A community-led catchment

Burdekin and Haughton Flood Resilience Strategy

June 2021

Barcaldine Regional Council
Burdekin Shire Council
Charters Towers Regional Council
Isaac Regional Council
Mackay Regional Council
TRC
Townsville
Whitsunday Regional Council
Australian Government
Queensland Government

Document details

Security classification	Public
Date of review of security classification	June 2021
Authority	Queensland Reconstruction Authority
Document status	Final
Version	1.0
QRA Reference	QRATF/21/748 (GD/0623)

Interpreter

The Queensland Government is committed to providing accessible services to Queenslanders from all culturally and linguistically diverse backgrounds. If you have difficulty in understanding this report, you can access the Translating and Interpreting Services via www.qld.gov.au/languages or by phoning 13 14 50.

Disclaimer

While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained within.

To the best of our knowledge, the content was correct at the time of publishing.

Copies

Copies of this publication are available on our website at: www.qra.qld.gov.au/burdekin-haughton

Further copies are available upon request to:

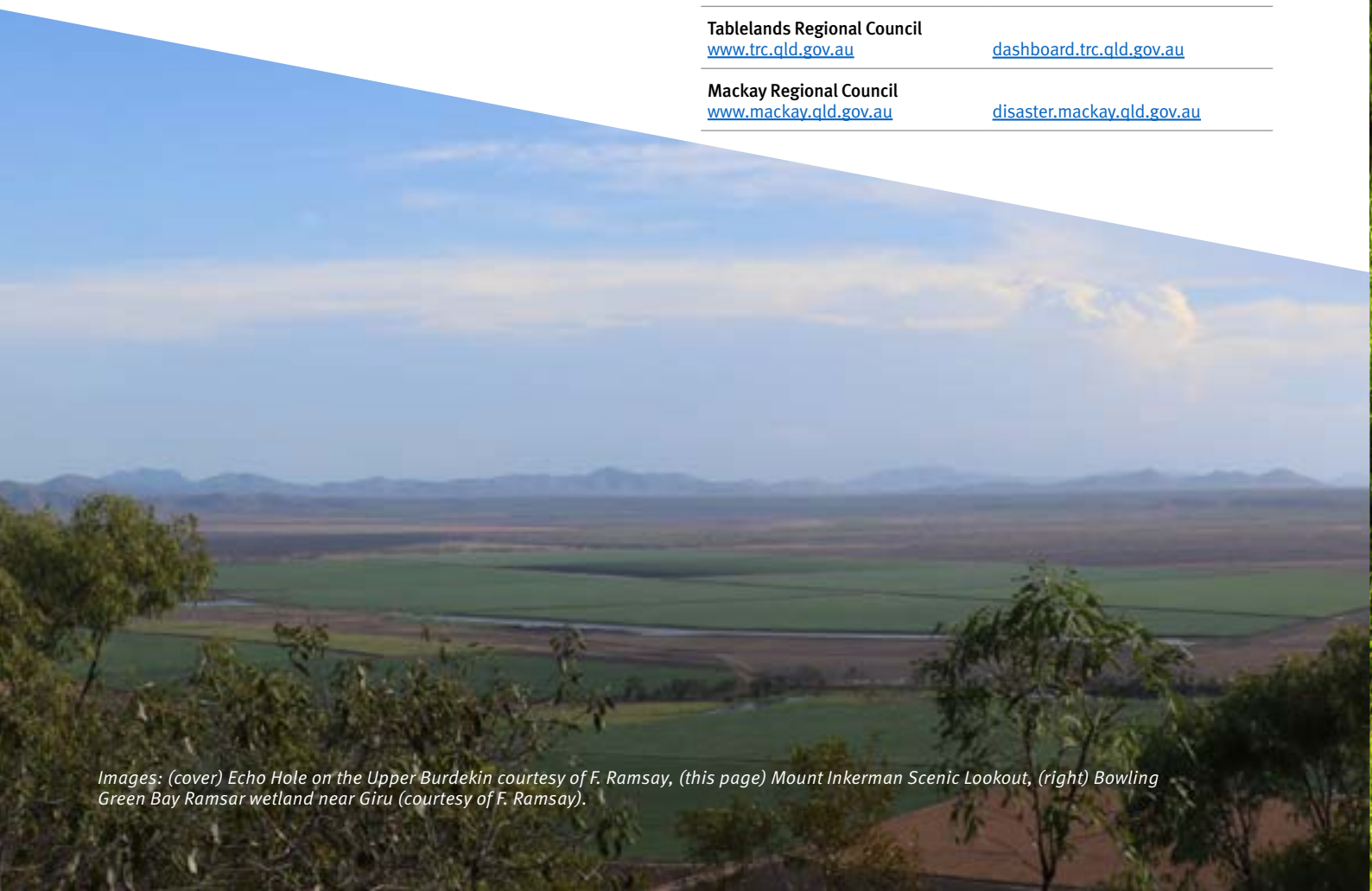
Queensland Reconstruction Authority
PO Box 15428
City East QLD 4002
Phone (07) 3740 1700
info@qra.qld.gov.au
www.qra.qld.gov.au

The Burdekin and Haughton Flood Resilience Strategy is a community-led approach and partnership between eight councils working towards a shared vision of flood resilience for our region.

Councils can assist you with up-to-date flood related information including evacuation centre openings and locations, river heights, road conditions and closures, power and phone outages. Many councils provide an online dashboard for disaster management or emergency management, including information about local hazards, key situational awareness information and other resilience initiatives.

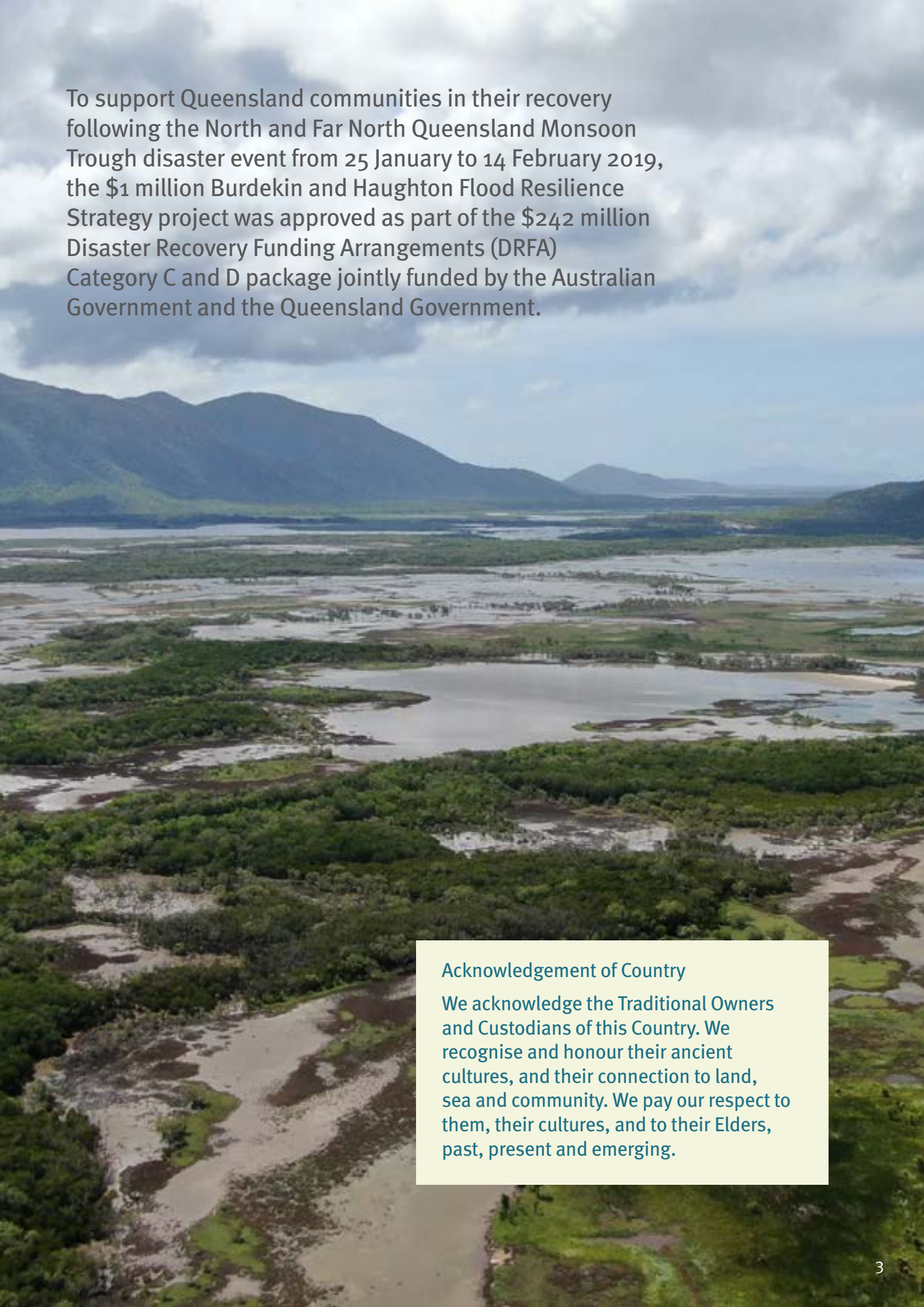
For emergencies, dial Triple Zero (000) for Police, Fire and Ambulance. For help with a damaged roof, rising flood water, trees fallen on buildings, or storm damage use the SES app or phone 132 500. For information about emergency services and safety visit www.qld.gov.au/emergency.

Council/website	Disaster Dashboard
Burdekin Shire Council www.burdekin.qld.gov.au	disaster.burdekin.qld.gov.au
Charters Towers Regional Council www.charterstowers.qld.gov.au	www.getready.ctrc.qld.gov.au
Whitsunday Regional Council www.whitsundayrc.qld.gov.au	disaster.whitsundayrc.qld.gov.au
Isaac Regional Council www.isaac.qld.gov.au	dashboard.isaac.qld.gov.au
Barcaldine Regional Council www.barcaldinerc.qld.gov.au	
Townsville City Council www.townsville.qld.gov.au	disaster.townsville.qld.gov.au
Tablelands Regional Council www.trc.qld.gov.au	dashboard.trc.qld.gov.au
Mackay Regional Council www.mackay.qld.gov.au	disaster.mackay.qld.gov.au



Images: (cover) Echo Hole on the Upper Burdekin courtesy of F. Ramsay, (this page) Mount Inkerman Scenic Lookout, (right) Bowling Green Bay Ramsar wetland near Giru (courtesy of F. Ramsay).

To support Queensland communities in their recovery following the North and Far North Queensland Monsoon Trough disaster event from 25 January to 14 February 2019, the $1 million Burdekin and Haughton Flood Resilience Strategy project was approved as part of the $242 million Disaster Recovery Funding Arrangements (DRFA) Category C and D package jointly funded by the Australian Government and the Queensland Government.



Acknowledgement of Country

We acknowledge the Traditional Owners and Custodians of this Country. We recognise and honour their ancient cultures, and their connection to land, sea and community. We pay our respect to them, their cultures, and to their Elders, past, present and emerging.

Foreword

In recent years, the Burdekin and Haughton River catchments have experienced repeated and severe flooding events that have impacted on the livelihoods and properties of people who live and work in our region.

The Burdekin River is Australia's largest river when at its peak discharge volume, and we rely on this water as the lifeblood of our productive region.

Our communities accept flooding occurs naturally in Queensland, and we appreciate that understanding how our environment works is intrinsically linked to our ability to thrive.

Our communities already have solid foundations in resilience, and our community-led approach to disaster resilience is part of life for Central and North Queenslanders.

This Burdekin and Haughton Flood Resilience Strategy outlines how we will work together to proactively reduce flood risk and increase resilience throughout the catchments.

We can better prepare for the future and keep our communities safe by coordinating efforts, sharing knowledge and capability, and setting a proactive agenda for improving resilience over time across the catchments.

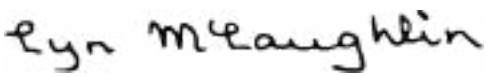
This Strategy is about reinforcing the shared responsibility of disaster resilience, and providing pathways to strengthen our capability and capacity. It also identifies opportunities to boost our resilience efforts and actions to advance social, environmental and economic goals for our communities, and our region more broadly.

By understanding the potential disaster risks we face, and working together to better manage our collective disaster risk, our region will contribute to a stronger and more resilient Queensland.

The Strategy has been developed in partnership between the Australian and Queensland Governments, the local governments of the Burdekin and Haughton River catchments, and a range of stakeholders with a valued connection to the region.

The following eight councils have collaborated to focus on how we will work towards our shared vision of flood resilience for the Burdekin and Haughton River catchments:

- Barcaldine Regional Council
- Burdekin Shire Council
- Charters Towers Regional Council
- Isaac Regional Council
- Mackay Regional Council
- Tablelands Regional Council
- Townsville City Council
- Whitsunday Regional Council.



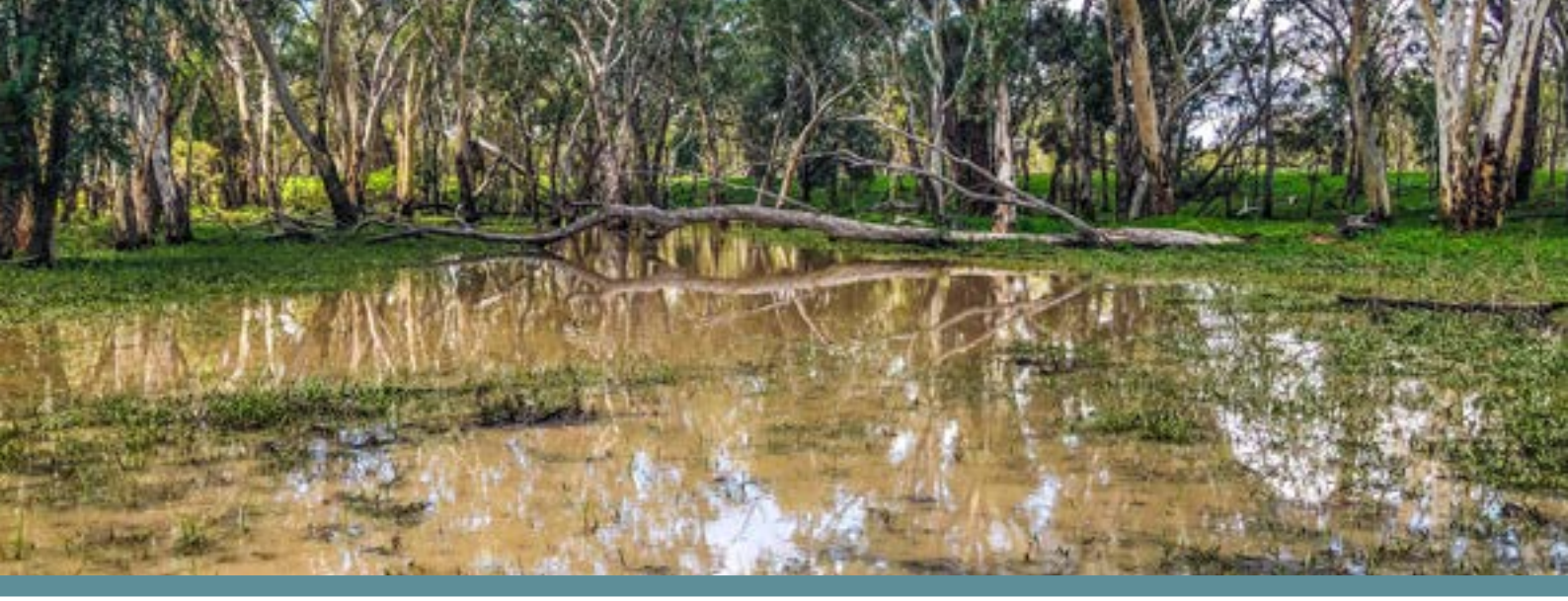
Cr Lyn McLaughlin
Mayor, Burdekin Shire Council

Acknowledgements

The Queensland Government thanks the following councils, agencies and organisations for their contribution to this Strategy:

- Barcaldine Regional Council
- Burdekin Shire Council
- Charters Towers Regional Council
- Isaac Regional Council
- Mackay Regional Council
- Tablelands Regional Council
- Townsville City Council
- Whitsunday Regional Council
- Queensland Reconstruction Authority
- Queensland Fire and Emergency Services
- Department of Environment and Science
- Department of Transport and Main Roads
- Department of State Development, Infrastructure, Local Government and Planning
- Department of Agriculture and Fisheries
- Department of Resources
- National Drought and North Queensland Flood Recovery Agency
- Great Barrier Reef Marine Park Authority
- NQ Dry Tropics NRM
- SunWater
- Burdekin Water Futures
- Energy Queensland
- Telstra
- Optus
- Northern Drone Services
- NBN Co
- Wilmar
- James Cook University
- Bureau of Meteorology

Image: The township of Giru in flood, 2018 (courtesy Burdekin Shire Council).



Contents

Image (this page): Localised flooding in the upper Belyando near Alpha, 2020.
(Opp page): Burdekin River historic flood marker at the Macrossan Bridge in the Charters Towers region.

Our vision

We are a region of people who are proudly self-sufficient and self-reliant.

We take care of our own, and are robust about dealing with flood events.

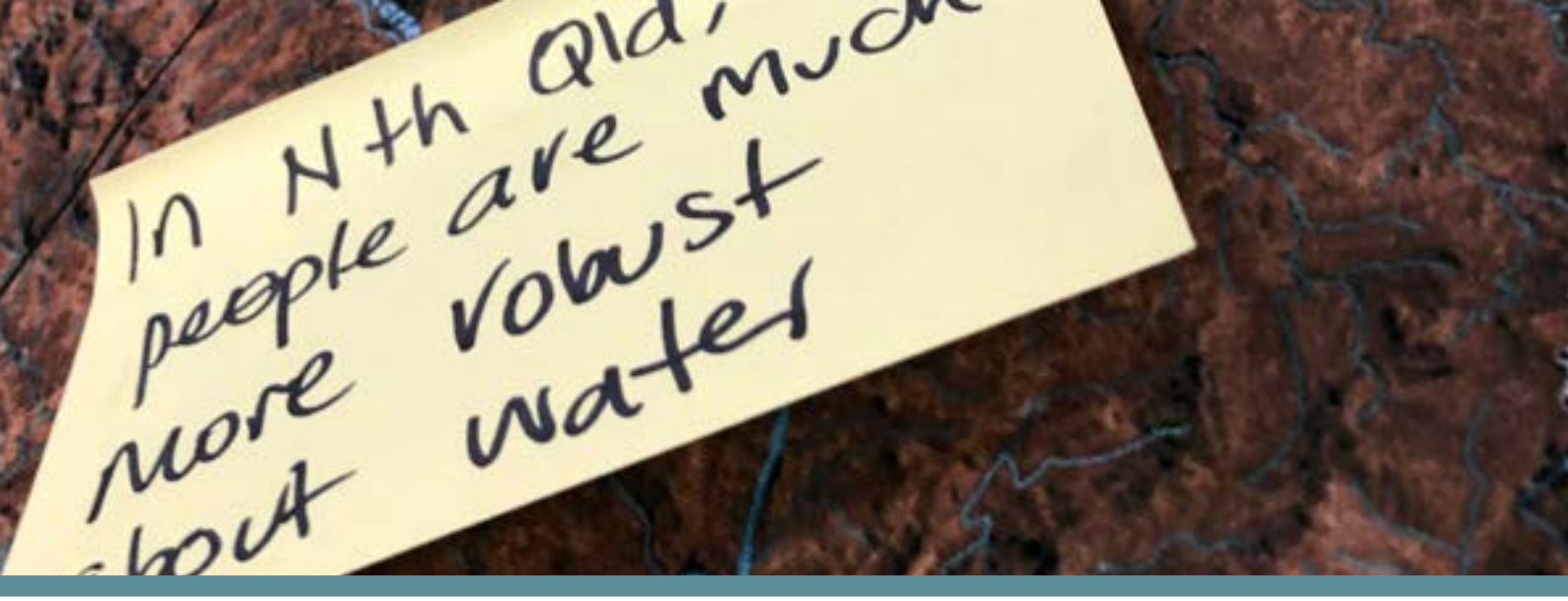
We have a long history of flood exposure, it is part of living in North Queensland.

Because of this, we are adaptive and know what to expect when the rain comes both now, and into the future.

We acknowledge and embrace our diversity as a community, and revel in our shared values.

We lend a hand to each other, and help newcomers to 'learn the ropes' about living with flood.

As a community, we proudly lead our own resilience.



Our community-led approach

During the wet season, there is no shortage of water flowing through the Burdekin and Haughton catchments. While flooding may bring with it a range of different impacts, water is a resource that is highly valued. Water supply underpins much of our region's social, economic and environmental prosperity.

