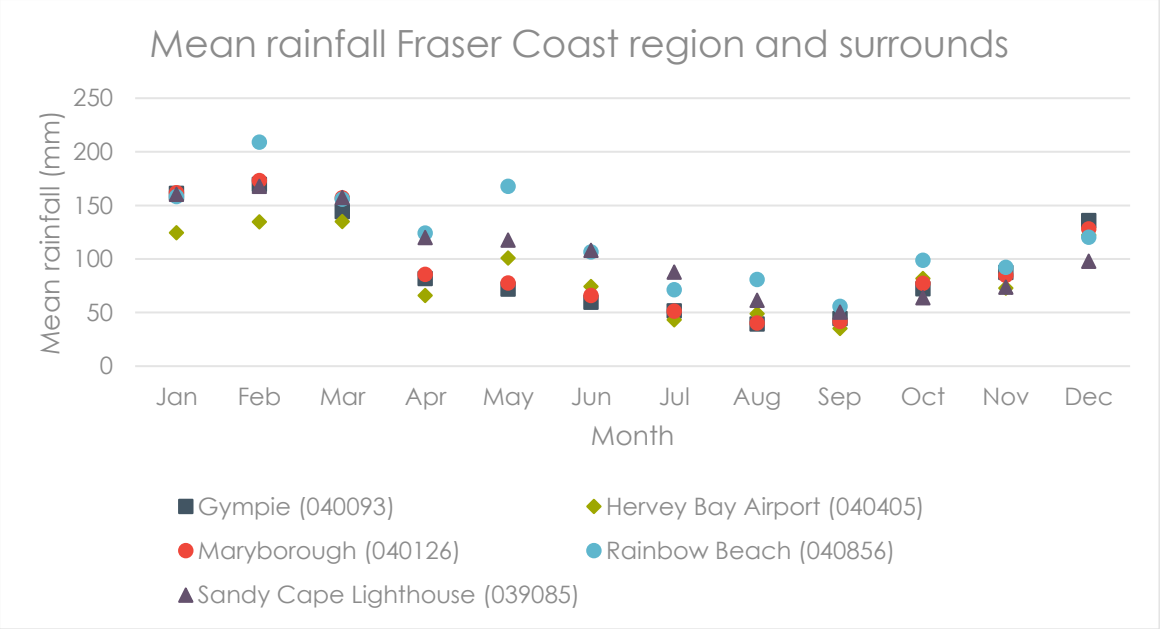


Figure 6-4 – Mean monthly rainfall for five (5) weather stations across Fraser Coast Region and Surrounds (Source: BoM, 2022)

6.2.5 Relative humidity

Mean 3pm relative humidity data, measured as a percentage is available via BoM's 'Climate Data Online' facility, with data for the five (5) weather stations collected between varying dates as early as the 1938 until 2010. The 3pm daily mean is representative of the general time that FFDI peaks each day.

The period of lowest relative humidity, and conducive to increased fire weather, occurs from July to September each year, which aligns with other meteorological elements to give rise to increased fire danger from August and into the summer months (Figure 6-5). It is noted that both Maryborough and Hervey Bay recorded the lowest mean humidity during these months compared with the other sampled weather stations.

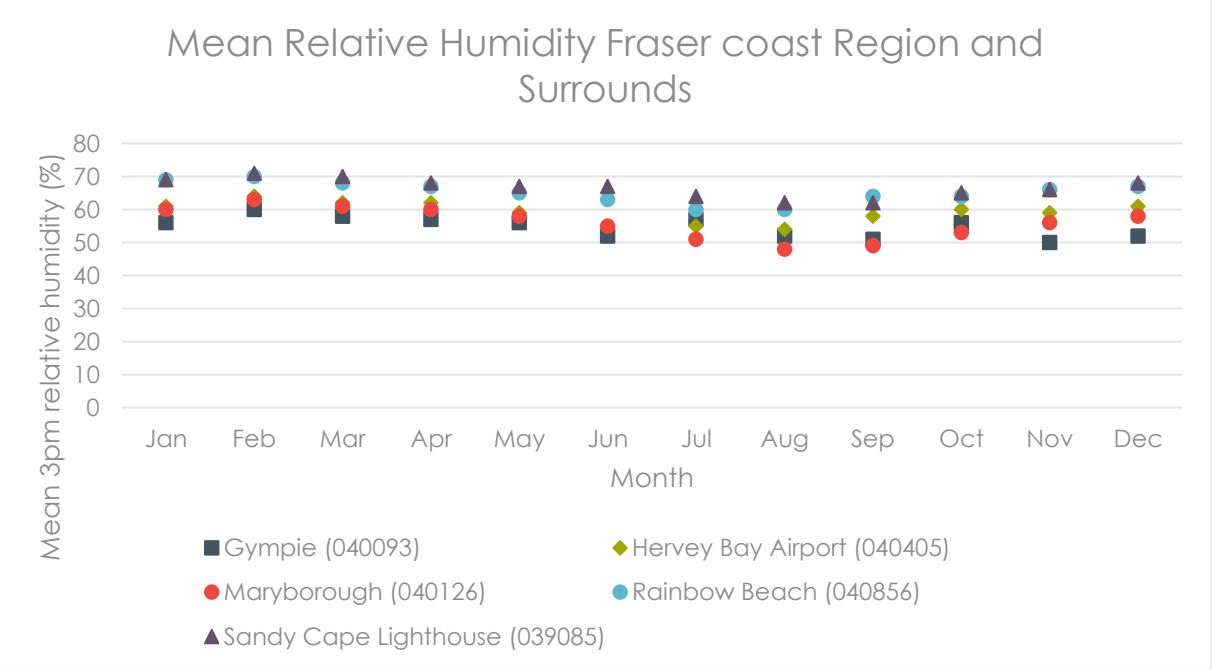


Figure 6-5 – Mean 3pm relative humidity for five (5) weather stations (Source: BoM, 2021)

6.2.6 Localised fire weather

The state-wide bushfire prone areas mapping is based upon 1 in 20 year Annual Return Interval (ARI) (generally equivalent to a 5 per cent Annual Exceedance Probability (AEP)) climate-adjusted FFDI values. These values increase in scale from south east to north west, estimated up to FFDI 50 (Figure 6-6).