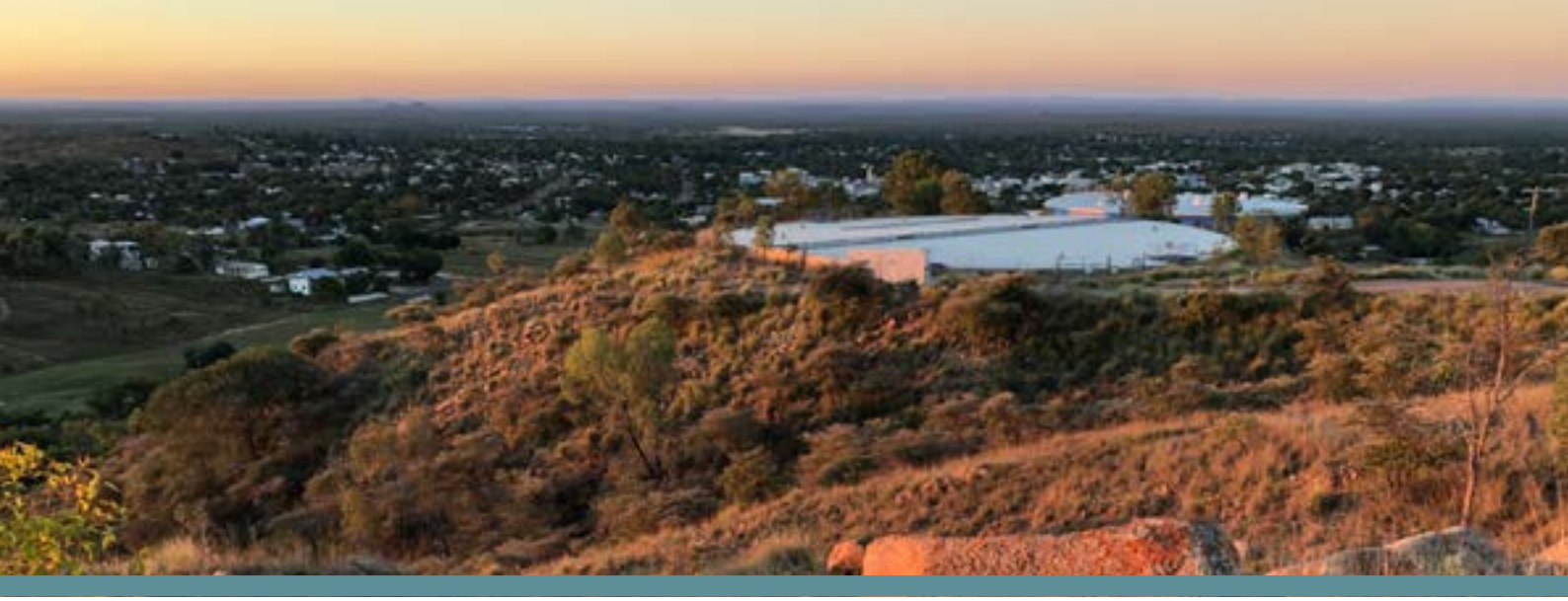
Serious weather events can cause flooding, and cyclones, monsoon troughs and severe storms, are commonplace. Our exposure to flooding in the Burdekin and Haughton catchments has shaped our resilience over time. Both our capability and capacity to endure have been tested time and time again, and on each occasion, we rise to the challenge.

The Burdekin and Haughton Flood Resilience Strategy (the strategy) is our locally-led and regionally-coordinated blueprint, to leverage the existing resilience of our communities. It unites our community-led approach to flood resilience with innovative and coordinated opportunities to further reduce our region's flood risk and strengthen the resilience of our townships, economy, infrastructure and the environment.

Locally-led → **Regionally coordinated** → **State facilitated**

Video: Find out more about the Burdekin and Haughton Flood Resilience Strategy by watching the videos at www.gra.qld.gov.au/burdekin-haughton.

Image: Notes captured from 'big map' engagement activities during strategy development.



Our region

Local governments

There are eight local governments within the Burdekin and Haughton catchments. The six councils with a majority area contained within the catchment boundary are:

- Burdekin Shire Council
- Charters Towers Regional Council
- Whitsunday Regional Council
- Isaac Regional Council
- Barcaldine Regional Council
- Townsville City Council.

Two councils with a partial area within the catchment are Tablelands Regional Council and Mackay Regional Council.

These eight councils are working together, to deliver shared solutions to common resilience challenges across the Burdekin and Haughton catchments.

Our communities

The Burdekin and Haughton catchments stretch from south of the town of Alpha, north to the Atherton Tablelands, west to the Great Dividing Range, and east to the coast where the catchments discharge to the Great Barrier Reef coastal zone.

Our communities are diverse and unique. The population of the Burdekin and Haughton catchment area is approximately 111,360 people.

The fertile alluvial soils of the catchments support the rural and agricultural land uses occupying much of the region. A rich mining history and strong community networks are maintained through townships and centres dotted across the landscape including Collinsville, Glenden, Charters Towers and Ravenswood.

The major urban centres within the catchment are located at Charters Towers, Ayr, Home Hill and Collinsville. A small portion of the Townsville local government area forms part of the Haughton catchment.

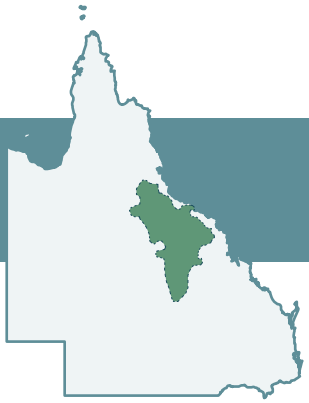
In the Haughton catchment are the townships of Clare, Ayr, Brandon, Jerona and Giru, as well as Mingela and Woodstock, which are located toward the catchment's headwaters. It should be acknowledged that while Ayr and Clare are technically located within the Barratta sub-catchment of the Haughton system, riverine flooding in both towns stems from the Burdekin River.

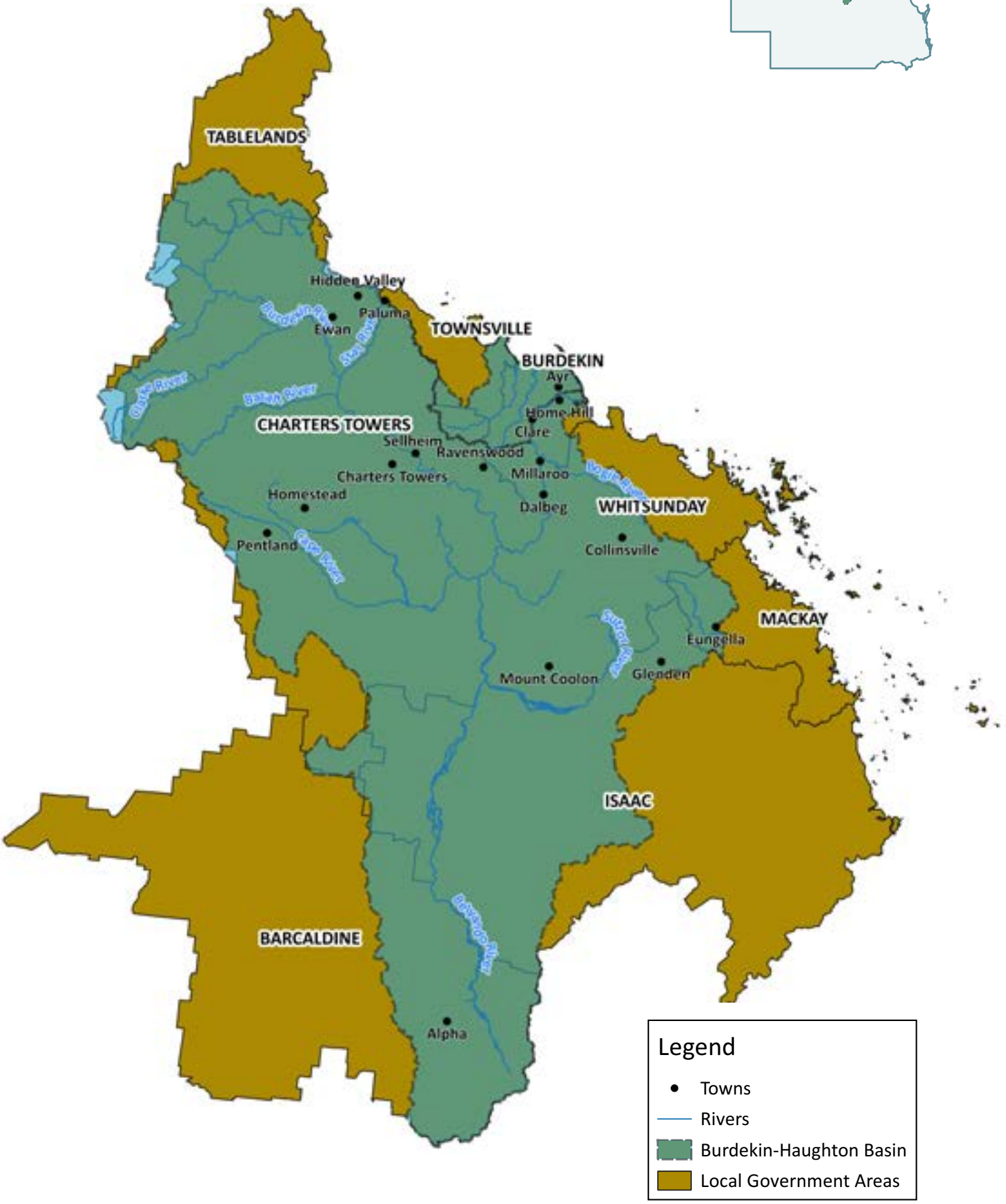
The Burdekin and Haughton catchments comprise a series of sub-catchments, these include:

- Belyando
- Suttor
- Cape and Campaspe
- Upper Burdekin
- Bowen (including the Broken and Bogie)
- Lower Burdekin
- Haughton
- Barratta Creek.

Image: View across Charters Towers from Tower Hill.

The Burdekin and Haughton catchment





About this strategy

Objectives for flood resilience

The purpose of this strategy is to achieve the following objectives:

- recognise and encourage the behaviours, mindsets and activities that contribute toward flood resilience
- adopt whole-of-catchment approaches that deliver shared solutions to common problems
- understand how the nature of localised flood risk intersects with regionally relevant resilience goals
- work cohesively toward common catchment or regional resilience goals
- combine strategy with long-term investment to support continued community-focused resilience.

> ***"This is about being on the front foot with resilience... so when we do have another event, we are actually better prepared."***
>
> Mayor Andrew Wilcox, Whitsunday Regional Council

Recognising our own resilience

This strategy seeks to guide how we will proactively work together to enhance flood-related disaster resilience over time. It combines strategy and investment in resilience action in a way that encompasses the impacts of our weather and climatic conditions across the Burdekin and Haughton catchments.

This strategy adopts a holistic view of the factors that underpin and contribute to flood resilience, with regard to the multitude of ways we are exposed to flood-related impacts across the region, and the various ways in which we can collectively address our risks.

Central to this is recognising the role and value of water for the environment and our livelihoods. Flooding is a natural process we have duly shaped our lives and behaviours around.

While the coordination of disaster resilience action is a key aspiration of this strategy, it must also be recognised that no two places or communities are the same – especially in a catchment with an area equivalent to the size of Tasmania.

> From time to time, as much as the river system gives, it also takes away.

Diagram: disaster risk reduction.

Image: A swollen Belyando River on the Capricorn Highway, 2020.

A systems-based approach

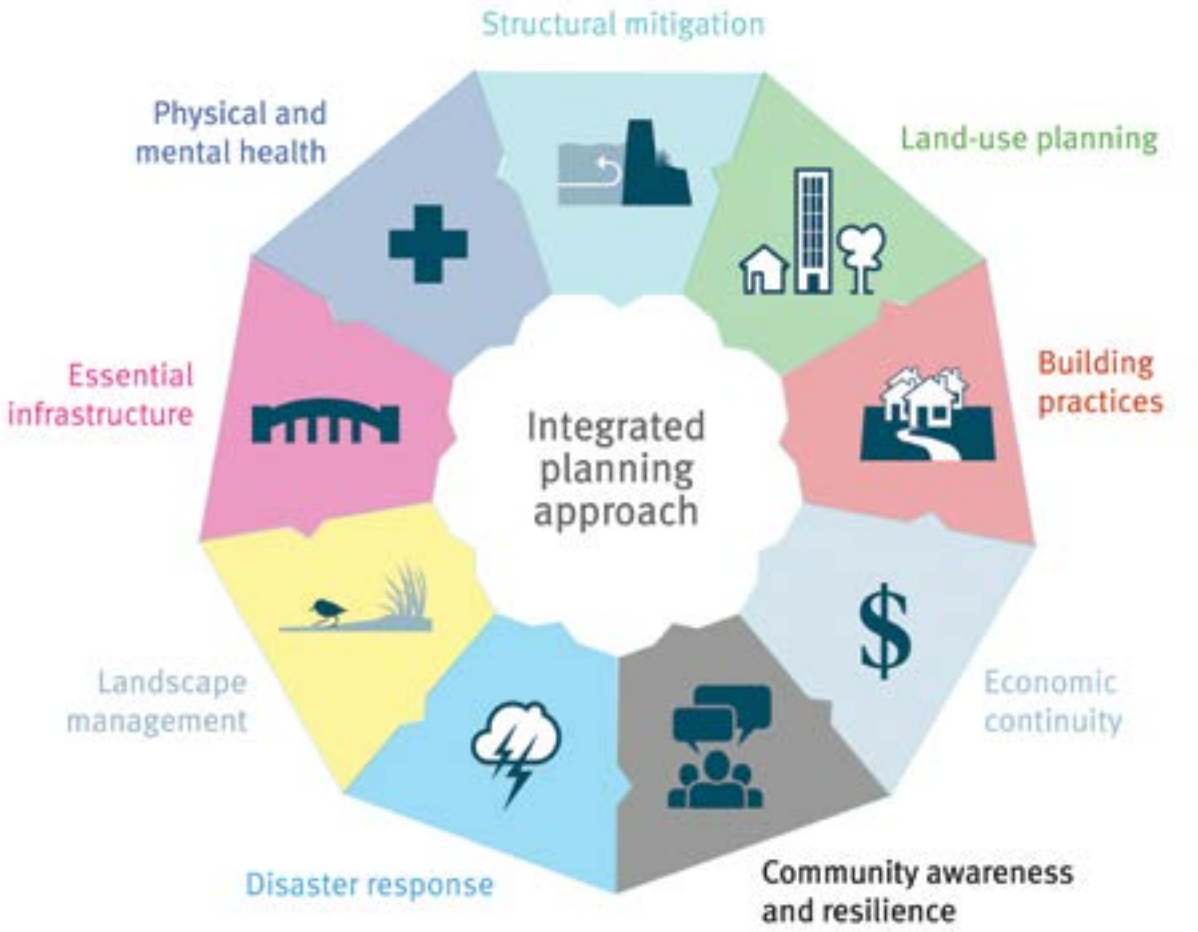
Some aspects of resilience are relatively straightforward in terms of the opportunities for enhancement. Other aspects of resilience can be complex and deeply entrenched in systemic issues.

Integrated floodplain management involves a multidisciplinary approach across a range of sectors engaging in disaster management, engineering, land-use planning, community and economic development, transport, environmental management and communications. This approach contributes to an overarching, shared evidence base of knowledge with the capacity to explore systemic issues.

This approach also integrates a trans-disciplinary approach, which brings science, research, social science, governance and policy together with local knowledge.

These approaches culminate in an Action Plan which supports the implementation of this strategy, providing a blueprint for project delivery to support enhanced flood resilience, led by local government.

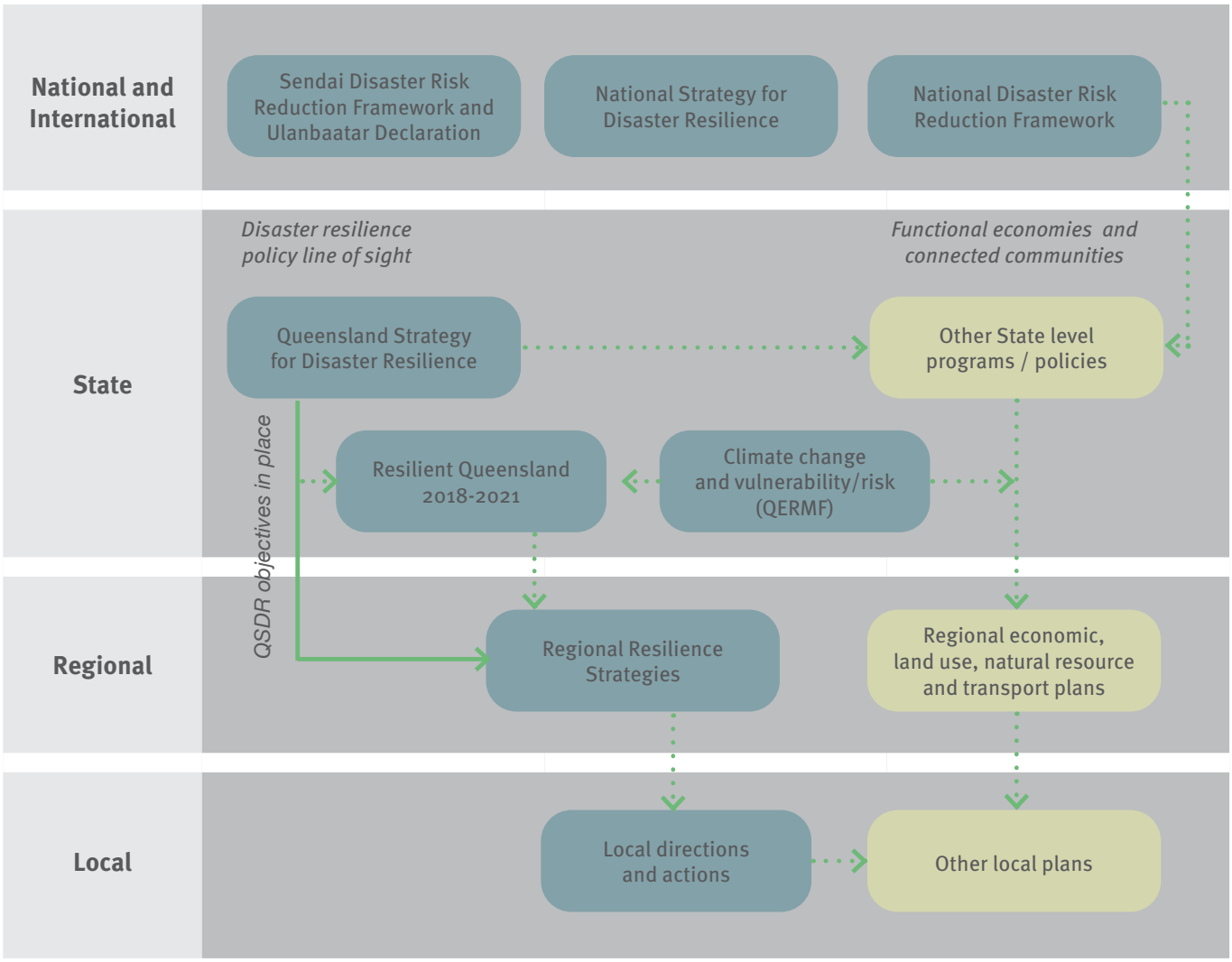
Diagram: Integrated catchment planning approch (source: QRA).



How this strategy connects

This strategy represents a local approach to resilience building and forms part of a broader strategic landscape at the State, national and international levels that guides how we will collectively achieve our resilience goals with a focus on disaster risk reduction and sustainable development.

Diagram: Disaster resilience policy line of sight.



Integrating programs and projects

This strategy combines and builds upon a range of local and regional strategic documents to articulate the various aspects of resilience action identified across the Burdekin and Haughton catchments. The following outlines some of the key plans, projects and studies that have been drawn upon to inform this strategy.

National Disaster Risk Reduction Framework

The National Disaster Risk Reduction Framework (NDRRF) is a multi-sector collaboration led by the National Resilience Taskforce within the Australian Government Department of Home Affairs. The NDRRF was co-designed with representatives from all levels of government, and business and community sectors. Over 100 participants from more than 80 diverse organisations came together at a three-day intensive 'policy sprint' to develop key components of the NDRRF.

The NDRRF outlines a coordinated approach to reducing disaster risk, which is a critical component of enabling resilience. It is designed to leverage the great work and progress made across all sectors since the 2011 release of the National Strategy for Disaster Resilience, and to better understand and reduce disaster risks, improve resilience, and bolster the capability and capacity of communities to withstand natural hazards.

More than ever, limiting the impact of disasters now and in the future requires a coordinated effort across and within many areas, including land-use planning, infrastructure, emergency management, social policy, agriculture, education, health, community development, energy and the environment.

Resilient Queensland – delivering on the Queensland Strategy for Disaster Resilience

The Queensland Government is focused on strengthening disaster resilience so that communities are better equipped to deal with the increasing prevalence of disaster events.

A key outcome of Resilient Queensland is the development of regional resilience strategies that will support the coordination and prioritisation of future resilience-building and mitigation projects across Queensland.

By 2022, every local government in Queensland will be part of a regional resilience strategy that clearly identifies and prioritises actions to strengthen disaster resilience over time.

A community-led catchment is one of the first five regional resilience strategies prepared as part of Resilient Queensland. The strategy seeks to identify and address locally derived challenges that may be shared across local government jurisdictions.

As the most disaster-impacted state in Australia, it is critical we harness best practice and look for new ways to work together to improve the resilience of communities across Queensland, adopting pathways toward a safer, stronger and more resilient Queensland.

North Queensland Regional Plan

The North Queensland Regional Plan was released in 2020 and is a 25-year strategic statutory planning document for the local government areas of Burdekin, Charters Towers, Hinchinbrook, Palm Island and Townsville.

It has been prepared to support the established and emerging industries in the region, and to address changes expected to occur within the region. These changes include a growing and ageing population, shifting economic and employment patterns, impacts from climate change and continued technological advances.

The principal aim of the regional plan is to determine how land-use and infrastructure planning can best support economic growth and population change in the region over the next 25 years and beyond. This will be achieved by enhancing the social, economic and environmental systems that support the region's liveability.

Image: Passenger train crossing the Burdekin Bridge.

Mackay, Isaac and Whitsunday Regional Plan

The Mackay, Isaac and Whitsunday Regional Plan establishes a vision and direction for the region to 2031. It provides certainty about where the region is heading and provides a framework to respond to challenges and opportunities that may arise.

The regional plan aims to respond to the variety of distinct challenges facing the region to 2031, having regard to cycles of the resources sector, growth and contraction, and the need to sustainably manage development and resources. The regional plan also seeks to plan effectively for essential infrastructure services, such as transport, community and social services. It further recognises the need to prepare for, and appropriately respond to, the anticipated impacts of climate change.

Regional Transport Plans

The Northern Queensland, Mackay, Isaac and Whitsunday, and Central West Regional Transport Plans (RTPs) seek to prioritise and manage their respective transport systems so that they effectively support regional communities, growth and productivity.