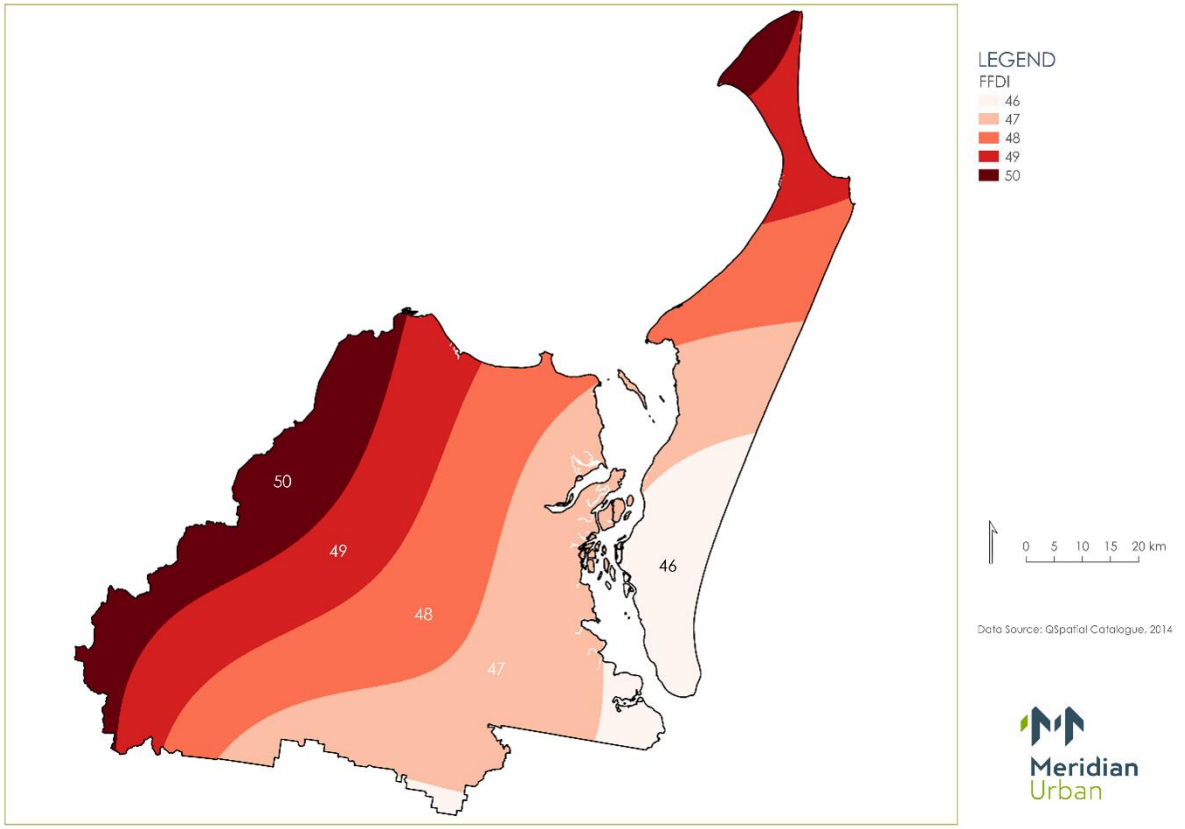


Figure 6-6 – Climate-adjusted 1 in 20 year fire weather (FFDI) for the Fraser Coast region

The 2019 '*Changes to Fire Weather in Queensland*' report prepared by BoM for Queensland Fire and Emergency Services (QFES) indicates a change in extreme annual (highest daily) FFDI from 1950-2018, indicating that annual accumulated FFDI across the South East Coast sub-region (of which Fraser Coast forms part) has increased by 51 per cent between 2050 and 2018 (BoM, 2019). This represents the largest change of any region in Queensland.

The average annual occurrence of FFDI >50 days has increased by 368 per cent (BoM, 2019).

Based on a time-series index, indicators of fire season commencement (FFDI <25) is occurring 18 days earlier and ending 16 days later, demonstrating a lengthened fire season is now occurring in this region compared with previous decades.

In summary, the following climatic and fire weather observations are apparent for the Fraser Coast region:

- Current climate-adjusted 5 per cent AEP FFDI values for the region range from 46 in the south east and 50 in the north west of the region
- The frequency of higher FFDI days is increasing, as are hot nights
- The annual fire season has grown longer over recent decades and is likely to continue to do so
- Precipitation has, over recent years, remained relatively stable across the region, with the exception of along the coastline
- Temperatures across the region over recent years have increased and is projected to continue to do so as a result of climate change and this has driven an increase in higher FFDI days and more frequent high FFDI days, and is likely to continue to do so.

6.3 Vegetation and fuels

Fuel load, arrangement and connectivity (or conversely, fragmentation) represents a considerable component in dictating to a large degree the behaviour of fire in terms of intensity, rate of spread and flame height. Different vegetation groups yield very different fire behaviour and intensities by virtue of their characteristics such as density, arrangement, fuel loads and other characteristics.

Vertical and horizontal continuity of fuels is also a considerable factor. Vegetation characteristics guide estimates on how quickly fire might spread and the likely fire behaviour and intensity which may occur.

Regional Ecosystem status is used to identify relevant vegetation hazard classes (VHCs), pursuant to the QFES *Bushfire Resilient Communities technical reference guide*. This system translates Regional Ecosystems into a series of VHCs which represent vegetation community typologies, against which potential fuel load and continuity is established.

Vegetation across the region is largely dominated by moist to dry eucalypt woodland, low grass or tree cover and moist to dry eucalypt open woodlands. Areas of heathlands, scrubs, shrublands, exotic and hardwood plantations, and spotted gum open forests and woodlands are also present (Figure 6-7).

In 2021, RedLeaf was commissioned by Council to undertake a Regional Ecosystem (RE) Vegetation Mapping project delivering a refined mapping product. The project intended to deliver a mapping product a 0:25,000 scale and refine the broad and unrefined State RE vegetation mapping for the region. There were 11 priority areas selected for the Regional Ecosystem mapping which are understood to be located within anticipated growth areas for Council including within the following locations:

- Booral
- Burrum Heads
- Toogoom
- Nikenbah
- Dundowran
- Kawungan
- Maryborough North
- St Helens
- Tinana.

This report identified several instances where the State's RE mapping did not reflect the identified vegetation communities. In Booral, an area along Janine Road was cleared with a parkland type cover and localised remnants remain present however, this does not reflect the 12.3.11 RE class.

In Maryborough North, channels in Deadman's Gully and Saltwater Creek were mapped as 12.3.5 and 12.3.6. Site inspections found that RE 12.3.20 may be a better fit for these areas. This does not change the fuel load for these two areas.

The area sampled in the south west of Toogoom, north of Oregan Creek Road and West of Toogoom Road were mapped as 12.5.4. This area has been re-mapped as 12.2.11 which does not change the fuel load of the area.

Sample areas mapped as 12.2.12 at Burrum Heads and Toogoom were found to be more aligned to RE 12.2.13. This change does not result in an increased fuel load.

The report identified some instances where changes in RE classes were recommended. These instances have not resulted in significant changes to fuel loads relevant to creating the BPA mapping. It is noted that there were instances where the spatial extent of vegetation mapping was able to be refined based off the study undertaken. If utilised, improved accuracy of the BPA mapping may result.

Most of the region's bushfire hazard is located on Fraser Island, in the south-eastern, western and northern areas of the LGA. These are also the locations where steep topography occurs within the region.