The plans seek to establish common transport priorities between the Queensland Government and local governments, communicating the planning intent for the regions. They also define the transport systems' role in achieving regional goals and priorities for forward planning and investment, in partnership with local government.

Improved flood resilience is identified as a key priority and objective for each of these RTPs. Underpinning this, each RTP includes a number planning actions to improve flood resilience through better planning of infrastructure, collaboration and intelligent transportation systems (ITS).

Queensland Climate Adaptation Strategy

The Queensland Climate Adaptation Strategy 2017–2030 outlines how Queensland will collectively prepare for current and future impacts of a changing climate to reduce risk and increase resilience. This strategy recognises Queensland is already experiencing hotter summers, more frequent natural disasters and more impacts on our natural environment, and that these changes pose a threat to our economy, our communities, our environment and our way of life.

The strategy, along with specific sector-based adaptation plans, outlines our commitments and the actions we will take to transition to a low carbon, clean growth economy, and adapt to the impacts of a changing climate.

Sector adaptation plans are an important component of the strategy. These eight plans help to prioritise climate change adaptation activities across the key sectors of the community. They have been developed in consultation with sector and industry stakeholders to reflect the needs and priorities of each sector. They identify emerging opportunities, share knowledge and encourage collaboration. The sector adaptation plans focus on:

- small and medium enterprise
- biodiversity and ecosystems
- human health and wellbeing
- emergency management
- agriculture
- built environment and infrastructure
- tourism.
- industry and resources.

Image: The Upper Burdekin sub-catchment.

Queensland State Natural Hazard Risk Assessment 2017

Prepared by Queensland Fire and Emergency Services, the State Natural Hazard Risk Assessment provides a state-wide analysis of relevant natural hazard risks, including tropical cyclones, severe storms, flooding, coastal hazards, heatwaves, bushfires and earthquakes. The assessment considers the nature of natural hazards relevant to Queensland, as well as elements of likelihood, consequence, exposure and vulnerability to understand both inherent and mitigated risk profiles. The assessment links to the Queensland Emergency Risk Management Framework (QERMF), which provides a comprehensive and systematic approach to informing risk-based planning across Queensland.

Queensland Emergency Risk Management Framework

The Queensland Emergency Risk Management Framework (QERMF) has been developed to inform risk-based planning across the emergency management sector in Queensland. The application of the 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 QERMF assists key stakeholders working within Queensland's Disaster Management Arrangements (QDMA) to review existing natural disaster risk management processes and assist in enhancing resilience, as outlined within the Queensland Strategy for Disaster Resilience.

Initial stages of the QERMF process have been used to develop this strategy, ensuring that it is appropriately risk-informed and aligned to the QDMA.

Local government and industry documents

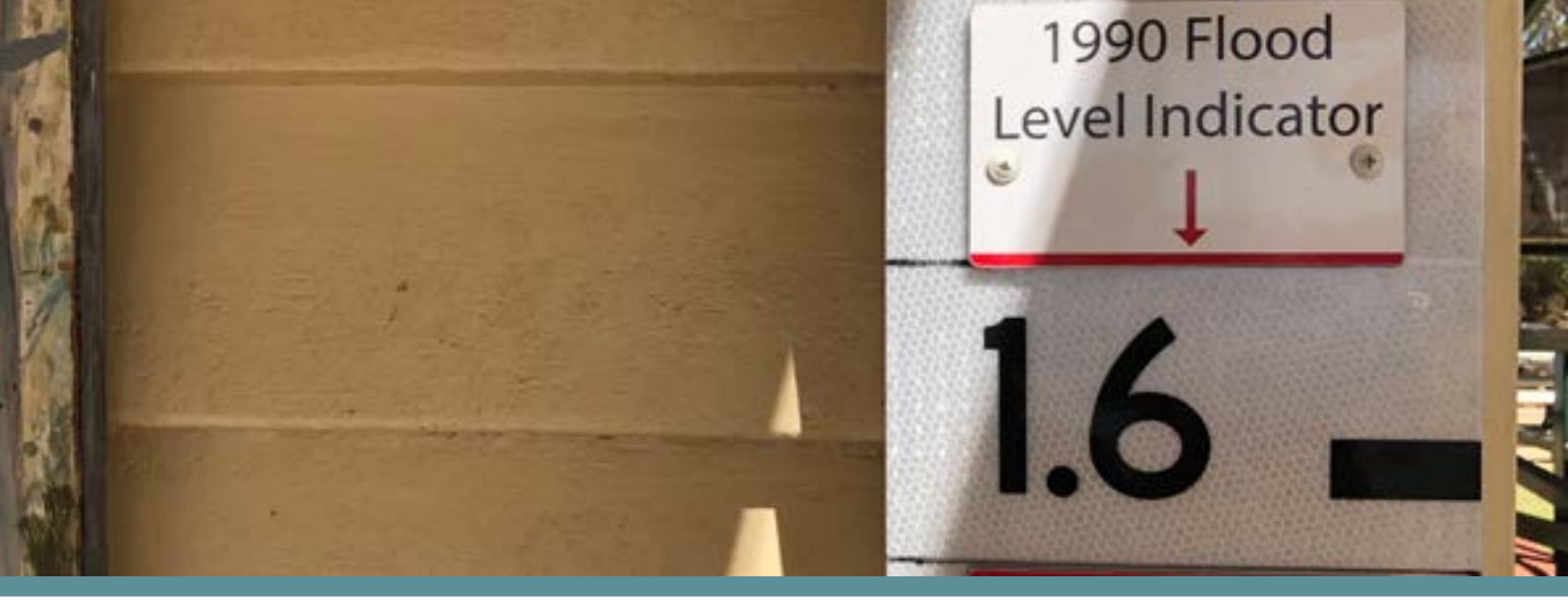
A range of local government plans, strategies and studies have also been used to inform this strategy. This includes local disaster management plans, planning schemes, community and economic development plans, and coastal hazard adaptation strategies among others. This is in addition to a series of industry-based documents and content prepared by relevant not-for-profit organisations and non-government organisations with a presence in the Burdekin and Haughton region.

Queensland Floods Commission of Inquiry

The Commission of Inquiry was established by the Premier of Queensland in response to the 2010–2011 flood events. The Commission of Inquiry conducted a comprehensive review, focusing on areas such as preparation and planning, adequacy of response, adequacy of forecasts and early warning systems, and land-use planning in the lead up to the 2010–2011 floods.

The final report included recommendations across a vast range of technical and governance disciplines highlighting the complexity of flood risk management in Queensland. Included in the recommendations was the need to conduct additional flood studies and undertake further consultation with local governments to enhance the cooperative approach to flood risk management.

Image: A view over Burdekin Shire from Mt Inkerman.



What is resilience?

Resilience can mean many things, including the ability to bounce back or withstand a disaster event, and continue to move forward. The term 'resilience' can often take on a very personal meaning, and can be characterised by a range of unique attributes.

When an emergency, disaster or trauma event occurs, there are many different ways in which resilient behaviours and processes can play out. The following sections consider the varying aspects of resilience, and how we all have a role to play.

Elements of resilience

The multi-dimensional and cross-disciplinary approach of this strategy contemplates five elements that contribute to systems-based resilience. These are:

Image: Historic flood marker information at Alpha.

Community resilience

The attributes underpinning community resilience are slightly different in nature to those characterising resilience in individuals.

Resilient communities are embodied by the collective behaviours and mindsets of individuals and households, which focus on connections with others for support and capacity before, during and after trying times. Resilient communities also tend to be adaptable to changing circumstances, stewarded by strong community leadership. They are also diverse and enterprising, and maintain a strong sense of identity and belonging.

Household and individual resilience

At the household and individual level, resilience can be characterised by a sense of resourcefulness, open-mindedness, and self-reliance or self-sufficiency.

One's awareness of risk and its realities is also paramount. Ingenuity, capability and capacity to accept challenges and seek to overcome them is a common trait. This is supported by a strong set of values and a desire to connect with and support others. These attributes stand a person in good stead to overcome and adapt to life's challenges.

Being prepared and having a plan for severe weather and its impacts increase our ability to exercise resilience.

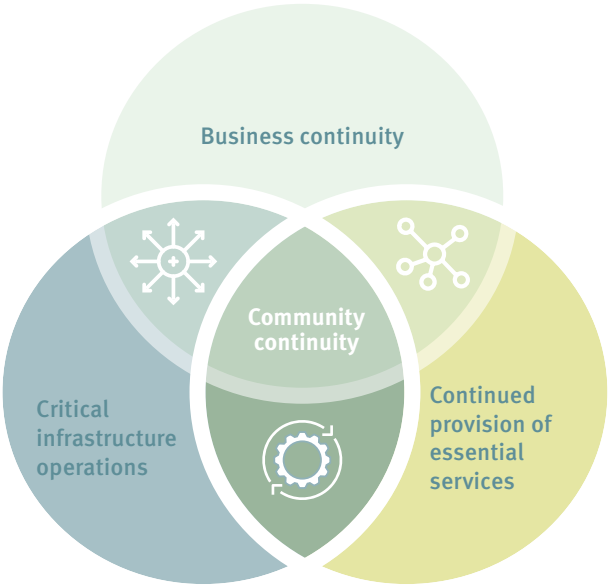
However, there is a difference between stoicism and resilience. Looking after ourselves, our mental and physical wellbeing and that of others around us is critical.

Business resilience

The businesses in our region, both small and large, are critical to the continuity of community functions before, during and after a flood event. The provision of ongoing services and employment, no matter the scale, makes a difference to broader community resilience.

It is for this reason that business continuity planning for small, medium and large enterprises in the Burdekin and Haughton region is central to the resilience of communities. In addition, the ability to continue operating minimises disruption to business and cashflow.

This can be essential for business owners, managers and employees who are impacted by events and seek to maintain gainful employment and continue to be productive members of the community during difficult times.



Flood hazard characteristics

How catchments work

Almost every season, somewhere in Queensland will experience heavy rainfall that can lead to flash flooding and riverine flooding. This is due to our climate and can be driven by monsoon troughs, east coast low events and cyclones.

Where rainfall goes depends upon topography. River catchments are defined by elevated areas, known as the headwaters, at the top of the catchment. Catchments generally comprise a number of tributaries that catch and convey rainfall into our river systems.

Catchments are not just relevant in terms of flooding and floodwater, but can be important to consider in relation to other natural hazards such as bushfires and landslides. The inter-linkages between different hazards are highly evident at the landscape scale. For example, in some cases, bushfire events can burn very hot, stripping vegetation and damaging soils across vast areas. Degraded landscapes can also occur after years of persistent drought.

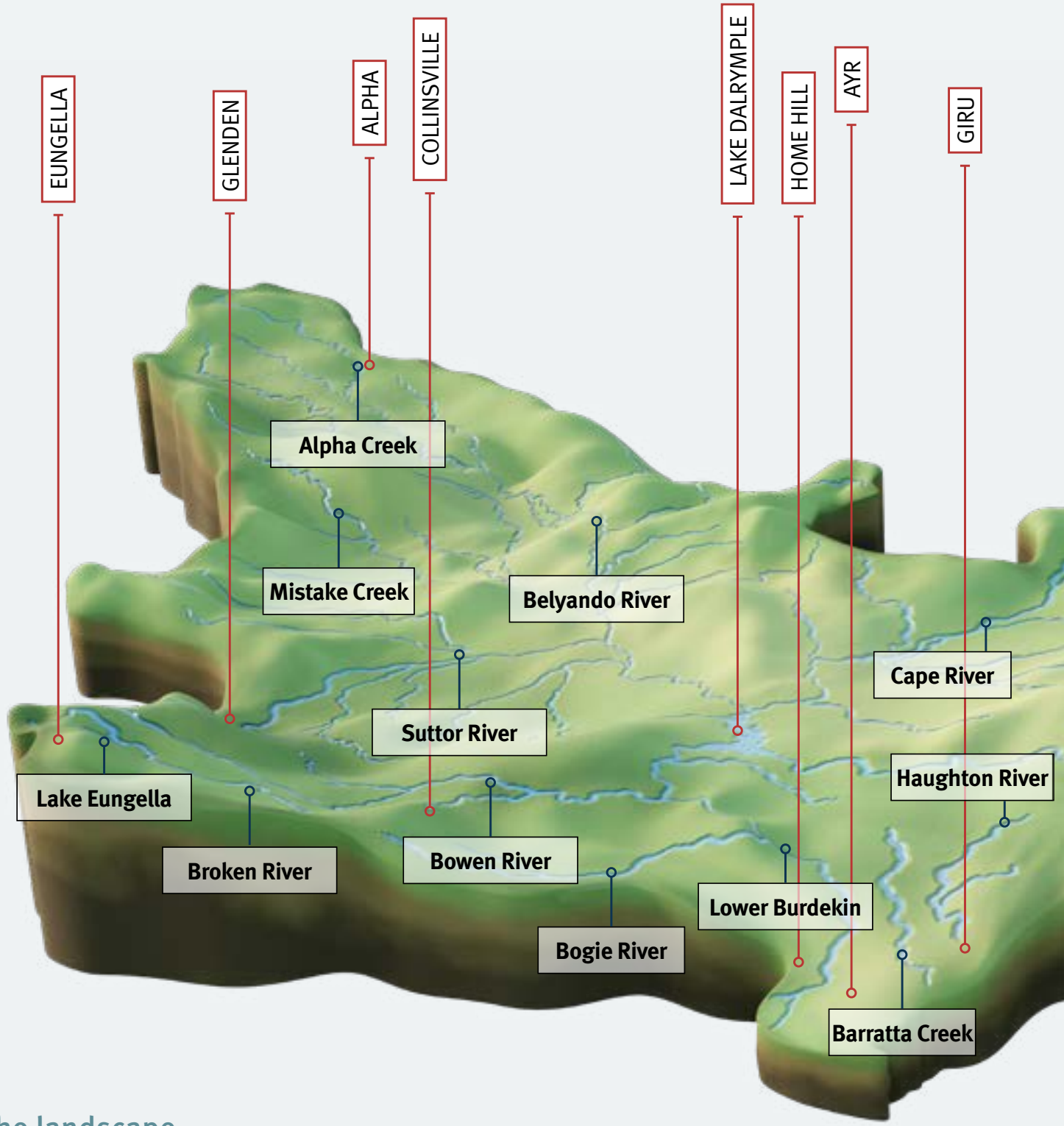
Especially in Queensland, the disaster season is that period of the year where we can experience all types of natural hazard events, and this is changing as a result of climate-related considerations. This means we might experience a bushfire event one week and a major flood the next. Where our landscape is degraded, either by fire, drought or poor land management practices, flooding rains can lead to landslips and extensive landscape and riverine erosion.

Catchment contamination, erosion, sedimentation, increased nutrient loads and silting are particular challenges for the environmental quality of our rivers, and the fauna and flora they support. This can also impact on the quality of water supplies on which our communities and economies depend.

Understanding how our catchments work is vitally important, as they can be subject to impacts from a wide range of natural hazards beyond just flooding.

Video: The video at www.gra.qld.gov.au/burdekin-haughton includes a 3D model to help explain how the Burdekin and Haughton catchments work.

Image: Historic flooding in the township of Alpha.



The landscape

The Burdekin catchment occupies a significant portion of the state, stretching from the south of Alpha in Central Queensland, to the Atherton Tablelands in the north, from the Great Dividing Range in the west and out to the coast, east of Home Hill. The Haughton, which adjoins the Burdekin to the north, finds its headwaters in the area of Mingela (part of Hervey Range), flowing east to the coast, past Giru.

The Burdekin catchment comprises several sub-catchments, with the Burdekin River said to be 'the centrepiece to an entire network of rivers'. It is estimated that on average, approximately 50 per cent of the water discharged from the mouth of the Burdekin River is derived from the Upper Burdekin sub-catchment alone.

From the south, the Belyando sub-catchment comprises Alpha Creek and Native Companion Creek, which merge into the Belyando River to the north of the township of Alpha. The Belyando River originates on the western slopes of the Drummond Range, located in the southern reaches of the catchment in Central Queensland. The Belyando flows north about 350 kilometres to join the Suttor sub-catchment.

This general area of the region maintains similar characteristics to that of the headwaters of the channel country of the Lake Eyre Basin, with both located within this Desert Uplands Bioregion of Queensland.

The Suttor River flows from the Denham and Leichardt Ranges east of Glenden in a westerly direction, before joining with the Belyando River to the north of Belyando Crossing. The Suttor River then continues to flow north for approximately 100 kilometres before discharging into Lake Dalrymple (Burdekin Falls Dam). Over half of the Suttor sub-catchment is made up of floodplains and lowlands.

Lake Dalrymple is where three of the upper sub-catchments converge within the Burdekin system. This includes the Suttor (and Belyando), the Cape and Campaspe, and the Upper Burdekin sub-catchments.

The Cape and Campaspe sub-catchment finds it headwaters in the Great Dividing Range to the north of the Flinders Highway, flowing in a generally south-easterly direction to meet Lake Dalrymple.

The Upper Burdekin flows south from the Seaview and Gorge Ranges to the north-east of Lake Lucy and the Valley of Lagoons. It journeys south where it is joined by a number of major creek and river systems from the east and west before transitioning into the Lower Burdekin sub-catchment in the general vicinity of the Macrossan Bridge at Sellheim. The river continues to flow south for a further 120 kilometres into the northern area of Lake Dalrymple.

This river system, along with the Douglas, Dry, Running and Star Rivers and Oaky and Camel Creeks, drain the northern extremities of the catchment to the west of the Seaview, Gorge and Paluma Ranges. Allingham, Hann, Lion, Fletcher and Lolworth Creeks and Basalt River drain the catchment from the western extremities, flowing east to the Burdekin River. The Fanning and Kirk Rivers are the last major tributaries flowing into the Upper Burdekin sub-catchment, joining near Sellheim.

Lake Dalrymple is formed by the Burdekin Falls Dam, which was constructed in the 1980s and is the largest body of fresh water in Queensland. Located 159 kilometres upstream from the mouth of the Burdekin River, the dam was constructed to support water supply and irrigation in the region, servicing an irrigation area of approximately 100,000 hectares downstream. The dam wall measures 876 metres in width, with a spillway of 504 metres.

That portion of the Lower Burdekin that is downstream from the dam drains the western slopes of the Clarke Range, approximately 70 kilometres inland from Mackay.

Discharging into the Lower Burdekin sub-catchment, below the dam, is the Bowen system, which is bound by the Denham, Leichardt and Clarke Ranges. This system has a major impact on the hydrology and water movement of the Lower Burdekin sub-catchment. The headwaters of the Bowen sub-catchment start at the Broken River in the Mackay region, flowing over 200 kilometres north through the Eungella hinterland before becoming the Bowen River. The Bowen River enters the Lower Burdekin upstream from Dalbeg.

Downstream from Millaroo, the Bogie River system meets the Lower Burdekin, which flows from the inland area to the west of Bowen for approximately 120 kilometres.

From its juncture with the Bogie River, the mighty Burdekin River continues for a further 80 kilometres, sprawling into a large coastal delta, and through the main mouth of the river approximately 25 kilometres east of Ayr. The coastal delta comprises many drainage outlets, which discharge to the Great Barrier Reef coastal zone.

Flanking the northern side of the Lower Burdekin sub-catchment is the Haughton River system, which also includes the Barratta sub-catchment. The Haughton systems flows east from Mingela (part of Hervey Range), through Giru, before also discharging to the Great Barrier Reef coastal zone. The Barrattas are a series of channels forming part of the Haughton catchment, running almost parallel with the Haughton River before discharging to the coast east of Jerona.

Receiving waters of the Burdekin and Haughton catchments include:

- the internationally significant Bowling Green Bay Ramsar site
- important declared fish habitat areas at Cleveland Bay and Bowling Green Bay
- Cleveland, Bowling Green and Upstart Bay dugong protected areas
- the State Great Barrier Reef Coast Marine Park
- the Great Barrier Reef lagoon, which is World Heritage-Listed and a marine park.

"None of us operate in isolation. A flood event at the back of Ingham affects Charters Towers and the Burdekin Shire. We all have to work as one with these flood situations and other disasters in order to get better outcomes."

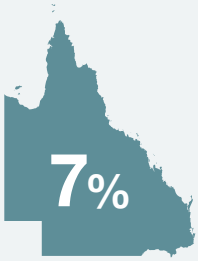
Mayor Frank Beveridge, Charters Towers Regional Council.

Image: Flows in the Bowen River (courtesy Whitsunday Regional Council).