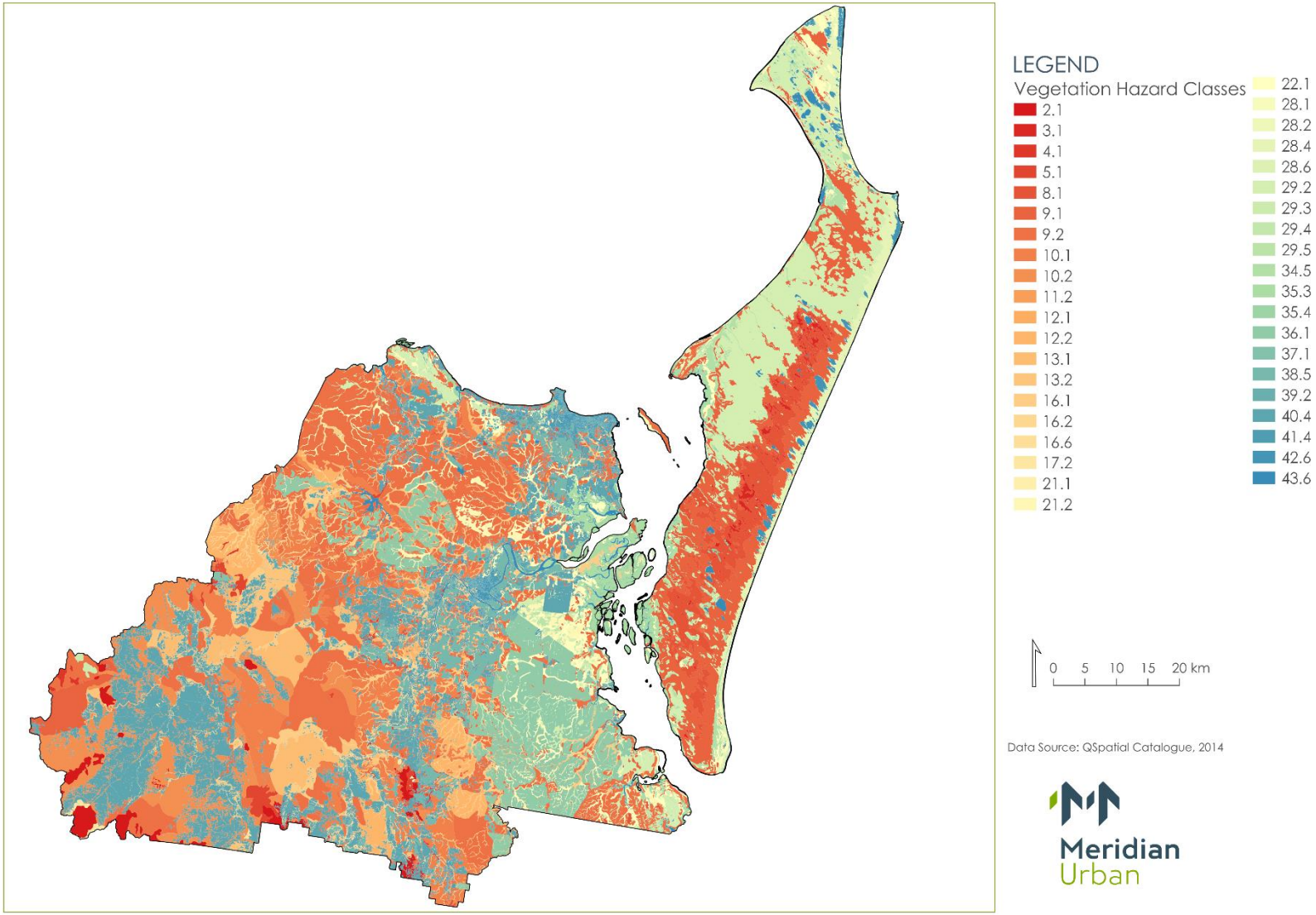


Figure 6-7 – Vegetation hazard classes for the Fraser Coast region

6.4 Topography

The region is flanked to the west by the Burnett, Clifton, Coast, Seaview and Urah Ranges, along with various mountains including Boogooramunya, The Bluff and Sugar Loaf Mountains. To the south and north are characterised by relatively flat, plain areas except for Guyra Mountain, Mount Bauple, Mount Kanigan and Theebine Mountain in the south which are isolated. To the east, the Fraser Island's topography is characterised by hills and sand dunes which are predominately facing towards the ocean as seen in Figure 6-8.

Several major rivers and waterways traverse and coverage in the Fraser Coast LGA before draining into the Great Sandy Strait or the Coral Sea. These include the Burrum, Mary and Isis rivers and the Tinana, Teebar and Munna creeks.