A snapshot of catchment characteristics

catchment size of 134,159 square kilometres

Lake Dalrymple holds 4 times the volume of water of Sydney Harbour

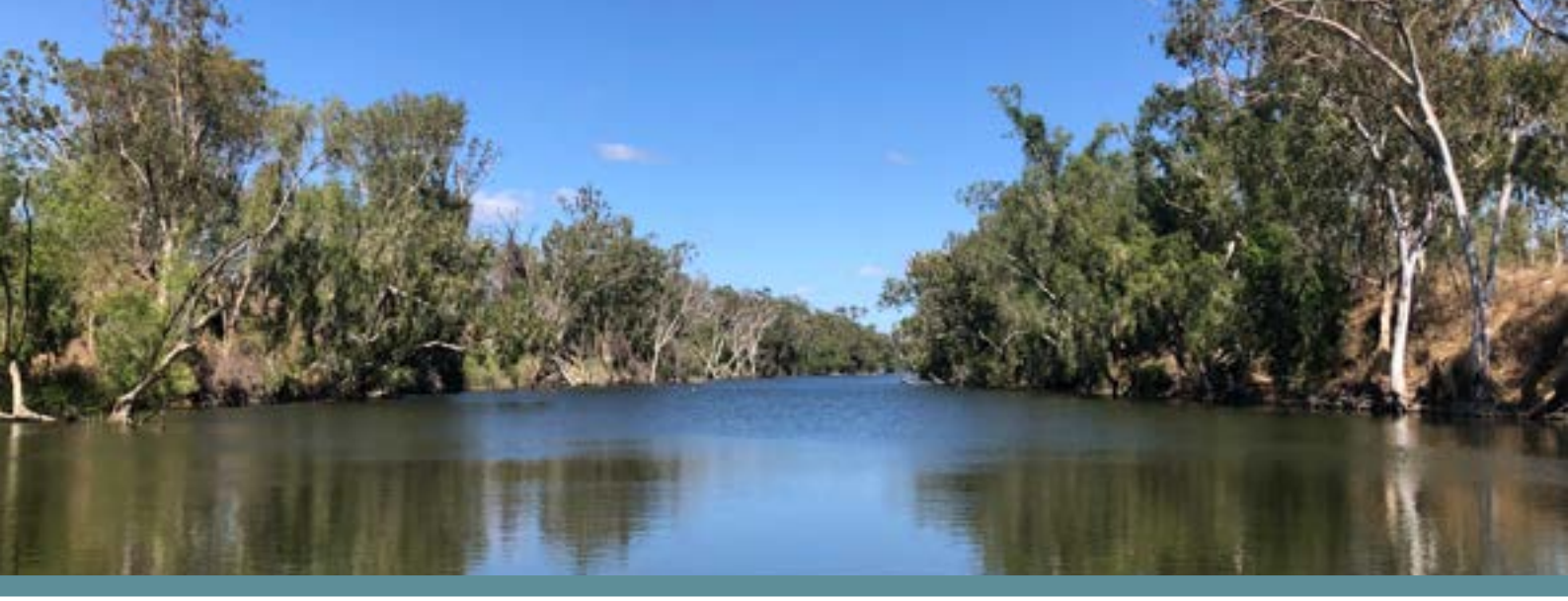


the Burdekin catchment drains 7 per cent of the land mass of Queensland

the Burdekin is the largest river in Queensland by flow volume

the Burdekin River flows over 710 kilometres and is the centrepiece of a series of waterways

the Haughton catchment is known as one of the most flood prone in Queensland



Catchment stories

This strategy is supplemented by a separate body of work, led by the Department of Environment and Science involving the 'Walking the Landscape' process and the development of a catchment story.

Through this processes, particpants work systematically through catchments in facilitated workshops during which knowledge of landscape features and processes are gathered to develop a whole-of-landscape understanding of how water flows in catchments. The information gained is used to inform the development of catchment stories.

Catchment stories describe the location, extent and values of catchments as well as demonstrating the key features, which influence water flow, including geology, topography, rainfall and run-off, natural features, human modifications and land uses. Map journals and videos form the basis of catchment stories providing mechanisms for integrating spatial information, photographs and animations with an informative narrative to demonstrate the features of catchments. Catchment stories are valuable tools that can be used to improve evidence-based decision-making for the sustainable management and restoration of ecological systems.

Catchment stories for parts of the Burdekin and Haughton region, produced by the Department of Environment and Science, can be viewed at www.wetlandinfo.des.qld.gov.au.

Rainfall

The Dry Tropics region usually experiences annual wet and dry seasons, with most of the rainfall typically between November and March. The Burdekin River typically flows for a short period of the year (WetlandInfo, 2018).

Rainfall across the catchments is highly variable, due to the sheer scale of the area ranging from Desert Uplands to the Wet Tropics Bioregion. For example, average annual rainfall in the Haughton catchment region is approximately 953 millimetres, but can range between 550 to 3200 millimetres per year. In the Belyando sub-catchment, the average annual rainfall is closer to 500 millimetres (WetlandInfo, 2018).

This variability is linked to the El Nino Southern Oscillation and the formation of tropical low pressure systems, sometimes referred to as a monsoon trough. Additionally, cyclones generated by low pressure systems and warm oceans can contribute significant volumes of rainfall on land (Dry Tropics NRM, 2016).

The Eungella area to the west of Mackay is a very high rainfall area, with steep gradients and hard geology, which has a major influence on the flows of the Broken and Bowen Rivers, and can lead to significant flooding through the Lower Burdekin.

The region's coastal areas are characterised by a tropical sub-humid climate, with relatively high temperatures all year round and heavier rainfall and associated higher humidity in the summer months. Higher altitude coastal ranges, particularly in the region's north and south, have a wet tropical climate with cooler temperatures, and rainfall is distributed more broadly across seasons. In contrast, rainfall gets progressively lower towards the west and is more variable compared to the coastal areas. The dry seasons are longer and cooler, and the wet seasons hotter and more unpredictable in these semi-arid inland areas (Dry Tropics NRM, 2016).

Image: The Upper Burdekin sub-catchment.

Climate change

While climate varies naturally on timescales, from millions of years to year-to-year, since the advent of the industrial age there has been a rapid increase in temperatures, and in the variability of weather events (Dry Tropics NRM, 2016).

The CSIRO's Monsoon North East technical report on climate change in Australia identified average temperature rises in the Monsoonal North region (in which the Burdekin Dry Tropics region is situated) of between 0.9 and 1.0 degrees Celsius since 1910, and predicts further increases of greater than 1.3 degrees Celsius by the end of the century (CSIRO, 2015 and Dry Tropics NRM, 2016).

General project catchment-scale changes due to climate change during the next century include:

- decreasing water resource quantity and quality
- decreasing plant and crop growth
- increasing intensity of rainfall events
- increasing intensity and frequency of bushfire
- increasing intensity of cyclones, but unlikely increase in frequency
- increasing temperatures and heatwaves
- increasing sea level and height of coastal hazard impacts
- increased evaporation (CSIRO, 2015).

The Queensland Future Climate Dashboard at www.wetlandinfo.des.qld.gov.au summarises 11 state-of-the-art climate models with regional-scale simulations through to 2100. These models are varied to consider different magnitudes of climate mitigation, including with limited action to mitigate greenhouse gas emissions, as well as a scenario based upon the stabilisation of greenhouse gas emissions.

Under a scenario where greenhouse gas emissions stabilise by 2060, the following projections for the Burdekin and Haughton catchments are identified:

- average mean climate of the catchment areas is predicted to increase by between 1.8 and 2 degrees Celsius by 2090, and this is expected to be higher for inland areas, including the Barcaldine region
- average heatwave temperatures are predicted to increase by between 1.3 and 1.6 degrees Celsius by 2090 across the catchments, with Burdekin Shire projected to increase by 1.8 degrees Celsius
- average extreme temperature days across the catchment areas are predicted to increase by 37 days by 2090
- average extreme precipitation in the catchment areas is predicted to decrease by -3.7 mm by 2090
- average drought months across the Burdekin and Haughton region are predicted to increase by 1.4 months by 2090
- 'wetness' in Queensland is usually associated with specific drivers such as La Niña years, and extreme events, for example, convective storms, low pressure systems and tropical cyclones, with average wetness for the catchment areas predicted to decrease by -0.65 months by 2090.

The above is consistent with the general projections of similar or possibly decreased rainfall events into the future, but with potentially increased intensity when they do occur. For further data and information, the Queensland Climate Futures Dashboard can be accessed at www.longpaddock.qld.gov.au/qld-future-climate/dashboard/.

Image: Downstream of Burdekin Falls Dam (courtesy F. Ramsay).

Weather systems that cause flooding

In any year in Northern Australia, it is likely that a significant rainfall event will occur, but not all major floods lead to disastrous consequences. It must be remembered that, for many parts of Queensland, flooding brings significant benefits.

Major flooding in the Burdekin and Haughton catchments is often caused by monsoon rains, monsoon troughs, east coast low events and tropical cyclones during the monsoonal wet season. Multiple large weather events have occurred in more recent years.

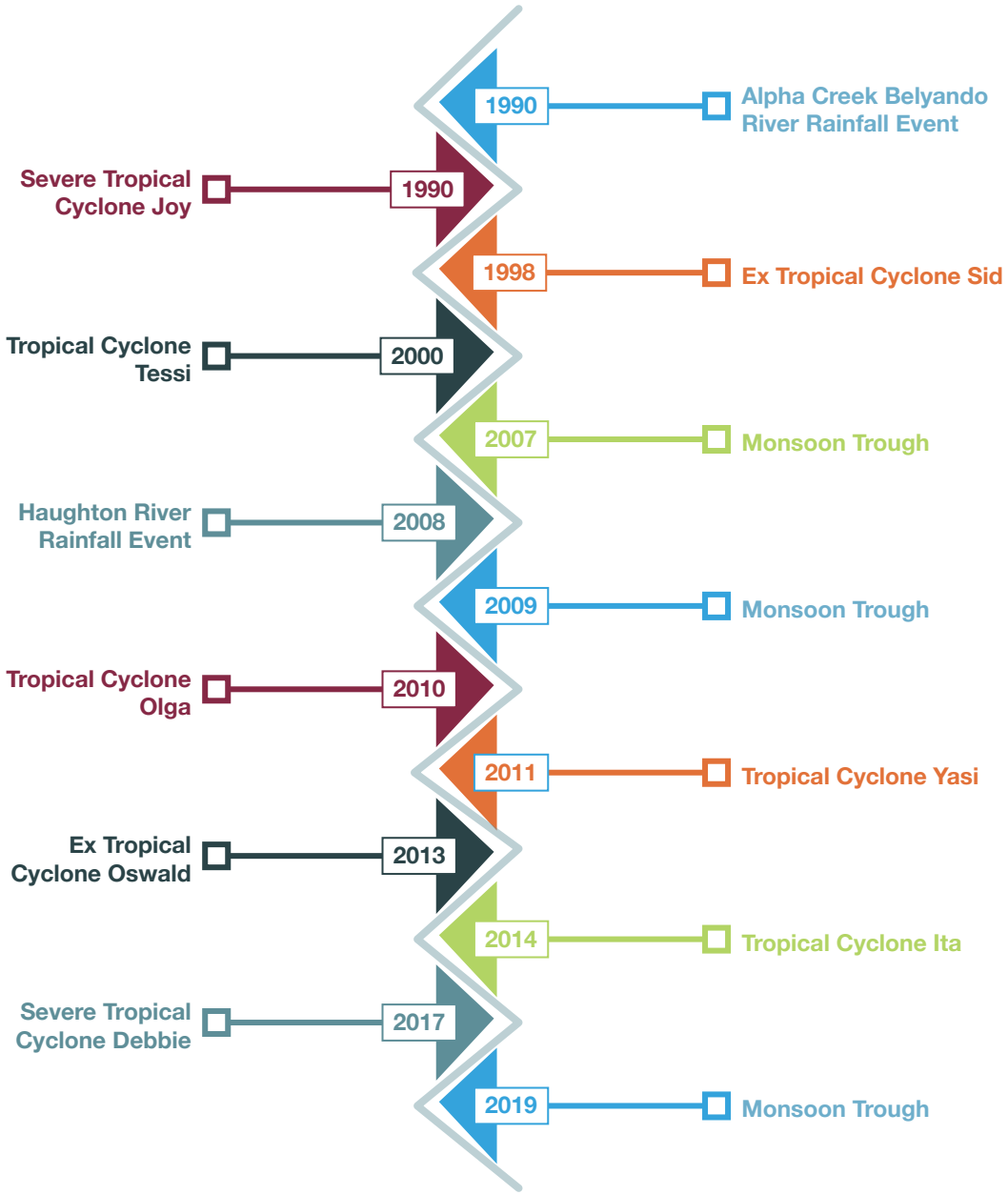


Image: Storm clouds over Burdekin Shire (courtesy Burdekin Shire Council).

Tropical cyclones

Tropical cyclones are low pressure systems that form over warm tropical waters with sustained winds of 63 kilometres per hour or greater, and gale force winds with wind gusts in excess of 90 kilometres per hour near the centre. In the most severe cyclones, gusts can exceed 280 kilometres per hour.

The Burdekin region has felt the impact of tropical cyclones on numerous occasions. The Bureau of Meteorology's (BoM) Southern Hemisphere Tropical Cyclone Data Portal shows 40 cyclones tracking within 200 kilometres of the Townsville tracking station between the 1969–1970 and 2017–2018 cyclone seasons. Tropical cyclones in the Burdekin and Haughton catchments often result in extensive rainfall, which can lead to major flooding. Previous cyclone events have caused flooding for parts of the Charters Towers and Isaac regions and as such, must not be discounted in inland areas.

As well as extreme winds, a tropical cyclone can cause the sea to rise well above the highest tide levels of the year when it comes ashore.

These storm surges are caused mainly by strong, onshore winds and reduced atmospheric pressure. Storm surge is potentially the most dangerous hazard associated with a tropical cyclone.

Storm surge is an abnormal rise in sea level over and above the normal (astronomical) tide levels. It can be thought of as the change in the water level due to the presence of a storm. These powerful ocean movements are caused by strong winds piling water up against the coast as a tropical cyclone approaches.

Storm tides can swamp low-lying areas, sometimes for kilometres inland. Strong winds at the coast can also create large waves, worsening the impact and giving rise to coastal erosion. Storm surges are at their most dangerous when they arrive at high tide – when the sea is already at its high point. The resulting storm tide can flood inland areas.

For further information, refer to the Queensland Fire and Emergency Services Queensland State Natural Hazard Risk Assessment and Burdekin Shire Council's Coastal Hazard Adaptation Strategy, both available online.

Image: Flooding of Plantation Creek across the Bruce Highway at Ayr (courtesy Burdekin Shire Council).

Monsoonal rains and monsoon troughs

The Australian monsoon develops in response to summertime heating over the northern Australian region, when the continent warms at a faster rate than the surrounding oceans. This sets up a giant sea breeze circulation, drawing in moisture from these oceans over the lower pressure on the land. As the humidity progressively builds, a monsoon trough becomes established over the Australian region. True monsoonal flow, with deep low-level westerly winds, exists north of the trough, so when the trough moves south over a location, this area becomes affected by monsoonal conditions (BoM, 2012).

Farmers and graziers, communities and the ecosystems that have evolved across Australia's north depend on monsoonal rains to replenish water storages and recharge natural aquifers. However, these rains can also create substantial flooding and restrict movement across large areas (BoM, 2012).

Climate factors such as El Niño, La Niña and the Madden-Julian Oscillation can be important influences on the timing and intensity of monsoon phases.

Severe storms

BoM defines a severe storm as a thunderstorm that produces:

- large hail (two centimetres in diameter or greater)
- damaging wind gusts (90 kilometres per hour or greater)
- tornadoes
- heavy rainfall conducive to localised and/or flash flooding.

Thunderstorms are associated with a very tall cloud mass called a cumulonimbus cloud, and usually develop when warm, humid air carrying a lot of water vapour near the ground is forced upwards due to surface winds converging with an approaching front or low pressure trough to make the moist air rise rapidly in an unstable atmosphere.

Thunderstorms can become severe when the atmosphere is particularly unstable and/or additional energy is drawn in from surrounding winds. Spring and summer seasons in Queensland are particularly known for the rapid onset of severe storms, super cells and downbursts.

A key example of this was the February 2020 localised rainfall event over parts of the Burdekin Shire, which saw over 500 mm of rain fall in just over 24 hours. Water levels quickly rose in Ayr, and the Bruce Highway was closed between Ayr and Home Hill, in addition to local roads. Rita Island received 615 mm of rain in the same period, which isolated residents. The rainfall event was driven by a slow-moving tropical low sitting over the waters of the Gulf of Carpentaria.

Flood warning system

The flood warning system in the Burdekin and Haughton catchments is made up of four elements:

- 150 gauge assets like rainfall and river gauges in the Burdekin system, and 32 in the Haughton system
- additional supporting infrastructure like flood cameras, 'flooded road' signage, data transmission and power supply
- flood prediction services, including eight flood forecast locations on the Burdekin system and one on the Haughton system
- communications/messaging processes (see flood classifications information below).

Each of these elements need to function properly before, during and following a flood event in order for people to fully understand their exposure to the flood risk. An optimised infrastructure network (i.e. the gauges and the supporting infrastructure) is the backbone of ensuring the right people have the right flood information at the right time.

BoM notes that flood warning is an integral component of counter disaster arrangements for a community at risk from flooding. The aim of the warning system is to minimise loss of life and property damage by warning people in a timely way of the likelihood, size and duration of a flood so that they may take the necessary actions to mitigate any adverse consequences to the event. Examples would be to evacuate to a safer location, or relocate property or stock to higher ground.

Warnings are of limited value unless they are delivered in a timely and effective manner, and property owners and residents in the flood-threatened area heed the warning and take appropriate action in advance of being flooded.

Flood classifications

As part of the effective implementation of the flood warning system, BoM uses a three-tiered classification scheme that defines flooding as minor, moderate or major at key river height stations, known as the river gauge locations. Each classification is defined by the water level that causes certain impacts upstream and downstream of the station. These levels have been determined and described based on standard descriptions of flood effects (see below), historical data and relevant local information.

This helps to inform communities to understand their risk, and provides triggers for action to prepare for flooding.

Minor flooding

Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas, inundation may affect some backyards and buildings below the floor level, as well as bicycle and pedestrian paths. In rural areas, removal of stock and equipment may be required.

Moderate flooding

In addition to minor flood effects, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may experience water above the floor level. Evacuation of flood-affected areas may be required. In rural areas, removal of stock is required.

Major flooding

In addition to moderate flood effects, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood-affected areas may be required. Utility services may be impacted.

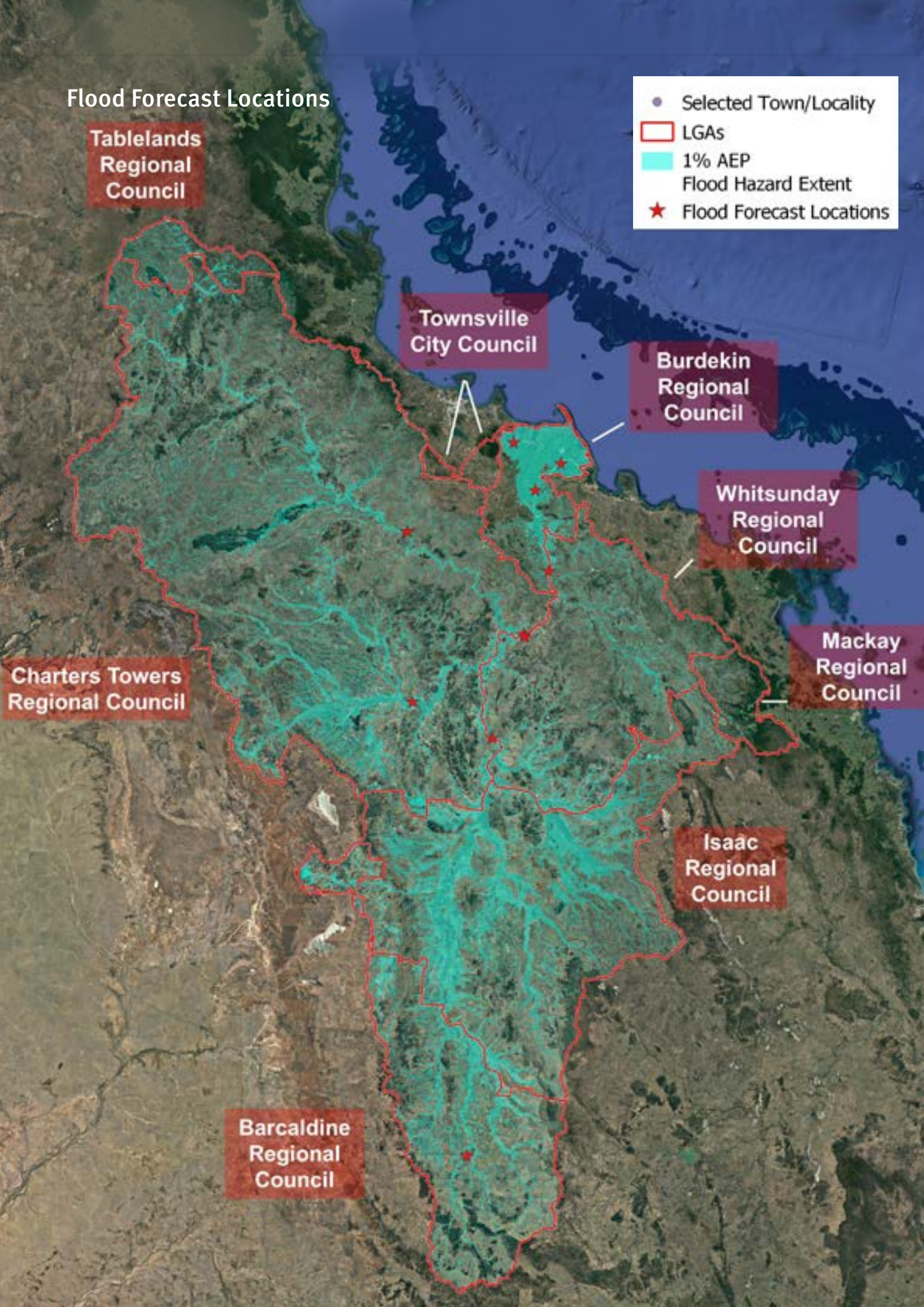
Flood forecasting

There are eight forecast locations in the Burdekin system and one in the Haughton system.

A forecast location is a location for which BoM provides a forecast of a future water level, either as the class of flood that is predicted (minor, moderate or major), or as a level and class (e.g. '4.6 metres – major flood level').

The Burdekin forecast locations are Alpha, St Anns, Taemas, Sellheim, Burdekin Falls Dam, Dalbeg, Clare and Inkerman Bridge. The Haughton forecast location is at Giru.

Image: Automatic flood warning gauge at the Burdekin Bridge.


Flood Forecast Locations
Selected Town/Locality
LGAs
1% AEP
Flood Hazard Extent
Flood Forecast Locations
Tablelands Regional Council
Townsville City Council
Burdekin Regional Council
Whitsunday Regional Council
Mackay Regional Council
Charters Towers Regional Council
Isaac Regional Council
Barcaldine Regional Council

Flood behaviour and history

Burdekin catchment

The Burdekin River catchment is capable of producing major flooding following heavy rainfall, causing inundation of properties and closure of main roads both upstream and downstream of Lake Dalrymple.

Flooding in the upper catchments of the Burdekin may not necessarily lead to downstream flooding.

At Lake Dalrymple, the three upper tributaries converge: the Belyando and Suttor; the Cape and Campaspe; and the Upper Burdekin Rivers. The streamflows from each tributary are very different.

The Belyando and Suttor systems occupy 57 per cent of the total area of the Burdekin catchment, but are responsible for only 33 per cent of the catchment streamflow. In the Belyando sub-catchment, the highest recorded flood for Alpha was 10.26 metres, which occurred in April 1990, 2.26 metres above the major flood level. Other major flood events have occurred in 1950 and in 2010, in addition to a series of moderate flood events in the 1990s and 2000s.

At the St Ann's gauge on the Suttor River, downstream of Belyando Crossing, the classification of a 'major' flood event is at 10 metres on the gauge. There are no records to date of a major flood at this location.

The Upper Burdekin system accounts for only 28 per cent of the total catchment area, but generates approximately 52 per cent of the catchment streamflow. This means that more than half of the floodwaters generated across the vast Burdekin catchment comes from the Upper Burdekin sub-catchment tributaries, as opposed to the Cape and Campaspe or Belyando and Suttor sub-catchments. Of the upstream catchments above the dam, flows from the Upper Burdekin in particular is more likely to generate downstream flooding than the Cape Campaspe or Suttor and Belyando. Irrespective, the effect of Burdekin Falls Dam alters streamflow to the lower reaches.

Major flooding in the Upper Burdekin sub-catchment, recorded at the Sellheim gauge, occurred in 1972, 1974, 1991, 1998, 2009, 2012 and 2019. It can be observed that major flood events in this sub-catchment have occurred more frequently over recent decades when compared with the Lower Burdekin, measured at the Inkerman Bridge gauge.

Image: Historic flood marker at Hann Creek in the Upper Burdekin sub-catchment.

At the Taemas gauge on the Cape River, downstream of its junction with the Campaspe River, major flood events have been recorded in 1974, 1991 (on two separate occasions), 1998, 2008, 2009, 2012, and fell slightly short of reaching major flood height in 2019.

The Bowen and Broken system, which enters the Lower Burdekin below Burdekin Falls Dam, occupies 7 per cent of the total catchment area, and yields an estimated 13 per cent of the total catchment stream flow. High rainfall west of Mackay can generate major flooding in both the Bowen and Lower Burdekin systems.

From a likelihood perspective, flooding on the Lower Burdekin may be more likely to stem from flooding in the Bowen and Broken system than the upper tributaries, due to the effect of the dam. The dam itself, however, was not constructed for flood mitigation purposes. Rather, it supports water supply for the region, as well as a complex irrigation system that spans the Lower Burdekin delta and supports a thriving agricultural industry, which is a key economic generator for the broader region.

The upper tributaries support a range of different land uses and economic activities, including mining and grazing, as well as other forms of agricultural production.

In terms of its geology, the Burdekin and Haughton landscape is highly variable. Scientific evidence suggests the Lower Burdekin previously travelled north around Mount Kelly and discharged into the Haughton River some 6000 to 10,000 years ago, before shifting to its current course to the south of Mount Kelly and out to the coast. Recent palaeo investigations have also found the Burdekin delta has migrated approximately 100 kilometres south along the ice-age coastline of the Great Barrier Reef, underpinning the dynamic and constantly changing course of the Lower Burdekin channel.

Flood impact on communities across the Burdekin is vast. In many Queensland catchments, upstream flooding within headwater tributaries is usually characterised by flash flooding. This can be difficult to manage, particularly in terms of flood warning as well as rapid-onset impacts. In these conditions, floodwaters usually recede as quickly as they rise. However, this is not the case in some areas of the Burdekin headwaters.

Flooding impacts in Alpha, for example, can be major. Alpha can receive an average of approximately 18 hours warning of a major flood event, but anecdotally as little as 10 hours, and the duration of impact can be significant. Flooding in Alpha is generated by far less rainfall than experienced in other parts of the catchment.

Charters Towers is located some 20 kilometres from the Burdekin River, and as such, its most significant issue is isolation during major flood events. As a township steeped in rich history, the urban form of Charters Towers has adapted to the impacts of heavy rainfall events which are commonplace in the region, via the construction of significant roadside drainage systems to collect and discharge large volumes of water over short periods during high rainfall events.

At the lower end of the catchment, Ayr, Home Hill and other communities, including Rita Island and Groper Creek, occasionally experience severe flooding with multiple residences and businesses affected. This can occur either via major riverine flooding on the Lower Burdekin, or by localised rainfall events generating significant overland flow and localised flooding. It is also generated more commonly from the Bowen and Bogie sub-catchments, which enter the Lower Burdekin below the dam.

Home Hill in particular is exposed to considerable flood risk on the basis of its geographic relationship to the Burdekin River.

The most recent major flood in Ayr and Home Hill occurred in February 1991, with the Inkerman Bridge gauge recording a record height of 12.53 metres, noting this event occurred after the construction of Burdekin Falls Dam. Prior to this, the same gauge recorded a record height of 12.62 metres in April 1958.

Other major flood events recorded at the Inkerman Bridge gauge occurred in 1968, 1972 and 1974, prior to the construction of Burdekin Falls Dam. Large-scale moderate events, falling short of reaching a 'major' flood classification, have occurred in the Lower Burdekin system in 1991 (in a separate event to the major flood in February of the same year), 2008, 2009 and 2019.

The 2019 North and Far North Queensland Monsoon Trough event saw considerable flooding across large areas of the Burdekin and Haughton catchments, and across North Queensland and the Far North in general. The monsoon's heavy rain was the result of an intense and very slow-moving monsoon low over Northern Queensland. Heavy rainfall from the 2019 Monsoon Trough event caused major flooding in several river systems, including the Burdekin River and its tributaries, the Haughton River and Barratta Creek.

> ***"Flood and relying on wet weather events is part of our DNA."***
>
> Mayor Sean Dillon, Barcaldine Regional Council.

Image: A spilling Burdekin Falls Dam, 2021 (courtesy F. Ramsay).

Haughton catchment

The Haughton River catchment covers an area of approximately 1850 square kilometres and includes the major tributaries of Reid River and Majors Creek.

The Haughton is a short-run system, meaning it does not take long for rainfall in the Mingela area (part of the Hervey Range, at the catchment's headwaters) to generate downstream flooding. The upstream areas comprise granite geologies, contributing to the ease with which water runs from its headwaters. Because of this, the Haughton catchment is notoriously responsive to rainfall, and thus flooding.

Flooding in the Haughton catchment is not in any way unexpected, or without precedent. In fact, it can be known to flood several times a year. As a result, residents of Giru are well acquainted with flood hazard due to its frequent nature. An existing levee around the town provides flood attenuation for events up to a depth of 2.30 metres on the flood gauge (BoM, 2020). In February 2018, the highest flood on record reached 3.20 metres and caused widespread flooding through commercial and residential areas of Giru.

The Haughton River crosses the western area of the Lower Burdekin floodplain and quickly loses capacity, leading to widespread overbank flooding. The intermediate area between the Haughton and the Lower Burdekin is drained by Barratta Creek. Barratta Creek forms part of the Haughton system, but can receive overbank flows from both the Haughton and the Lower Burdekin, as well as discharge from its own catchment area.

Based on local knowledge, this only occurs in rare events and depends on the characteristics of rainfall across a temporal scale, noting the Lower Burdekin is a much larger system than the Haughton, and they usually experience flooding at different intervals.

Before floodwaters reach Giru, the Haughton system crosses the Bruce Highway and the North Coast railway line. This section of the floodplain is subject to the Haughton River Floodplain Upgrade Project (Bruce Highway Horeshoe Lagoon – Palm Creek), which is designed to increase the flood immunity of the Bruce Highway across the Haughton River floodplain, reducing isolation and improving connectivity and resupply opportunities between Ayr and Townsville.

Irrigation systems across the floodplain have altered the natural flows of the area over time, and support major cane growing and other crop production industries on the fertile soils of the coastal delta.

Heavy rainfall within the catchment area regularly leads to major flooding of agricultural areas adjacent to waterways, and major flooding in Giru.

Since 1978 when flood records started for the Haughton River, there have been almost 20 major flood events.

Brandon experiences riverine flooding associated with Sheep Station Creek to the west of town, which can, in major events, join with flooding in Lilliesmere Lagoon in the Kalamia Creek system immediately north of Ayr. Barratta Creek, further to the west, transects the coastal delta before discharging to the coast near the township of Jerona.

The Barratta sub-catchment experiences overbank flows from both the Haughton and the Burdekin catchments, making this portion of the catchment a complex and dynamic system. It also means the catchment and sub-catchment boundaries in delta locations may not completely align with flood behaviour.

Burdekin River catchment

Major flooding requires a large-scale rainfall situation over the Burdekin River catchment. The completion of the Burdekin Falls Dam in the 1980s has reduced to some extent the occurrence of major flooding in the lower reaches. Major flooding still occurs, however, in the lower reaches from the run-off produced by heavy rainfall and flooding in the Lower Burdekin, Bowen and Bogie River catchments. The following can be used as a rough guide to the likelihood of flooding in the catchment:

- Average catchment rainfalls in excess of 200 mm in 48 hours may cause moderate to major flooding and traffic disruptions to develop, particularly in low-lying areas of the Burdekin River catchment downstream of the Burdekin Falls Dam and extending into the Burdekin River delta area.
- Average catchment rainfalls of in excess of 300 mm in 48 hours may cause major flooding and traffic disruptions to develop, particularly in low-lying areas of the Burdekin River catchment downstream of the Burdekin Falls Dam and extending into the Burdekin River delta area.

Haughton River catchment

Major flooding requires a large-scale rainfall situation over the Haughton River catchment. However, the following can be used as a rough guide to the likelihood of flooding in the catchment:

Average catchment rainfalls of in excess of 200 mm in 24 hours may cause moderate to major flooding and traffic disruptions to develop, particularly in low-lying areas of the Haughton River catchment downstream of Huston's Farm, extending into the Giru township and Haughton River delta area.

Average catchment rainfalls of in excess of 300 mm in 24 hours may cause major flooding and traffic disruptions to develop, particularly in low-lying areas of the Haughton River catchment downstream of Huston's Farm, extending into the Giru township and Haughton River delta area.

Image (above): Burdekin weir. (Left:) Automatic flood warning gauge at the Giru rail bridge.

Flood exposure

The following section provides a high-level overview of the nature of flood exposure relative to each local government area within the Burdekin and Haughton catchments. The below observations relate to a 1 per cent annual exceedance probability (AEP) event, unless otherwise stated, in large part drawn from the 'process one' analysis of the region using the QERMF approach for each local government area.

AEP describes the probability of a specific rainfall total over a given duration being exceeded in any one year (BoM, 2020). This is the most accurate manner in which to describe a certain flood event magnitude. The annual recurrence internal (ARI) is a commonly used method to describe flood event magnitude (e.g. a 1 in 100 year event); however, the periods between exceedances are generally random and as such, the ARI is not an accurate representation of flood magnitude or probability.

As the climate continues to change, event probabilities are changing such that the ARI is becoming less applicable over time.

However, for the purposes of interpretation of the information contained within this strategy, the following comparison is provided:

- a 2 per cent AEP event is generally equivalent to a 1 in 50 year ARI event
- a 1 per cent AEP event is generally equivalent to a 1 in 100 year ARI event
- a 0.5 per cent AEP event is generally equivalent to a 1 in 200 year ARI event
- a 0.2 per cent AEP event is generally equivalent to a 1 in 500 year ARI event.

Barcaldine

The Barcaldine region occupies just over 11 per cent of the total Burdekin catchment area. The primary town within the Belyando sub-catchment area of the Barcaldine region is Alpha. The township of Alpha serves a large grazing community in the region, and takes its name after one of the first cattle stations established in the region.

In terms of its flood exposure, a significant proportion of residential properties in town are subject to potential inundation or isolation. Located on the Capricorn Highway, major sections of state and local roads are subject to inundation to depths of over 2 metres, which can isolate the township from its surrounds, and also create challenges for resupply depending on flood duration and impact.

In addition to the exposure of residential properties, other significant land uses and infrastructure items are also exposed. These include:

- Alpha railway station
- the only telecommunications tower located in town (but flood impacts may not necessarily cause damage)
- both fuel stations being exposed to potential flood inundation of 1 and 2 metres in depth
- the supermarket within town being exposed to inundation
- electricity infrastructure within town being exposed
- the grounds of Alpha State School being exposed to a flood depth of approximately 1.2 metres
- Alpha aerodrome being subject to potential isolation
- exposure of surrounding grazing land on the floodplains within the Belyando sub-catchment is not uncharacteristic, vulnerability is largely associated with loss of income
- weed transfer downstream, a potential environmental issue as a result of flood events.

The April 1990 flood was the highest event on record, at an estimated AEP of 0.5 per cent. During the event, there was a levee on the upstream side of the Capricorn Highway, near the former hospital site, which was breached and collapsed during the flood event. Since this event, additional culverts have been installed as part of the railway bridge crossing to facilitate easier and faster flood conveyance across the floodplain.

Over recent years, the hospital, aged care facility and emergency services facilities have been relocated to higher ground at the western end of the township, off the floodplain.

Image: Historic flooding in the township of Alpha.

Isaac

The Isaac region occupies almost 22 per cent of the total Burdekin catchment area. That part of the catchment which traverses the Isaac region includes parts of the Belyando and Suttor sub-catchments. Perhaps the most prominent issue in relation to flood exposure within the Isaac region relates to the magnitude of existing and future planned mining activity and the movement of product and workers.

There are a number of discrete communities within the Belyando and Suttor sub-catchments, where the local school is the primary hub of the community, such as Mistake Creek and Kilcummin.

The township of Glenden, located within the Suttor sub-catchment, was constructed in the 1980s to provide accommodation for workers and their families at the nearby Newlands Coal Mine. The township itself is not prone to flood due to its geographical context, situated off the floodplain. However, it can be isolated to an extent, having regard to the exposure of roads that connect it with nearby communities.

Land use across the Isaac portion of the catchment is largely related to mining and grazing. Linear infrastructure such as roads and private railways transect the floodplains, transporting product to ports on the coast.

Mackay

The Mackay region occupies about 1.4 per cent of the total Burdekin catchment area. This small area of the Mackay region is located at the headwaters of the Broken and Bowen system. The hinterland township of Eungella, an hour inland from Mackay, is perched 686 metres above sea level.

The Broken River flows around the western side of Eungella. The Eungella Dam on the Broken River is situated to the west of the township, before the river continues its journey north to Urranah, where a declared coordinated project for a further dam is being considered. The geology in this country is largely granite, creating a fast-flowing landscape where limited absorption into soils means run-off can be of high volume and high velocity. The velocity of water flowing off the steep granite geology of the Broken system and the water from the upper Bowen sub-catchments can impact on the sedimentary layers in the lower Bowen sub-catchment, resulting in considerable gully erosion. These are key contributing factors to the large volume of sediment produced by the Bowen system, which is carried downstream and eventually deposited into the Great Barrier Reef coastal zone.

Eungella does not experience significant flood inundation but it does get isolated, with a section of the Eungella Dam Road exposed to flood impact. It also becomes isolated from the nearby town of Crediton.

The loss of electricity during and after an event may occur, but damage to electricity assets may be limited, again due to the geographical location of the township.

Of particular note in relation to flood exposure, Eungella attracts a significant number of visitors both to the township and its surrounds, which include national parks.

Whitsunday

Downstream from Eungella, the Broken River meets the Bowen River before continuing on to enter the Lower Burdekin. The Bowen and Bogie Rivers within the Whitsunday region occupies just over 13 per cent of the total Burdekin catchment area.

Land use in both the Bowen and Bogie systems is largely characterised by grazing and other agricultural activities.

Within the Bowen sub-catchment are the townships of Collinsville and Scottville, to the north-west of the Bowen River. These communities are joined by Scottville Road, and are flanked by Pelican Creek, which discharges into the Bowen River. Issues of flood exposure relevant to Collinsville and Scottville include:

- at least one fuel station in Collinsville is likely exposed to flood impact, with others located nearby
- the sporting oval of Collinsville State High School is subject to potential inundation
- the grounds of Collinsville State School are subject to potential flood impact
- Collinsville Community Centre is potentially exposed and/or isolated
- several short-term accommodation facilities may be impacted, with potential flow-on effects for FIFO workers and mining activities
- several places of worship may be exposed to flood impact.

Tablelands

The headwaters of the Upper Burdekin sub-catchment rise at the very southern extent of the Tablelands region, which occupies just under 2 per cent of the Burdekin catchment area. The creeks and tributaries flowing into the Burdekin River in this area are highly responsive to rainfall events, rising quickly to enter the main river channel as it starts its journey south.

Just as quickly as floodwaters rise in this location, they also fall, leading to short, episodic events rather than long-range inundation. Land use in the Burdekin area of the region is typically associated with grazing and agricultural production, and protection of stock and water pumps during the wet season is a key focus for graziers.

The geographical context of the Tablelands region, high above sea level, places it at the headwaters of a number of coastal and gulf catchments, including the Herbert, Barron, Gilbert, Johnstone, Mitchell, Mulgrave-Russell, Murray and Tully catchments (WetlandInfo, 2020).

Image: The Bowen sub-catchment (courtesy Whitsunday Regional Council).

Charters Towers

The Charters Towers region is the largest local government area within the Burdekin and Haughton catchments by land area, comprising almost 48 per cent of the Burdekin catchment area and almost 19 per cent of the Haughton catchment area. Charters Towers incorporates three sub-catchments, including the Upper Burdekin, Cape and Campaspe, and part of the Suttor sub-catchment. The region is steeped in rich history, with the town of Charters Towers founded in the 1870s following the discovery of gold. Much of the town's history has been lovingly retained in the form of its heritage-listed buildings.

The town of Charters Towers is located 13 kilometres from the banks of the Burdekin River. It is accessed via two main road connections – the Flinders Highway from Townsville, which continues west through to Hughenden and is part of the National Road Network, and the Gregory Developmental Road, which traverses the region from south of Belyando Crossing to north of Greenvale, and is part of the State Strategic Road Network. These roads are key freight, logistics and tourism routes, facilitating inter-regional connectivity and alternative access when the Bruce Highway is closed due to flooding. However, both major road connections are subject to flood inundation at numerous locations as well. Facilitating alternative access to the Bruce Highway, via an improved inland highway system, is a key element of the State Government's resilience strategy for central and northern Queensland.

While Charters Towers itself is not subject to riverine flooding, it does experience heavy rainfall events. Over time, significant roadside drainage systems have been constructed throughout the town to quickly convey overland flows to creeks and tributaries.

Other key townships of the Charters Towers region within the Burdekin catchment include Ravenswood, Greenvale, Hidden Valley, Hervey Range, Homestead and Pentland.

Greenvale was developed in the 1970s to accommodate workers of the nearby Greenvale Nickel Mine, which closed in 1993. While it is not subject to flood inundation, it is subject to isolation due to its location at the confluence of three rivers – the Burdekin, Star and Clarke Rivers. The local pub, named the Three Rivers, was made famous by a Slim Dusty song of the same name.

Hidden Valley is an off-grid township located in the Seaview Range, approximately 20 kilometres from Paluma. It is also located immediately downstream of Paluma Dam which is a referrable dam.

Ravenswood, Homestead and Pentland are each subject to flood impacts of varying magnitudes, and to inundation of properties.

Both residential and commercial flooding has previously occurred in some events, particularly in Pentland. A significant portion of the grounds of Homestead State School is subject to potential flood inundation stemming from overbank flooding of Homestead Creek. Ravenswood township is downstream from Suhr's Creek Dam which is a referrable dam.

Outside of townships, land use in Charters Towers is largely associated with primary production, as well as mining activity. Large portions of the region are also occupied by the Australian Defence Force, including the Greenvale Field Training Area and the Townsville Field Training Area, situated at the headwaters of Keelbottom Creek in Hervey Range.

The basalt geologies of the western and north-western parts of the region give rise to remarkable flood behaviour in certain events, including expansive waterfalls. Flooding of the Upper Burdekin, Cape and Campaspe and Suttor sub-catchments often results in overbank flooding, spilling across large floodplains. Stock management and removal of pumps from watercourses prior to flooding are key activities for graziers i.e: relocating equipment and stock to higher ground. BoM data and forecasts, as well as local landholder communication networks up and down the systems, help to distribute information and trigger preparations during wet seasons.

In terms of major projects on the floodplain, the final business case for the Big Rocks Weir on the Upper Burdekin was handed to the Australian Government in 2020, and aims to boost water security in the Charters Towers region. A business case is underway for the broader Hells Gates Dam Scheme, led by the Australian Government (North Queensland Water Infrastructure Authority, 2020).

All tributaries and rivers flow to the south-eastern portion of the region, discharging into Lake Dalrymple. A small portion of the Charters Towers region also forms the headwaters of the Haughton catchment, in the area of Mingela in the Hervey Range.

Image: A swollen Burdekin River at the Macrossan Bridge.

Burdekin

The Burdekin Shire occupies the majority of the Lower Burdekin sub-catchment, as well as the majority of the Haughton catchment. Parts of the Haughton catchment are also shared with Charters Towers and Townsville local government areas.

By virtue of the large, sprawling delta system of the Lower Burdekin and Haughton, a number of communities across the Burdekin Shire experience the impact of localised as well as riverine flooding. This includes the townships of:

- Dalbeg
- Millaroo
- Clare
- Home Hill
- Ayr
- Brandon
- Rita Island
- Groper Creek
- Jerona
- Giru.

Despite maintaining a relatively small proportion of the catchment area, the total area of the Burdekin and Haughton catchments flow out to the coast through the Burdekin Shire, placing it at the highest level of potential impact. This extends beyond townships to the significant agricultural activities and assets operating on the delta. The rich, fertile alluvial soils on the delta make it a prime location for agricultural production, dominated by sugar production.

Given the level of exposure across the coastal delta, Burdekin Shire maintains detailed flood models, which assist the council and other agencies to better understand the potential impact of flooding under various conditions.