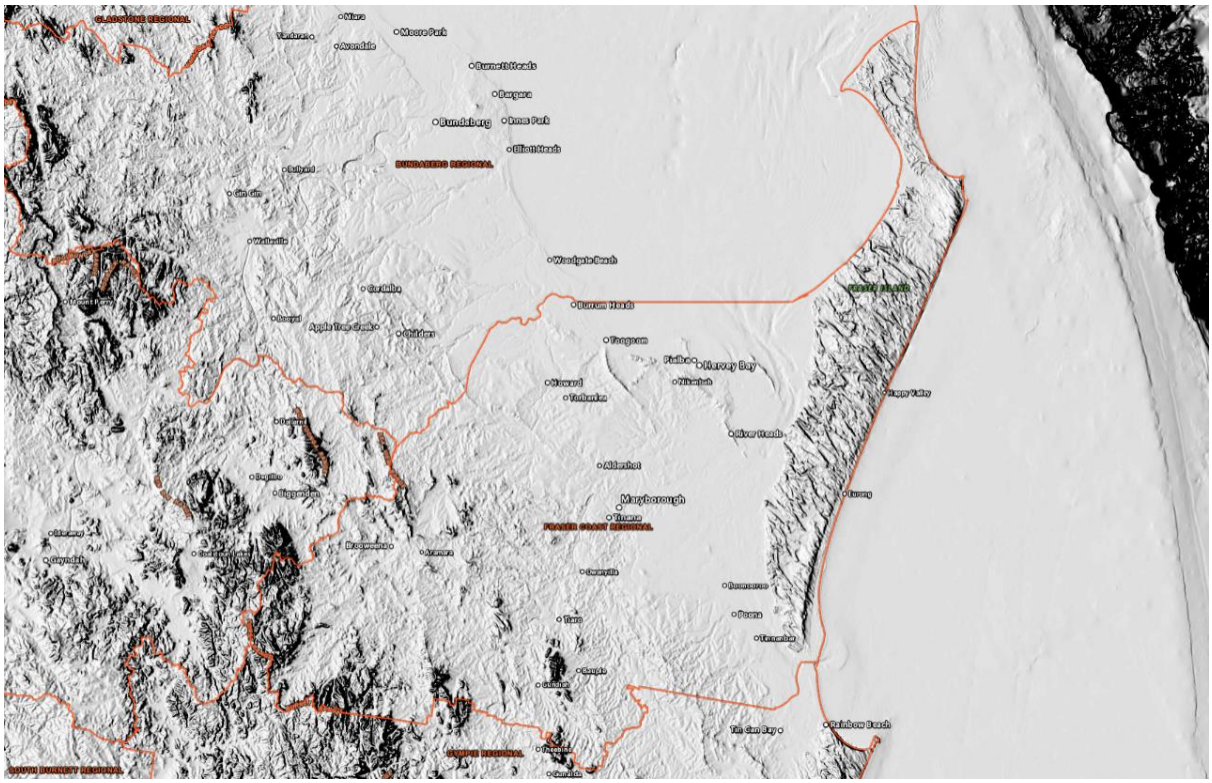


Figure 6-8 - Topography (hillshade) of the Fraser Coast region (Source: Queensland Globe, 2022)

6.5 Fire history

Fire history is an important parameter for examination as it gives an indication of aspects of potential likelihood and consequence, which are two factors which give rise to the consideration of risk.

The history of fire in the Fraser Coast region includes records dating back to the 1964-1965 fire season where fire burnt through approximately 92,000 hectares of the region and surrounds. Recent fire events on Fraser Island impacted communities and visitors in 2020 and burned from October to December.

The 2020 bushfires were ignited by an illegally lit campfire which was not properly extinguished. Campers first reported a fire on 14 October at Orange Creek in the north-east coast of the island. This fire then spread to encompass nearly the entirety of the northern part of the island and spread to both sides of the island. On the western side of the island, the fire affected as far south as the Kingfisher Bay Resort. The fire stemmed south of the Happy Valley township to Yidney Rocks and the Oaks on the eastern side of the island.. The fire was eventually contained on 3 December through joint agency efforts in collaboration with the Butchulla people and

extensive waterbombing operations dropping over 13.3 million litres of freshwater, seawater and gel additives.

During this two month event, the fires burnt through approximately 85,000 hectares, equating to more than half of the island however, there was no loss of life nor homes lost. Campers on the island were relocated to the south, with some choosing to leave although, no evacuation order was given. A place of refuge was also established at Eurong. Staff from Kingfisher Bay Resort were relocated to the mainland to reduce personnel at the resort should the fire progress further.

Several factors were attributed to the severity and spread of the 2020 bushfires on Fraser Island. These being high temperatures, strong dry northerly winds, complex vegetation types and structures which were dry and receptive to fire, difficult terrain and limited and remote access across the island coupled with loose, narrow and dry sand tracks. Containing the 2020 bushfires on Fraser Island was further exacerbated by the necessity to traverse the island in four-wheel drive vehicles, no power mains or town water supply, no connected sewerage and limited telecommunications and internet across the island.