The construction of Burdekin Falls Dam in the 1980s has altered flows from upstream catchments, with the exception of the Bowen and Bogie sub-catchments, which flow into the Lower Burdekin below the dam. As such, riverine flooding from the upper catchments is not frequent, and localised flooding from significant rainfall events over the coastal delta are likely more commonplace. The Haughton system experiences flooding each year, and sometimes on multiple occasions in each wet season.

In addition to the inundation and isolation of residential dwellings in towns, the following summary of key aspects of flood exposure are identified.

Image: An aerial view of the urban centre of Ayr.

Home Hill

Aspects of flood exposure relevant to Home Hill include:

- the wastewater treatment plant ponds (rarely used) being exposed to an estimated flood depth of between 0.5 and 1.5 metres
- all fuel stations being exposed to potential inundation
- major sections of the Bruce Highway being exposed to inundation impact
- most state and local roads on the coastal delta being subject to inundation
- the North Coast rail line being exposed to flood impact including the Home Hill railway station
- private railway infrastructure servicing the cane industry being exposed
- the mobile phone tower and telephone exchange being subject to over 1 metre of inundation
- the aerodrome landing strip being subject to between 1 and 2 metres of flood inundation
- a significant number of educational facilities (including child care and tertiary) being either directly exposed or likely to be isolated
- Burdekin Memorial Hall possibly being exposed in higher magnitude events
- residences and businesses being exposed to potential inundation
- the police station and hospital possibly being exposed to potential inundation
- aged care facilities possibly being exposed to inundation of over 0.5 metres
- Kirknie Road landfill, and Kirknie Road itself, being exposed to flood impact.

Ayr

Aspects of flood exposure relevant to Ayr include:

- likelihood of experiencing flood impacts shortly after Home Hill, primarily related to flooding from Plantation Creek
- major sections of the Bruce Highway being exposed to inundation impact, particularly across Plantation Creek
- private railway infrastructure servicing the cane industry being exposed
- a significant number of educational facilities (including child care and tertiary) being either directly exposed or likely to be isolated, or part thereof
- Ayr Hospital being exposed to potential isolation
- a number of caravan sites being subject to potential flood impact
- Ayr aerodrome being subject to isolation
- a number of electricity substations being exposed to potential inundation.

Giru

Aspects of flood exposure relevant to Giru include:

- the majority of the North Coast railway line running parallel to the Bruce Highway being exposed
- the Haughton River Floodplain Upgrade Project (Bruce Highway Horeshoe Lagoon – Palm Creek) has a project criteria to not influence the flood levels upstream and downstream of the Bruce Highway, including Giru
- private railway infrastructure servicing the cane industry being exposed
- educational facilities in town being exposed to potential inundation and isolation
- residences and businesses being exposed to potential inundation
- the police and ambulance stations possibly being subject to minor levels of inundation in major events
- the fire station being potentially exposed to a flood depth of over 0.5 metres
- the Invicta Mill and substation being subject to flood inundation.

Groper Creek

Similar to Giru, the community of Groper Creek on the southern side of the Burdekin River also experiences significant and frequent seasonal flooding. However, its impacts generally tend to be minimal, the principal issues relating to impacts to infrastructure such as roads.

Over time, the built form of Groper Creek has adapted to its flood impact and frequency in a manner that is unique, and not compelled or mandated by regulation. That is to say, residents take it upon themselves to adapt their homes to accommodate flood events. At a cost to the home owner, residences and local business premises are raised off the ground, including garages, water tanks, clotheslines, telephone boxes and electricity infrastructure assets.

While requiring upfront investment, this approach to the accommodation and acceptance of flooding enables residents to protect their assets and remain in their homes during sustained flood events. It is the lifestyle trade-off that is most valued by its residents. This is, of course, made possible by consideration of the nature of flood behaviour, flows of which are of a low velocity in this location. These outcomes are not possible in more dangerous, fast-flowing flood-prone areas.

Loss of life has occurred in flood events at Groper Creek. As such, it is important to always remain vigilant about the danger of floodwaters.

Images (above): Twilight in Home Hill. (Right): Flood mitigation in the community of Groper Creek.

Agricultural lands on the coastal delta

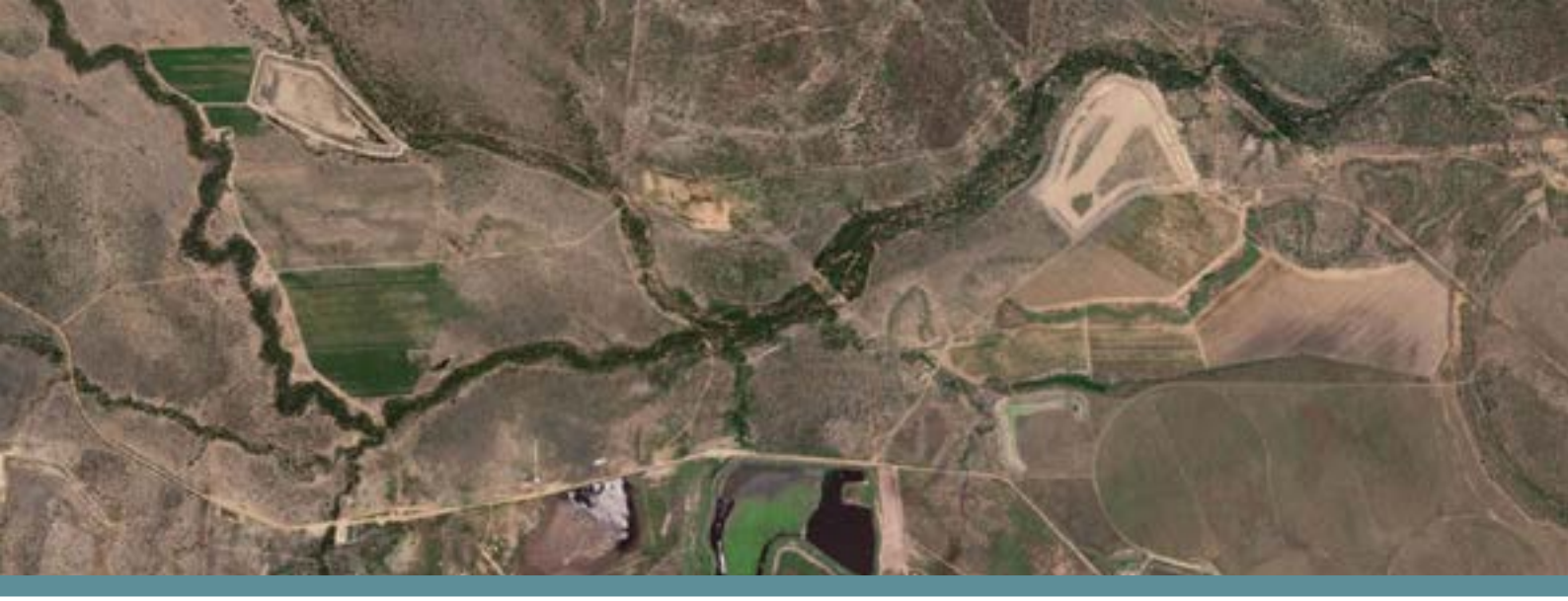
Exposure of surrounding agricultural land on the delta floodplain is not uncharacteristic, and is not unexpected by those living or operating business activities across the delta. Vulnerability to flood impacts in this area is largely associated with loss of income and cascading environmental issues associated with the flooding of production lands.

It is estimated that 82 per cent, or over 87,000 hectares, of cropping land on the coastal delta is exposed to flood impact.

More broadly, Abattoirs in the Burdekin Shire at Giru and Ayr are potentially exposed to flood impacts, in addition to the only bulk grain storage facility in the region.

In terms of infrastructure exposure, approximately 42 per cent of mobile phone towers in the region are potentially exposed, along with over 60 per cent of transmission powerline and over 70 per cent of sub-distribution powerline infrastructure assets. This includes potential for isolation, not necessarily inundation of assets. Over half of the fuel stations in the region are subject to potential inundation or isolation.

Burdekin Shire Council's current disaster management arrangements recognise these aspects of potential flood exposure, relative to various scales of events.



Townsville

The upper catchment areas of the Haughton system are located in the very southern area of the Townsville local government area, to the west and south of Mount Elliot. This includes the areas of Woodstock, Majors Creek, Reid River and part of the coastal community of Cungulla. The Townsville local government area occupies 22.5 per cent of the Haughton catchment area.

Townsville experienced significant flooding as a result of the 2019 Monsoon Trough event. This was largely associated with major sustained flooding in the Ross, Bohle and Black catchments, as well as Bluewater Creek.

The heavy rainfall was associated with an intense and very slow-moving monsoon low over Northern Queensland that continued to affect the state in the first half of February 2019. Such slow-moving weather systems are relatively rare for this part of the country, and the large size of monsoon lows means the areas they impact may be larger than tropical cyclones.

In and around Townsville, the accumulated daily rainfall totals were the highest since records began in 1888. Numerous areas reported 12-day accumulations of more than 2000 mm, including at Paluma, Woolshed and Upper Bluewater (BoM, 2019).

During major events, Townsville City Council, Burdekin Shire Council, Hinchinbrook Shire Council and Charters Towers Regional Council work together to support isolated communities that may be in other local government jurisdictions. This was the case with the communities of Woodstock, Reid River and Majors Creek during the 2019 Monsoon Trough event, which were isolated from Townsville City for a prolonged period.

These communities within the Haughton catchment are largely agricultural in nature. The proposed Lansdown Eco-Industrial Precinct is intended to be situated within the Haughton catchment, in the vicinity of Woodstock and Calcium along the Flinders Highway. It aims to be Australia's first environmentally sustainable advanced manufacturing, processing and technology hub.

Image: Majors Creek in the Townsville local government area.

Local knowledge

Accompanying this strategy is a series of sub-catchment local knowledge maps. These maps seek to combine local knowledge with historic data and the latest in climate science and flood risk to clearly communicate the diverse breadth of locally relevant aspects of flood across sub-catchment systems.

The local knowledge mapping products document the local dynamics and observations of flood behaviour, landscape characteristics, geology, rainfall, biodiversity status, flood gauge asset locations, flood travel times between key catchment landmarks, and other valuable intelligence that helps us to understand and interpret how these unique catchment systems operate.

A series of 'big map' workshops were held across the region, attended by local governments, state and federal agencies, emergency services, community and natural resource management groups, industry groups and local landholders, to contribute to the collation of locally specific flood behaviour information. The workshops were held in Charters Towers, Home Hill, Bowen, Clermont and Barcaldine.

These local knowledge maps supplement technical flood modelling mapping through the clear articulation of what happens on the ground, and key knowledge that may inform decision-making and flood preparedness.

Local knowledge maps have been prepared for the Belyando sub-catchment (encompassing the entire Barcaldine local government area, including the headwaters of the adjoining Cooper system), the Upper Burdekin, Cape and Campaspe, Lower Burdekin and Haughton systems. These maps can be accessed at www.qra.qld.gov.au/burdekin-haughton.

Local knowledge mapping prepared for the Belyando and Cooper catchments in the Barcaldine region.

Image: Notes captured from 'big map' engagement activities during strategy development.

Elements of resilience

The following section provides an overview of the various characteristics of holistic community resilience, as they relate to the Burdekin and Haughton region.

Community and societal resilience

Social resilience largely focuses on the collective resilience of individuals and communities to be self-sufficient during emergencies and disasters, to the extent possible, and self-reliant in ensuring they have the capacity to cope with the impacts that floods and other hazards can bring. Proactive community effort to anticipate, endure and recover quickly from severe weather events ensures emergency services can focus on those who need help the most, while limiting long-term community reliance upon recovery support payments and services.

Across the Burdekin and Haughton catchments, people and communities demonstrate self-sufficiency by the nature of their behaviours to accommodate flood events as a part of seasonal routine. This is particularly evident across the grazing and agricultural communities across the catchments.

The Burdekin and Haughton catchments are home to an estimated 111,360 people across almost 39,000 properties. Across the community, people will experience the impact of flooding events in different ways. For some, there may not be any tangible impact, while for others, flooding can generate devastating consequences, including the loss of homes, businesses, equipment, personal property and possibly lives. Flooding can also lead to longer term impacts that in turn take longer to recover from. In extreme events, people may never fully recovery from trauma.

Everyone's flood experience is different.

Managing stress, supporting families and family relationships, and accessing post-disaster emotional support are just as critical as repairing roofs and fencing.

Support resources and disaster recovery information, including translated fact sheets in multiple languages, can be accessed at www.qld.gov.au/disasterrecovery.

Vulnerable communities

People are vulnerable and resilient in varying ways. The terms are contrary – lower resilience leads to higher vulnerability along a sliding scale. Despite the wealthy being the most exposed in terms of the value of their assets, it is often the less fortunate who suffer most as they have higher degrees of vulnerability. Resilience should be thought of as a system of complex interwoven dependencies that lead to vulnerabilities across the community. All parts of society, including governments, institutions, organisations and individuals, have a role to play in both increasing resilience and lowering vulnerability.

The demographics of the Burdekin and Haughton catchments indicate a slightly higher proportion of the population is aged 65 years or over, compared with the state average. The proportion of children (aged 14 years and under), people with a disability and people on low incomes in the region are comparable with state averages.

The Indigenous population of the Burdekin and Haughton catchments, at 5.7 per cent, is higher than the state average of 4.0 per cent. This is an important factor when considering overall vulnerability to natural hazard impacts. The Queensland Government is committed to working with First Nations peoples to achieve better life outcomes in health, education, employment and housing (National Agreement on Closing the Gap). Partnering and working with Traditional Owner groups across the catchment is a key opportunity to consider mutually beneficial approaches to resilience.

Working with the vulnerable people of our communities to support their self-reliance is therefore a key focus for resilience activity.

Vulnerable members of the community can experience extreme stress during emergencies and flood events. Assisting and empowering vulnerable community members and their families and neighbours to consider what actions they might take, and the triggers for those actions or decisions, is a helpful way to prepare ahead of the annual wet season.

Facilities and services working with vulnerable people can also assist, particularly with regard to continuity of services and how best to support people during trying conditions.

Image: Kayaking in the Upper Burdekin sub-catchment (courtesy Charters Towers Regional Council).

A snapshot of community characteristics

population of **111,360** people

almost **39,000** properties

16.5% people aged 65+ years, compared with **15%** Queensland average

4.6% people with disability, compared with **5.2%** Queensland average

5.7% Aboriginal and Torres Strait Islander population, compared with **4%** Queensland average

Sharing our knowledge and experiences

It is widely known across the catchments that no two flood events are the same, given the variables contributing to each event such as rainfall, location, the prior level of saturation of the catchment, length of time since last rainfall and vegetation characteristics.

This can change what we experience and observe in relation to flood behaviour and its impacts. The region's frequent experience with flooding can and does breed resilience, but likewise we must remain mindful that flood behaviour can deviate from previous known experiences, and observations from past events may be different to those in the future. We therefore need to remain vigilant in terms of our own resilience, and be mindful of the risk of relying on past trends to inform how we maintain resilience moving forward.

In terms of sharing our knowledge and experiences, our communities welcome newcomers on a regular basis, including people who are not familiar with the nature of flood hazard and flood behaviour across the catchments, and their sub-catchments and tributaries. Our communities also maintain a great deal of knowledge of the particular aspects of certain weather systems that produce flooding. Preparing new neighbours ahead of the wet season will help them to understand what to possibly expect, and what they should consider and prepare in advance for their own property and family.

Sharing our own initiatives for flood resilience with neighbours and newcomers helps to build collective, collaborative resilience in relation to what to do when flooding occurs.

Indigenous cultural heritage

Our region's First Nations Peoples are inextricably bonded to country as the very substance of their culture. Much can be learnt from their stories of the earth, tradition, kinship and ceremony, which nurtured their culture and the land over the past 60,000 years. Our region includes a large Aboriginal and Torres Strait Islander population, higher than the Queensland average.

There are a number of Traditional Owner groups in the region, each sharing a unique relationship with country. NQ Dry Tropics Natural Resource Management works closely with Traditional Owner groups, participating in decision-making and on-the-ground land and sea management activities. The Department of Environment and Science Indigenous Land and Sea Ranger program works to conserve Queensland's important ecosystems and cultural heritage on country. A ranger group is located in Home Hill.

A resilient community is one that is connected to and celebrates its heritage. We value our region's rich Aboriginal cultural heritage, and we respect it by protecting important Aboriginal heritage sites, artefacts and histories, and work with Traditional Owners, locals and historians to educate ourselves and others.

Recognising the profound relationship between Aboriginal communities and the land, we aspire to draw together Indigenous knowledge of the land with modern practices for mutual benefit and common understanding of lived history. With help, we can celebrate our abundant heritage legacy locally, preserve it for the future and communicate it to others.

Image: This 60 metre artwork at Plantation Park, Ayr depicts Gubulla Munda, the Aboriginal totem and the protective spirit for the Birri Gubba people. Gubulla Munda holds sacred cultural and spiritual significance to the Traditional Owners.

Case study: Alpha rural recharge day

In November 2018, the Alpha rural recharge day was organised by local graziers, the Sparrow family of Malden Station. The focus of the day was centred on the theme of 'recharge', including physical and mental health wellness. Following years of drought and without immediate relief in sight, the day provided an opportunity for discussion, learning and continued fostering of community spirit and resilience.
The recharge day was attended by more than 130 people from across the Barcaldine region and beyond, coming together to discuss a range of topics, including:

- the Department of Agriculture and Fisheries drought relief assistance scheme
- other drought assistance programs
- drought policy
- roads, infrastructure and community services
- surviving tough times
- low interest loans, grants, succession planning
- how to tackle drought and disaster at the property level
- physical stretching, safe lifting and carrying practices
- cattle nutrition.

The community-led event was supported by a range of additional agencies and organisations, including Queensland Health and Alpha Hospital, Royal Flying Doctor Service, Outback Futures, Department of Agriculture and Fisheries, Queensland Rural and Industry Development Authority (QRIDA), Ergon Energy, Anna Dyer Physiotherapy (on correct techniques for lifting and carrying), and the local Queensland Police Service.

Following on from this event, in 2019, Barcaldine Regional Council partnered with Outback Futures to invest in and launch a campaign called Head Yakka. The campaign is a tool to facilitate common purpose, conversation, activity and outcomes in all ages and for all parts of the community, combining smarts and the outback capacity for hard work to bring about meaningful change.
For more information on the Head Yakka program visit www.headyakka.org.au.

Case study: Caring for Country Plan

NQ Dry Tropics works closely with Traditional Owners as they have a crucial role to play in natural resource management (NRM) given their connection with the land and their traditional ecological knowledge. Incorporating Traditional Owners' ecological knowledge into strategic NRM decision making, and on-ground works, maintains their strong connection to country and also better protects and manages our region's natural resources.

NQ Dry Tropics worked with Traditional Owners to develop a Caring for Country Plan, with strategies and actions from the plan then embedded into the Burdekin Dry Tropics NRM Plan. A Traditional Owner Management Group provided regional Indigenous leadership and advice to NQ Dry Tropics.

The Caring for Country Plan identifies four main themes which are embedded in a hierarchy i.e. the need to establish representative structures and organisations in the Burdekin region was of the highest priority as without one it would be difficult to negotiate access to country and address Traditional Owner issues:

- Traditional Owner representative structures and organisations
- access to country
- the management of cultural resources
- the management of natural resources.

Traditional Owners have observed that the Caring for Country Plan remains relevant, although only partly delivered, and the implementation strategies require ongoing support and recognition. The Caring for Country Plan recognises that natural resources are culturally defined, and articulates strategies that support Traditional Owners to develop their capacity to undertake NRM actions on country.

A number of Traditional Owner groups also have local land and sea management plans, which identify the values, issues and actions for NRM on their country. The Traditional Owner Management Group identified capacity building in NRM activities as a priority for Indigenous people to improve personal, community and country health and wellbeing.

For further information visit nrm.nqdrytropics.com.au/people-connections/traditional-owners/.

Image: Alpha recharge day (courtesy Queensland Country Life).

Resilient towns and infrastructure

Across the built form of Burdekin and Haughton catchments, best practice adaptation to flooding can be observed. From the raised properties and services at Groper Creek, to dwellings in the Charters Towers region that raise on hydraulics above flood level, residents of the region routinely take it upon themselves to accommodate their lifestyles around the natural processes of the river catchment.

Into the future, development across the region should be contemplated with existing and future hazards and risk at front of mind, to reduce overall exposure of people and property to potential impact and disaster over time.

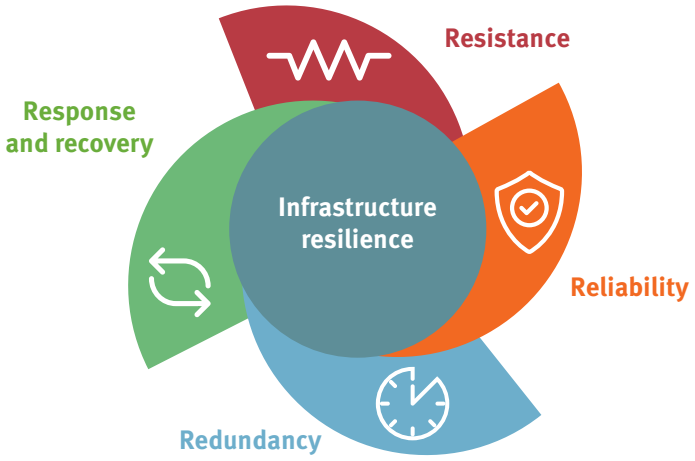
Infrastructure services and networks, and our reliance on them, are also an essential component of daily life. Water, electricity, communications, sewerage, hospitals and health care, banking and finance, transport, education, and other government services such as emergency services, all play a critical role in the day-to-day function of towns and communities.

Our infrastructure networks provide us with important services that support numerous aspects of our lives, and they also support our livelihoods. All economic activity within the region relies on at least one, and often many, interconnected infrastructure services. Our infrastructure networks are both complex and complicated, and we need to build resilience into these networks to ensure continued operations to protect lives and livelihoods.

> ***"By building a more Resilient Queensland, we will overcome some of the challenges currently being faced which include the costs of disasters, rebuilding of infrastructure, increased safety, rising sea water, larger cyclones, longer flood events and prolonged drought."***
>
> Mayor Lyn McLaughlin, Burdekin Shire Council.

Elements of infrastructure resilience

There are four key elements that contribute to infrastructure resilience:



(United Kingdom Cabinet Office, 2011).

Considering all elements when planning and designing infrastructure increases the ability to continue to supply services in a greater variety of conditions, and to restore service more rapidly after disruption.

However, infrastructure assets and networks should not be thought of as stand-alone, independent elements. Sometimes these systems are very tightly coupled, meaning impacts on one system can have very serious consequences on other systems. Understanding these dependencies, where one infrastructure system requires another to operate, and interdependencies, where both infrastructure systems need each other to operate, is important to ensuring service and community continuity within the Burdekin and Haughton catchments.

Complex system resilience is a further aspect of consideration that moves beyond the resilience of a single asset or network to contemplate the dependencies and interconnections across infrastructure systems. The resilience capacities of complex systems include their absorptive capacity, adaptive capacity, anticipative or predictive capacity, and restorative or transformative capacity (Francis & Bekara, 2013).

Image: Burdekin (Inkerman) Bridge crossing between Ayr and Home Hill.

Build to last

For new infrastructure builds or installations, or in the event of repair or reconstruction after damage from a flood, it is critical we maintain resilience at front of mind as part of organisational cultures. One way to address this is to understand infrastructure limitations in advance, and also understand its vulnerabilities. Where issues might be identified in advance, this process may allow the identification of interim and longer term solutions to increase asset, service and network resilience.

When infrastructure requires upgrade, replacement or rebuild, the opportunity to build back better is key.

Build better before

Build back better

Building back better can lead to different goals or objectives. It could encompass a focus on hardening assets, which may lead to enduring flood impact. On the coastal delta area of the Lower Burdekin and Haughton, for example, inundation may be difficult to avoid and as such, hardening of assets to endure impact may be preferred. In other situations, the focus may be on faster restoration of services and networks following disruption. This may acknowledge that service disruption is potentially unavoidable for different reasons, and preference is placed on service restoration objectives. Of course, the principal goal to avoid hazard exposure in the first instance is always preferred, but in Central and North Queensland, this is generally a challenge.

We also need to build better from the outset of design. This introduces a focus on resilience from the conceptual planning and design phase, where all of the risks the infrastructure will be exposed to during its lifetime can be considered. Through this process, building to last integrates resilience to those risks identified during design, enabling the infrastructure to perform at a higher level of resilience from the moment it enters service, and throughout its usable life. Building better infrastructure is also essential for reducing disaster costs when floods and other events occur. Stronger infrastructure that can withstand flood events, or be returned to service more rapidly after flood disruption, supports communities and builds prosperity.

The economics of resilient infrastructure

Infrastructure is a significant investment for the Burdekin and Haughton regional economy, but it is an investment that provides economic growth, supports community and economic stability, and contributes to general community amenity. Embedding resilience as a core factor in infrastructure investment decisions ensures we maximise the value for money and public benefit of infrastructure investment.

Resilience can be a key economic driver for infrastructure investment. With infrastructure designed to provide a service for long periods (20, 40 or sometimes over 100 years), we know that future conditions are likely to be very different, with potentially more severe floods based on current projections, in comparison with today's conditions. Rebuilding costly infrastructure each time it is damaged is unsustainable. Therefore, a longer term view of building to last is essential, building better before events occur, by focusing on resilience as part of conceptual planning and design phases.

Integrating resilience and sustainability into cost-benefit analysis methods on portfolios of infrastructure investment can have significant financial benefits to from a whole-of-asset-life perspective. Economic benefits can spread well beyond infrastructure service providers themselves, with significant benefits to communities and businesses.

The Building Queensland Business Case Development Framework includes information on embedding both sustainability and resilience into options assessment, and provides templates and frameworks for moving from cost-benefit analysis to include resilience in investment decisions via a multi-criteria analysis (Building Queensland, 2020). This includes considerations into preventative infrastructure to improve resilience, reduce ongoing maintenance costs and cater for the region's changing climate.

Multi-criteria analysis is a complementary approach to a cost-benefit analysis. It allows weighted consideration of non-financial objectives (or objectives that are difficult to monetise or quantify) in selection of best outcomes, and is particularly useful for infrastructure projects that provide public goods. The considerations that form part of the multi-criteria analysis approach ensure that organisation, and potentially community objectives (which may be difficult to reduce to a purely financial value in a business case), are considered more holistically than may otherwise be possible.

A further economic opportunity for the Burdekin and Haughton catchments is one which has already been realised within the region, and includes the integration of infrastructure into the circular economy. A circular economy is one that minimises waste, maximises economic and environmental outcomes, and maximises local reinvestment and catchment export opportunities. The idea behind a circular economy is one that has a net energy gain on its balance of trade.

In the Burdekin and Haughton catchments, the use of bagasse for electricity generation in sugar production takes what was previously a waste product in the milling process, and transfers it to a key source of energy and revenue for mill operators, with Pioneer Mill near Brandon the largest biomass electricity generator in Australia.

This example uses one set of infrastructure, for sugar milling, to support another set of infrastructure, being electricity networks. Overall, it provides infrastructure service and benefit to many more users than just the mill, and also yields significant environmental benefits.

Image: Manual-read flood boards on Alpha Creek.

Case study: Cogeneration – clean, sustainable energy

Wilmar is Australia's leading producer of renewable energy from biomass. Its eight Queensland sugar mills operate on renewable electricity generated on site by using bagasse, a by-product of sugar production. It generates enough electricity to export large amounts to the Queensland grid, and power more than 76,000 homes a year.

Bagasse is the fibre that is left over after the sugarcane has been crushed to remove its sweet juice. Bagasse is recycled and used as boiler fuel at each of Wilmar's mills. It is burned at temperatures of more than 800 degrees Celsius to produce steam. The energy in this steam is either converted into electricity or used as heat in the factories. This process of using both heat and power from a single energy source is called cogeneration. Each year, Wilmar converts the energy in over 5 million tonnes of bagasse into renewable energy.

Wilmar's eight sugar mills have a total generation capacity of 202 megawatts, producing about 600,000 megawatt hours of electricity each year. While all of its mills produce renewable energy, the Pioneer, Invicta and Victoria mills have greater generation capacity. Pioneer's cogeneration plant is the largest generator in Australia run on biomass alone. Surplus bagasse produced in Wilmar's Burdekin mills during the crushing season is stockpiled on large, specially designed pads at the Pioneer Mill, enabling Wilmar to continue to produce power outside of the crushing season. The Pioneer Mill, near Brandon, is capable of operating year-round, day and night.

The Invicta Mill, located at Giru, is also designed to accommodate regular flooding from the Haughton catchment, with a focus on restoration of service.

Image: An aerial view of the township of Giru, in the Haughton catchment.

Case study: Alpha emergency hub

In 2016, the Alpha Hospital, along with the police, fire, SES and ambulance stations, were relocated from the Alpha Creek floodplain to higher ground, enhancing the flood resilience of the community and its ability to endure flood events.

Alpha Hospital was previously located on the western bank of Alpha Creek on Swinburn Street, along with the town's ambulance station. The fire station, SES depot and police station were also located within low-lying parts of the township, east of Swinburn Street, and subject to significant inundation.

The Alpha emergency hub was the first co-located hospital, ambulance, police and fire facility in Queensland. In addition to this joint-service hub, a modern aged care facility also forms part of the now flood-immune precinct. The facility has been purpose-designed to enable expansion over time as needed.

Hospital services provided now include 24-hour emergency access, two inpatient beds, two observation beds, two resuscitation bays, a private practice clinic, a four-bed residential aged care facility, outpatient treatment facilities, telehealth facilities and non-clinical support services. The hub also comprises a combined police, fire and rescue facility (with room for the SES), ambulance service centre, community meeting rooms, amenities and car parking.

A variety of sustainable initiatives were incorporated into the facility, including a 15 kW solar power system to reduce electricity demands, as well as solar hot water with gas back-up. These were important due to the remote location of Alpha and limited electricity supply available from the grid (Queensland Health and Hutchinson Builders, 2020).

Image: Re-located emergency services hub, hospital and aged care in Alpha, improving flood resilience (courtesy Angus Martin Photography).

Resilient transport

Transport networks are an essential component of daily life across the region. This extends beyond road networks to rail, air and stock routes. Not only do these networks enable us to travel for work and for personal purposes, but they support product, freight and stock movements, and drive tourism, as foundations of our economy. Transport also provides a lifeline in times of emergency, and is critical for strong supply chains and resupply before, during and after disaster events.

A resilient transport system is one that responds to unexpected conditions and events in ways that ensure the transport needs of the region, its community and its economy are met (DTMR, 2018).

Due to the extent of road, air and rail (both public and private) throughout our vast catchment areas and geographically dispersed communities, there is substantial local experience in dealing with infrastructure damage and isolation. Especially from Central to North Queensland, we come to expect that on some occasions, we might become isolated or need to evacuate to a safer location. As a community, we generally accept a certain level of inconvenience associated with flood events. It is essential however, that transport networks are returned to service as quickly as possible to ensure minimal disruption to supply chains and community accessibility.

The State Infrastructure Plan maintains a strong focus on transport infrastructure that reduces the long-term cost of repair, improves infrastructure resilience, and improves safety and security. This corresponds with regional planning goals in supporting the region's communities and economic resources by developing resilient and reliable infrastructure and a transport network that moves people and freight efficiently (DTMR, 2020).

Road networks

Roads across North Queensland, and indeed across all of Queensland, are subject to flooding at times. There is much more to a resilient road network than flood immunity, and this can include traffic management during flood events, intelligent transportation systems, alternative route arrangements, 'flooded road' signage and lighting, traffic and road condition cameras, river height stations and cameras. It can also include improving community awareness through education and marketing campaigns. The 'If It's Flooded, Forget It – Back it Up 2020' advertisement campaign aims to increase driver understanding of the risks of crossing floodwaters. The campaign has been an effective way to improve road safety and driver resilience.

The DTMR's Northern Queensland Regional Transport Plan identifies that improving resilience and safety in North Queensland can be achieved through a combination of improved infrastructure, information, communication technology and education.

Specific actions identified in the regional transport plans, relevant to the Burdekin and Haughton catchments, include:

- rest areas and heavy vehicle rest areas to address driver needs and behaviours on the Bruce Highway, Flinders Highway and Gregory Developmental Road
- investigation into potential solutions to improve mobile communication coverage across the region's transport network, for example, at recognised rest stops
- updating and developing management plans for primary stock routes throughout the region
- identification of opportunities for intelligent transport systems on the Bruce Highway and other key linkages, including the Flinders Highway and Gregory Developmental Road
- road network resilience investigations across the region to identify key locations susceptible to weather events and understand requirements to manage, mitigate and avoid network impacts. Investigations should explore key routes susceptible to flooding resulting from major weather events, such as the Bruce Highway, Flinders Highway and Gregory Developmental Road
- examining resilience mitigation measures to help prioritise investments in transport infrastructure upgrades, including at the Belyando River on the Capricorn Highway between Emerald and Alpha, Hervey Range Developmental Road, and upgrading bridge and culvert structures on the Flinders Highway, Gregory Developmental Road and Woodstock-Giru Road
- development and adoption of best practices for coordination between relevant agencies to facilitate efficient and effective responses to flooding and extreme weather events
- cross-agency and governmental solutions to infrastructure resilience including improved collaboration to explore opportunities to coordinate disaster and reconstruction funding with investment into preventative infrastructure
- planning to improve the resilience of the defence transport network, particualry on the Bruce Highway, Flinders Highway and Hervey Range Developmental Road to field training areas.

Image: Flood warning signage on the approach to the Clarke River crossing on the Gregory Developmental Road.

During and following weather events, flooded roads and bridges present safety risks where drivers take undue risks crossing flooded roads. Driver behaviour and the expectations of the travelling public are significant factors. Drivers should take all appropriate measures to ensure they can travel to their intended destination in a safe manner, avoiding the possibility of becoming stranded.

If it's flooded, forget it.

Rail

The Burdekin and Haughton catchments represent a unique part of Queensland, with considerable public and private rail infrastructure assets across the region. The North Coast line extends from Brisbane to Cairns, and connects major towns and settlements along the coast. The Mount Isa line runs east-west connecting Mount Isa to Townsville. Both lines provide freight transport and passenger services. The rail network supports significant economic activity within the region, as well as adjoining regions, and is a key element of the overall supply chain.

Major sea ports are located at Townsville, Abbot Point and Mackay. Product from mining activities in the Bowen Basin, Galilee Basin and North West Minerals Province and surrounds is transported to major ports and processing facilities on the coast. The road networks servicing these activities are also paramount for key sectors such as the beef industry. Across the Lower Burdekin and Haughton, extensive private rail infrastructure networks support significant cane production activity between farms and local mills. This infrastructure crosses floodplains, rivers and tributaries, and can experience impacts as a result.

The reliability and resilience of rail networks can be an issue, with the long recovery time after flood events, ongoing problems with heat buckling the track, or movements of track requiring levelling due to moisture movements (DTMR, 2019). Operational management measures can mitigate potential risks to rail networks during the summer and wet season months, including speed restrictions when the air temperature is over 38 degrees Celsius, but this can significantly impact on the reliability and efficiency of rail freight and passenger movements. Into the future, the frequency of interruptions is likely to increase.

Air

From a disaster vulnerability and resupply perspective, a number of runways, aerodrome landing strips and helipads are subject to potential flood inundation or isolation during major flood events across the Burdekin and Haughton catchments. Some airstrips may also be constrained from receiving certain types of aircraft for resupply or emergency response. Differences in sizes and standards of runway characteristics can impact the type and size of the aircraft that can access an airstrip. Significant rainfall events can undermine airport pavements, limiting the ability of regional airports to function as a critical connection to isolated communities.

Image: Freight train crossing the Haughton River at Giru (courtesy F. Ramsay).

Case Study: Haughton River Floodplain Upgrade Project

The Haughton River Floodplain Upgrade Project (Bruce Highway Horseshoe Lagoon – Palm Creek) is situated at Giru along the Bruce Highway, approximately 40 kilometres south of Townsville and 30 kilometres north of Ayr. The project has a total distance of 13.5 kilometres and extends from south of the Bruce Highway intersection with Trembath Road, to north of the Bruce Highway intersection with Mailman Road.

This section of the Bruce Highway closes due to flooding, on average, every one to two years. These closures significantly affect locals, tourists, transport operators and other motorists, preventing goods from reaching market and sometimes the community from accessing essential services such as health. The project aims to improve safety and efficiency for road users, while significantly improving the capacity of this section of the Bruce Highway to withstand major flooding events. Further, the project will address community concerns regarding the condition of bridges within the project area and the width of the existing Haughton River Bridge.

Once the Haughton River Floodplain Upgrade Project (Bruce Highway Horseshoe Lagoon – Palm Creek) is complete, the duration of inundation will be greatly reduced from an average of 85 hours per year to one hour per year, and from 39 hours to 17 hours in a 2 per cent AEP (an approximate 1 in 50 year ARI) weather event.

The floodplain is impacted by a variety of factors and is considered among the most complex in Queensland.

Case Study: Dotswood Road Fanning River Realignment betterment project

Following the 2019 Monsoon Trough event, the Dotswood Road Fanning River Realignment project received Betterment Funding pursuant to Category D under the DRFA. As a result of the 2019 Monsoon Trough event, approximately one kilometre of the road's surface was washed away when the Fanning River broke its banks.

This event follows a series of occasions that saw the same stretch of road inundated and closed for lengthy periods to enable repairs to occur – at least six occasions over a 10-year period. This included one period where the road was closed for more than two weeks.

The realignment project involved the relocation of a section of Dotswood Road that formerly ran in the middle of the riverbed between two channels. The realignment works crossed the higher flow channel of the Fanning River to the middle height bank, which is only inundated in extreme events. The improved crossing includes a concrete causeway with a concrete entry and exit to the river, along with 1.5 kilometres of new road construction to reconnect the new section with that of the existing road.

This $1.67 million project now avoids reconstruction after each flood event on the Fanning River, which occurs relatively frequently, and allows better access for property owners, pastoral, agricultural and mining business, as well as the Australian Defence Force, which accesses this area. The road services a number of properties, businesses and employees, and now has increased levels of access and safety during the wet season, with reduced repair costs to government associated with frequent flood events.

Image: Dotswood Road project.

Resilient economy

Economic resilience is a critical aspect of overall community resilience, ensuring employment is disrupted as little as possible. Economic inputs and outputs that continue to flow through the region are important to keep local business open, maintain local employment, and continue the delivery of goods and services to support the local population.

Maintaining gainful employment after an event is essential for a variety of reasons. The economic impact of severe weather and disaster events can be felt by individuals and households, thus it remains important to ensure cash flow and income certainty. Employment also satisfies a sense of purpose. Having something to do or apply oneself to each day can be a necessary and welcome mechanism in some cases, where the psychological toll of personal experiences has been significant.

Among the strengths of the regional economy that benefit economic resilience are high levels of industry diversity, strong transport networks, access to manufacturing facilities, the climate of the region, the cost of living and land availability.

Economic drivers and activity

There are multiple economic activities and drivers that underpin the regional economy within the Burdekin and Haughton catchments.

Primary production industries account for a large percentage of employment and businesses within the Burdekin and Haughton catchment economy. Agriculture, forestry and fishing comprise 19.6 per cent of employment within the catchments compared to a 2.8 per cent average across Queensland. Mining comprises 8.7 per cent of employment within the catchments compared to a 2.3 per cent average across Queensland.

Business registration reinforces the very strong agriculture sector within the catchments, indicating agriculture is strongly supported by a large number of smaller businesses. Conversely, mining is less well represented in business registrations, showing that mining employment is overwhelmingly supported by larger organisations.

Key exports from the Burdekin and Haughton region include sugar, beef, fertiliser, molasses, minerals and coal, mostly through sea ports that are located just outside the Burdekin and Haughton catchment area. The strong grazing industry throughout the region accounts for the majority of land use by area.

Image: Cane fire in the Barratta Creek sub-catchment.

The majority of the metalliferous mining activity in the catchments occurs in the Northern Goldfields, centred around Charters Towers and Ravenswood, and almost wholly located within the Charters Towers local government area. The mines in this area play a significant part in the Charters Towers economy, and the wider catchment and North Queensland economy as well.

Other mining and quarrying activities occur across the catchment. Diatomaceous earths from Greenvale are processed near Charters Towers, with Greenvale also home to a marble mine which exports to overseas markets. Lime and limestone around Charters Towers are quarried and sold throughout Queensland. There is a small sapphire mine in the Upper Burdekin catchment, and oil shale deposits exist near Alpha in the southern end of the catchment.

Both types of coal, metallurgical and thermal, are mined within the Burdekin and Haughton region. Metallurgical coal is primarily used for making steel, and thermal coal is primarily used for producing electricity. Significant coal deposits exist in the catchment area, located at the northern end of the Bowen Basin, as well as in the Galilee Basin.

There are extensive areas of dryland cropping between Alpha and Kilcummin, in the Belyando and Suttor sub-catchment areas. Sorghum, wheat, chickpea and mung beans are grown, as well as cotton, sunflower, safflower and forage crops. Many of these crops, especially wheat and pulses, are grown for export, and some are grown for fodder to service the many cattle farms in the area. Mixed enterprise farms including both beef grazing and cropping are common.

A particular feature of both the Burdekin and Haughton catchments is the rich water resources available along the river systems and on the coastal delta. The Burdekin Haughton Water Supply Scheme provides water to the Lower Burdekin and Haughton catchments and is administered by Sunwater.

Access to water provides these areas with a strong irrigated cropping industry, primarily via sugarcane, but also through capsicums, eggplant, rockmelons, squash, pumpkins, watermelons and sweet corn, as well as rice. Fruit trees, including mangoes, are also irrigated from the scheme. Aquaculture is also a key industry on the Lower Burdekin. Access to water as an economic enabler is a significant element of economic and social prosperity across the entire region.

Within the Burdekin and Haughton catchments, especially in the areas around the townships of Ayr, Home Hill, Brandon and Giru in the Lower Burdekin, the economic impact of the sugarcane industry is significant, with estimates that every dollar of sugarcane production supports an additional $6.40 elsewhere in the related economy (Canegrowers, 2019). Sugarcane production in the Lower Burdekin and Haughton catchments accounts for close to 30 per cent of all jobs.

Small business

Many of the risks facing the Burdekin and Haughton economy are not unique, but the likelihood and consequence of the risks can be amplified by reliance on commodities. Other risks can include rainfall variability, drought, remoteness and access to services, commodity prices, biosecurity, decline in soil health and environmental conditions, disrupted supply chains and access to workforces.

Flood hazard is also a significant risk to the region's economy and can be more acutely felt in some locations of the region than others.

Township economies within the Burdekin and Haughton catchments exist to support primary industries such as agriculture and mining. As with many town-based economies, the needs revolve around human and social services, and support to other key parts of the economy. Higher levels of employment are generally in the areas of health and social assistance, retail, accommodation, food service, education, rental hire and real estate services, construction and defence.

Town-based businesses are an important component of regional economies, and provide vitally important social capital. Some town-based and small businesses have developed innovative strategies to enable them to survive. Many small businesses have significant experience recovering from disruptions of all kinds, including flood, and many of them have significant experience in withstanding other natural hazards such as drought.

Notwithstanding this, based on research, an estimated 25 per cent of impacted businesses do not reopen following a major disaster. Depending on location, approximately 66 per cent of affected businesses suffer significant damage to buildings or equipment, and over 90 per cent of business in flood-affected regions forego revenue due to disasters.