Landsat and Sentinel 2 imagery of fire frequency, provided at Figure 6-9 below, for the period from 1987 to 2016 indicates higher fire activity concentrated below Hervey Bay in north west, stemming through the centre of the region around Maryborough before continuing towards the south east. Activity is also present in the west of the region and north of Gympie. This is reflective of the vegetation hazard classes, bushfire prone areas and presence of protected vegetated areas. It is noted that the mapping does not distinguish between bushfire or controlled burns.

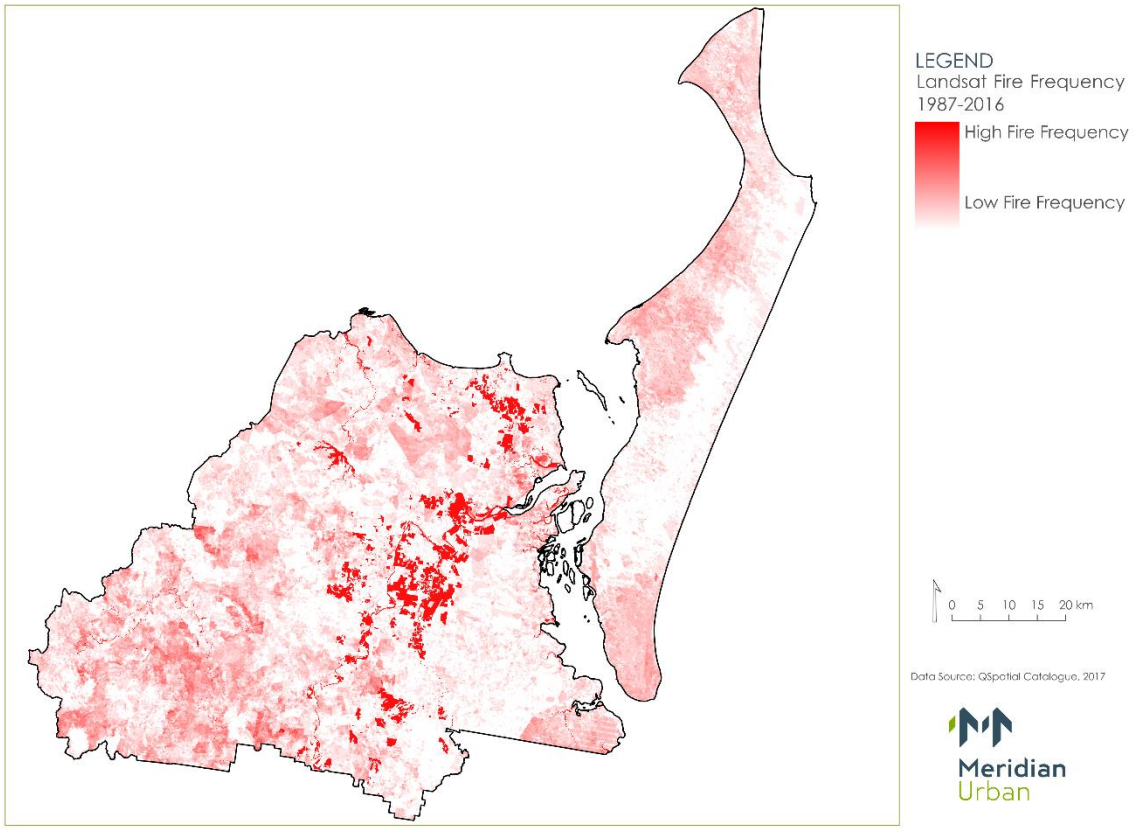


Figure 6-9 – Fire frequency extents from 1987 to 2016

6.6 QFES 'Operation Sesbania' risk assessment

Each year, QFES prepares LGA and region-based bushfire risk assessment which are used to inform 'Operation Sesbania', the annual bushfire mitigation program. It is a multi-agency operation which brings public land owners together to prepare for each annual fire season.

Each season, as conditions change, QFES undertakes detailed risk assessments which identify the localities in highest need of mitigation activities, based on a series of factors which includes recent rainfall, vegetation growth, time since last activity, people and property exposure, etc.

The types of bushfire mitigation activities include hazard reduction burning to reduce fuel loads, improvement of strategic fire breaks by landowners and targeted community education to inform residents in the highest priority areas of actions they can take to better prepare for bushfires.

There are two applicable Operation Sesbania plans for the Fraser Coast Region covering the Fraser Coast mainland and Fraser Island. Both plans identify key areas of risk on the mainland and the Island for mitigation activities. Key areas of risk identified for mitigation activities on the mainland include Boonooroo, Boonooroo Plains, Torbanlea, Tuan Forest and Burrum Heads. Key areas of risk identified for mitigation activities on Fraser Island include Orchid Beach Township, Cathedrals on Fraser, Waddy Point Campground, Dilli Village, Eurong South and Happy Valley. Other localities join this list on occasion each year, depending on seasonal fluctuations in fire weather, development and time since last mitigation activity.

The difference between the Operation Sesbania and this risk assessment is that the Operation Sesbania seeks to inform annual risk mitigation activities. In this sense, the localities of focus are likely to change year on year in response to changes in the local risk profile each season. This risk assessment however seeks to inform and guide long-term planning policy, strategy and statutory planning activities with a view to ensuring risk-responsive development outcomes for the community, and for regulators. Over time, the benefits derived from this risk assessment, and processes like it, will arrest growing burden placed on emergency services to defend communities and property as a result of increased interface development and a changing climate.

6.7 Local and landscape-scale bushfire hazard

This contextual Review of the elements which influence local bushfire hazard across the Fraser Coast region indicates that the environment ***experiences high fire activity and is likely to become more prone to bushfire into the future***. This is highlighted by the following observations:

- Bushfire is endemic to the Fraser Coast region, with a history of events which have given rise to some property loss and community / tourist evacuation over recent decades.
- Recent climate and weather trends indicate the hazard and risk profile of the Fraser Coast region has already changed in comparison with decades prior to the 1980's.
- Climate influences are projected to continue to change over future decades, which is likely to generate an increased likelihood of fire across the region. Fire weather is increasing more substantially in the south east corner of the state than any other region.
- The intensity and behaviour of fire may increase over future decades across the region as rainfall decreases and mean temperatures increase, giving rise to longer periods of drought, lower soil and biomass moisture, changes to vegetation communities and increase in ground fuels and dead materials.
- Longer fire seasons are already occurring and projected to increase over future decades.

From a spatial perspective, the topography, vegetation and fuel dynamics across the region combine to highlight a number of ***key areas where increased bushfire hazard is present***. These include:

- Areas where urban settlements interface with bushland in the south-west of the region around Glenwood, Tuan, Boonooroo and Magnolia.
- Urban areas of Toogoom, Takura, Eurong, Burrum Heads and Maryborough West that adjoin fragmented or condensed bushland.
- Rural residential communities of Duckinwilla, Pacific Haven, Burgowan and Adlershot in the north of the region where residential premises are intermixed with areas of moderate to high potential bushfire intensity.
- Rural residential communities in the south, south-west of the region where residential premises are intermixed with areas of moderate to high potential bushfire intensity being Bauple, Gootchie and Gigoomgan.
- The western area of the region around The Bluff, Burnett, Clifton, Coast, Seaview and Urah Ranges and Boogooramunya Mountain where the bushfire hazard is influenced by the steep topography and vegetation.
- Vegetated areas of Fraser Island, Howard, Cherwell, Glenbar, St Mary, Teebar, and Tiaro.
- The Great Sandy Strait communities which interface with bushland areas and have limited access and egress.

These areas will provide the context for focus of Part B of this body of work, which comprises the risk assessment.

Meridian
Urban