There were more than 17,000 small businesses situated in the impact zone of the 2019 Monsoon Trough event, and 97 per cent of businesses surveyed in the most heavily flooded areas reported financial impacts. Reported financial impacts mainly included closures, trade interruptions, forward booking cancellations and damage to premises and equipment. These disruptions and damages are estimated to have cost small businesses at least $116 million (Deloitte Access Economics, 2019).

Employment and business registration statistics indicate that an effective target for building economic and social resilience within the region includes a strong focus on small business, particularly businesses in agriculture with under 20 staff or turnover under $2 million.

Business continuity supporting community continuity

Community continuity is largely dependent upon business continuity and continued access to goods and services, retention of employment and continued economic activity. Research has shown that social capital has an impact on the speed and efficacy of disaster recovery. Higher levels of social capital also indicate that a community is more likely to support each other during disaster recovery, for example, by supporting local businesses during recovery.

Small businesses are the engine room of the Queensland economy, working across every industry sector. They make up 97 per cent of all businesses in Queensland and employ more than 914,000 people. Small businesses are both economically and socially vital to our regions, providing local jobs and reinvestment back into local communities.

Small businesses are important to good economic outcomes during normal operations, but even more so during and after disruption. Analysis of the 2008 global financial crisis has shown that regions that have more experienced workers and higher levels of self-employment are more economically resilient.

Small businesses with existing relationships, cultivated through chambers of commerce and other platforms, are more likely to help each other before and after flood events. These networks are pivotal for maintaining supply chains and ensuring business operations that support essential services continue to operate to support community wellbeing before, during and after an event.

Business continuity planning can greatly assist a business to identify pathways when disruption occurs. Small businesses in town that collectively plan for continuity by identifying where they can help each other can offer significant resilience benefits for the entire community.

Image (left): Main street activity in the township of Alpha.(Right): Historic flooding in the township of Alpha, including the main street.

Case study: Buy in the Burdekin

Stemming from the economic impact of the COVID-19 global pandemic in 2020, the Ayr and Home Hill Chambers of Commerce implemented a Burdekin rewards loyalty program, with the support of Burdekin Shire Council. In an effort to reduce the impact of COVID-19 on the local business community, the 'Buy in the Burdekin' campaign was established, with the mission to encourage all residents to support local businesses, boost local jobs and foster awareness of the benefits of supporting local small business.

Together, the chambers of commerce have over 140 members, which has grown in response to this campaign as more businesses seek to participate. The program rewards customers for shopping locally, using loyalty cards. The cards are then entered into a draw each month where winners receive 'Burdekin Gift Cards'. This culminates in a mega draw, where four large prizes are given away to loyal 'Buy in the Burdekin' shoppers.

This program has not only seen a direct increase in local spending with Burdekin Shire local and small businesses, but has also seen a strengthened network of businesses operating collectively toward a common goal, focused on business and community continuity following a period of significant economic and social disruption.

Case study: Disaster Resilience Planning for Agriculture Project

The Queensland Farmers' Federation (QFF) acknowledges the importance of disaster resilience planning for agriculture in Queensland, noting it is essential to have the mechanisms in place to support and prepare farmers and primary industries for flood inundation, tropical cyclones or drought. In 2015, the QFF completed a project looking into disaster resilience planning in Queensland agriculture, supported by the Queensland Department of Agriculture and Fisheries.

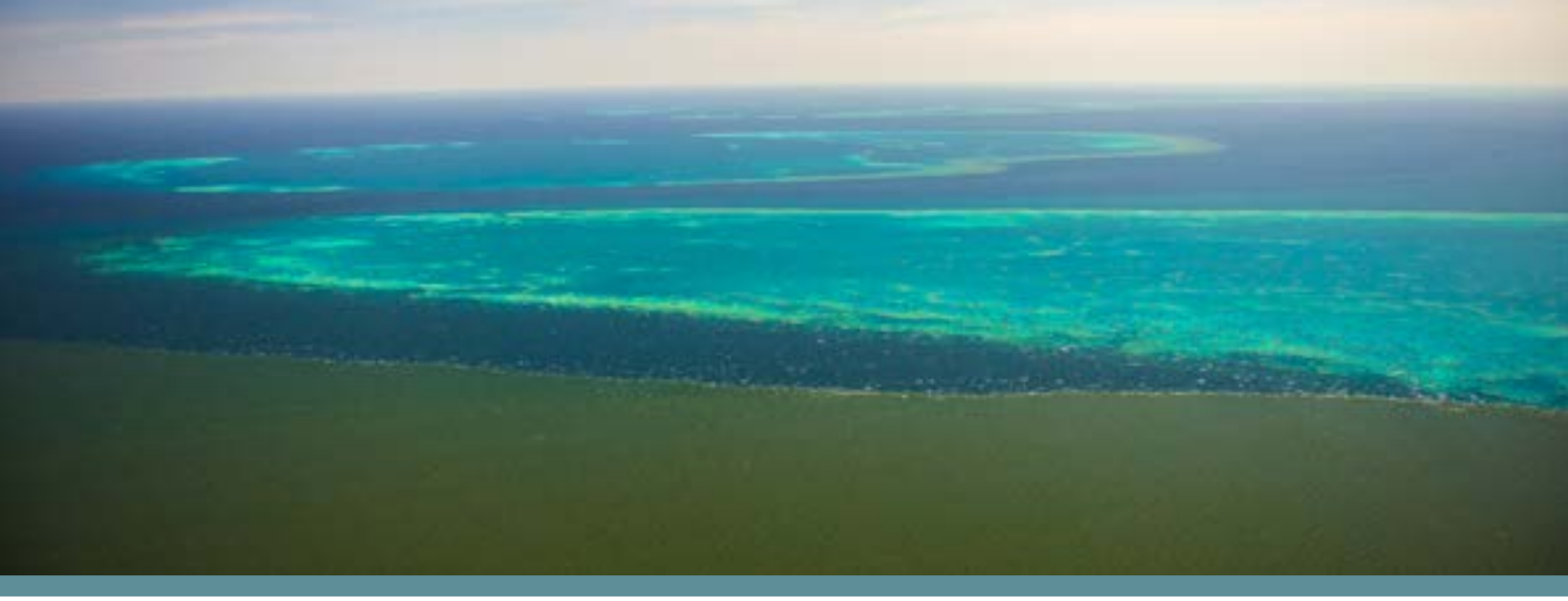
The QFF highlights that resilience in agriculture centres upon the ability to recover and attain full business functionality after a serious weather event. The Disaster Resilience Planning for Agriculture Project looked at the dairy and mango industries as part of the pilot studies to measure both industries' understanding and comprehension of the impacts of disaster events, and to assess the industries' preparedness and resilience planning for future events. Both industries showed strong governance around disasters, with appropriate communication in place. Both, however, demonstrated limited financial capacity to implement the work that needed to be done. Lack of financial backing to fully explore these resilience operations have been the main inhibitors to both the dairy and the mango industry, particularly at an individual business level.

QFF's findings from the Disaster Resilience Planning for Agriculture Project have informed the National Emergency Management Projects – Disaster Resilience Planning for Australian Agriculture project.

QFF has also designed a website with a one-stop shop search tool for farmers from all industries, to be able to enter their postcode and search for all industry specific, local, state, federal and not-for-profit assistance that is available in their local area.

QFF has delivered relief and recovery projects for severe natural disasters including Cyclones Larry (2006) and Yasi (2011), the 2011 Queensland floods, and flooding associated with Cyclones Oswald (2013), Marcia (2015) and Debbie (2017).

Image: Buy in the Burdekin program (courtesy Burdekin Shire Council).



Environmental resilience

The Burdekin and Haughton catchments comprise a complex system of freshwater rivers and streams that drain a diverse array of landscapes, from semi-arid drylands, wooded grasslands, tropical rainforests, coastal swamps to wetlands.

The region features an abundance of natural environmental beauty, from the series of low mountain ranges that make up the Great Dividing Range, to the numerous national parks dotted across the region, and the internationally important Ramsar wetlands of Bowling Green Bay, which are inherently connected to the Great Barrier Reef World Heritage Area.

A number of key environmental considerations underpin the resilience of the catchment's landscapes,and the impact they have on receiving environments, including Ramsar wetlands and the Great Barrier Reef. Certain environmental issues are amplified during the wet season when catchments experience flooding. The following sections outline some of the key environmental considerations relating to the catchments.

Great Barrier Reef

The Bowling Green Bay Ramsar site covers approximately 36,000 hectares and is one of two Ramsar-listed sites within the Great Barrier Reef coastal zone. It provides a diversity of wetland habitat types comprising palustrine, riverine, estuarine and marine wetlands. Complex patterns of saltmarsh and saltwater couch grasslands back onto thin fringes of low mangrove communities in the intertidal zone. The site contains one of the largest mangrove and saltmarsh habitats along the Great Barrier Reef Coast. The wetlands support a significant diversity and abundance of species including turtles, dugong, shorebirds and other waterbirds. Several of these species are listed as threatened at international, national and/or state levels. The site is recognised as a network site under the East Asian-Australasian Flyway Partnership and supports at least 3 migratory shorebirds at >1% of the flyway population. The site is high value for fisheries with important fish and crustacean nurseries. Some species depend on the site for certain stages of their life-cycle.

Adjoining Bowling Green Bay, the Great Barrier Reef is an Australian icon, and one of the most precious ecosystems in the world. It stretches more than 2300 kilometres along the Queensland coast and covers an area of 348,000 square kilometres. The Great Barrier Reef contains some 3000 reefs, 1050 islands, and other habitats that support a unique and diverse array of species (Australian Department of the Environment and Energy, 2018). The Queensland and Commonwealth governments are committed to ensuring the Great Barrier Reef retains the values for which it was declared a World Heritage Area, and that it continues to be one of the best managed protected marine areas in the world.

The ongoing health and environmental resilience of the Great Barrier Reef is dependent upon the ecological integrity of the adjacent catchments, including the Burdekin and Haughton catchments, which are intrinsically connected through coastal ecosystems.

Weed transfer

Over the years, the construction of levees and other infrastructure along parts of the river system, and the removal of vegetation and soil in some locations, has altered the flow regime across the catchments, which can lead to water quality impacts, weed infestations and reduced fish productivity as a result of changes to the volume and speed of freshwater flows through the catchment.

The spread of invasive weed species throughout the catchments can have devastating impacts on the natural environment, can reduce agricultural productivity, and is of concern to the community. During the dry season, altered flow regimes and reduced water quality can create ideal conditions for weeds to proliferate.

In times of flood, weeds are transferred to downstream areas, allowing further infestation of previously clean areas. Weeds can also be transferred throughout the catchment through land management practices. Improving land management practices along watercourses provides a key opportunity for resilience enhancement. QFF is currently managing the North & Far North Queensland Monsoon Trough Agricultural Recovery and Resilience Project and the Flood Mapping, Mitigation and Management Plans for Primary Producers Project.

For further information visit www.qff.org.au/projects/natural-disasters/.

Image: Flood plume discharge to the Great Barrier Reef coastal zone from the Burdekin River (courtesy Matt Curnock).

Sediment deposition, erosion and water quality

Land uses in the catchment have a significant impact on water quality, as run-off from the land enters the river system during the wet season.

Over the past 150 years, land uses in the catchment have changed, with the primary land use now consisting of grazing and intensive agricultural development, including sugarcane, dryland cropping and horticulture. Mining activities are also well established across the region, producing coal, gold, silver and zinc. Changes to land use across the catchments can amplify issues of erosion, resulting in extensive sediment transfer in the wet season. Sedimentation in the Burdekin catchment is also influenced by landscape geology, where high-velocity flows off granite country generate erosion, and sediment transfer when fast-flowing floodwaters reach erodible soils in downstream locations.

The Burdekin catchment is known to generate significant loads of sediment. Sediment transfer from the upper sub-catchments is mitigated to some degree, by the Burdekin Falls Dam, but fine sediments can continue to flow through to the Lower Burdekin. This includes transfer of sediment from the Bowen and Bogie systems. This sediment can create risks and impacts on marine life and vegetation, irrigation channels and pumps on the coastal delta of the Burdekin and Haughton, as well as water quality issues that cascade into broader risks upon discharge to the Great Barrier Reef coastal zone.

Sediment deposition can also alter the depth, size and shape of rivers. This may have implications for overbank flooding and may result in increased flooding across the broader floodplain, as well as changes in flood velocity in specific locations.

Additionally, water quality issues are known in some catchments as a result of pesticide use from some agricultural activities, as well as chemical leachate associated with former heavy metal extraction and processing activities, including the use of arsenic.

The changes in the way we use land in the catchment has led to significant increases in sediment, nutrient and chemical loads running off the land into the rivers and waters entering the Great Barrier Reef (Burdekin Dry Tropics WQIP, 2017). These impacts are often exacerbated during floods by the conveyance of floodwaters. Monitoring sediment movement through the catchment over time can underpin effective decision-making to support environmental resilience.

Hydrology and groundwater

Following rainfall, water flows across the landscape and into waterways and channels, with some of this water eventually reaching the Great Barrier Reef lagoon. Water that does not flow to the lagoon either:

- sinks into the ground, where it supports a variety of terrestrial and groundwater dependent ecosystems
- contributes to overland flow
- is used for other purposes such as agricultural production (WetlandInfo, 2018).

Extensive irrigation practices have evolved throughout parts of the Burdekin and Haughton catchments, largely associated with sugarcane production. The Lower Burdekin contains the largest irrigation area on the east coast of Australia. The area is famous for its year-round water supply, made possible by the construction of the Burdekin Falls Dam, as well as extensive natural and artificial drainage channels (NQ Dry Tropics, 2016).

The irrigation systems established to support sugarcane production have substantially modified surface water and groundwater systems in the Lower Burdekin area.

The Lower Burdekin groundwater systems that underlay the coastal delta are complex. The delta is the largest unconfined groundwater system of its type in Australia, and there is also a deeper aquifer beneath. Surface and groundwater systems are connected across the floodplain, with contaminants in surface water entering groundwater and vice versa (WetlandInfo, 2018).

Floodplain soils vary in terms of water infiltration, from the very porous soils, mainly sand, of the coastal delta to low transmissive soils such as clay. The more porous soils enable high amounts of water infiltration and recharge of groundwater.

Surface furrow irrigation, also referred to as flood irrigation, is the most common system used in the Lower Burdekin area, and across many parts of the world. Surface furrow irrigation can result in the loss of large volumes of tail water to waterways and wetlands if not appropriately managed on farm (WetlandInfo, 2018).

The Barratta Creek estuary is also 'freshening', which is shifting community composition and stressing estuarine vegetation including mangroves and saltmarsh. Some of the once seasonally dry wetlands areas are now subject to elevated and perennial freshwater inflows arising from upstream-irrigated agriculture (GBRMPA 2013, NQ Dry Tropics 2016).

Image: Breakneck Gully in the Upper Burdekin sub-catchment.

Conversely, the coastal floodplain groundwater system has exhibited increased salinity (NQ Dry Tropics 2016) since regular monitoring began in the 1960s (Lenahan and Bristow 2010). According to Bristow and Lenahan (2010) the increased groundwater salinity of the Burdekin coastal floodplain aquifer results from of a combination of evapotranspiration of irrigation water, displacement of unsaturated zone solutes, enhanced mixing with relict seawater and seawater intrusion.

The highly modified system has impacted the natural ecological processes, such as natural wetting and drying cycles. Other considerations include potential seawater intrusion, a rising groundwater table and increasing concentrations of salts, aquatic weed infestations and the impact of these on natural ecosystems (NQ Dry Tropics, 2016).

For further information in relation to the hydrology and groundwater considerations of the Lower Burdekin in particular, visit www.wetlandinfo.des.qld.gov.au.

Image: Sugar cane irrigation in the Burdekin Shire.

Case study: Arming the community with knowledge to tackle woody weeds

Weeds reduce the quantity and quality of Australia's agricultural, horticultural and forestry products, with NQ Dry Tropics identifying that Australian farmers spend an estimated $1.5 billion a year on weed control, and miss out on approximately $2.5 billion a year in lost agricultural production caused by weed infestations (NQ Dry Tropics, 2016).

NQ Dry Tropics notes that woody weeds such as parkinsonia (***Parkinsonia aculeate)***, prickly acacia (Acacia nilotica) and chinee apple (Ziziphus mauritiana) are a particular problem in Queensland's agricultural areas, and in recent years, they have been spreading on the Burdekin coast. They cause major issues for grazing and farming enterprises in the Burdekin region, and reduce habitat for native plants and animals. They are difficult to control, reduce the amount of land that can carry pasture and crops, and make it hard for graziers to efficiently muster cattle (NQ Dry Tropics, 2016).

NQ Dry Tropics acknowledges that landholders and environmental managers are becoming increasingly concerned about this spread of weeds. As a result, NQ Dry Tropics facilitated a field day in Bowen called 'The War on Western Weeds visits the coast'. This event was held in October 2015 and supported local farmers, giving them the skills and knowledge to control pest plants sustainably (NQ Dry Tropics, 2016).

NQ Dry Tropics invited Dr Vic Galea from The University of Queensland to speak about an innovative biological herbicide (bioherbicide) method he has developed to control woody weed infestations without using chemicals. The bioherbicide uses naturally occurring native fungi to give target trees a super-dose that eventually kills them. This biological control is administered by drilling a hole into the trunk of the woody weed and sealing a dissolvable capsule of the bioherbicide inside (NQ Dry Tropics, 2016).

As a result of this work, NQ Dry Tropics has continued to receive enquiries from land managers seeking information. This project uses an innovative, cost-effective approach to deal with a major environmental and economic issue (NQ Dry Tropics, 2016).

Case study: Reef Guardian Councils

The Great Barrier Reef Marine Park Authority's Reef Guardian Council program showcases environmentally sustainable practices undertaken by councils in the Great Barrier Reef catchment. The program recognises that effective management and protection of the Great Barrier Reef requires a coordinated effort from industries, communities and all levels of government (Australian Government Great Barrier Reef Marine Park Authority, 2018).

There are 18 councils in the Reef Guardian Councils program undertaking a range of projects, including six councils from the Burdekin and Haughton catchments (Australian Government Great Barrier Reef Marine Park Authority, 2018):

Notable projects showcased in the Reef Guardian Councils Highlights Report 2017–2018 for the Burdekin catchment region include:

- The Burdekin Shire Council's celebration of the International Year of the Reef with the It's Your Reef Festival at Alva Beach in June 2018. Hundreds of residents attended to learn about the values of the reef and what they can do to help its resilience and protection.
- The construction of a model of the Burdekin Shire region by Burdekin Shire Council's environmental health officers, which is used during educational talks with school students. The model was developed with the aim of educating youth on how land practices and poor waste management can affect Burdekin River and consequently the reef.
- Burdekin Shire Council partnering with James Cook University and Pacific Bio to seek funding for the first full-scale trials of a macro-algal treatment process in municipal wastewater in Ayr. The project aims to aid the removal of nitrogen and phosphate from wastewater before it is released to the Great Barrier Reef.
- Isaac Regional Council's St Lawrence Wetlands Weekend, held in June each year, which promotes local food producers and celebrates the nationally significant wetlands and their importance to the ecology of the region, adjacent inshore environment and reefs.
- Mackay Regional Council's trial of a steam weeding unit to reduce herbicide use. Steam weeding is the latest in safe, chemical free weed control and is ideal for urban areas, parks, playgrounds, schools and natural areas. There are many benefits of using steam to control weeds, including instant results, reduced chemical use and no run-off or pollution into waterways.
- Townsville City Council's installation of an innovative floating wetland trial in Fairfield Waters to counteract the effect of algal blooms and reduce nutrient input into the reef lagoons. It is a sustainable, cost-effective way to treat stormwater run-off flowing to waterways and the Great Barrier Reef. It biologically filters the water, reduces evaporation and improves aeration of the water.
- Townsville City Council's leadership in participating in a national Cooperative Research Centre for Water Sensitive Cities research project to develop a vision and strategic framework to accelerate Townsville's transition towards a water sensitive city.
- Whitsunday Regional Council's commitment to continuing the implementation of its Climate Change Adaptation Strategy and Policy.
- Whitsunday Regional Council's review of its erosion and sediment control policies and procedures relating to public and private development, resulting in a new Erosion and Sediment Control Policy and Program, with its intention to reduce sediment loss from private building sites and council construction projects and avoid it potentially entering the Great Barrier Reef lagoon (Australian Government Great Barrier Reef Marine Park Authority and Reef Guardians, 2019).

Image: Bowling Green Bay Ramsar wetlands, near Giru (courtesy F. Ramsay).

How we prepare

Having regard to the multiple elements of resilience, we can put these to good use around our home and property, and for preparing our business premises and operations for major flood events. The following tips provide a checklist of things to consider to be flood-ready.

Preparing your home

The following points provide a practical list of considerations to ensure your home is flood-ready.

- ☐ Check your insurance policy to make sure it is current, the types of weather events you are covered for, and additional inclusions such as debris/asbestos clean up and removal. This includes all types of insurance such as car, and home and contents insurance.
- ☐ Be prepared emotionally and mentally to deal with insurance issues, as these can sometimes take long periods to resolve.
- ☐ Have an evacuation kit ready, and supplies to last a minimum of three days without electricity, and up to three weeks.
- ☐ Identify how and where to turn off the mains supply for water, power and gas.
- ☐ Be prepared for power and telecommunications outages, even if your home is not directly impacted. Infrastructure networks may experience outages, or be de-energised to protect assets from damage. This helps to expedite reconnection as quickly as possible.
- ☐ Disconnect electrical items, appliances and external television/radio aerials.
- ☐ Repair rotten, corroded and termite-infested timber, particularly inside the roof. Check condition of the roof and repair loose tiles, eaves and screws.
- ☐ Clear gutters and downpipes.
- ☐ Purchase supplies such as masking tape, tarps, sandbags and water containers.
- ☐ Take photos of home and business contents and belongings for evidence in case of damage during the event.
- ☐ Plan in advance which indoor items of furniture and appliances you will raise off the flood or empty (such as fridges and freezers) if water threatens your home.
- ☐ Store all poisons and garden chemicals above ground level and out of reach of children.
- ☐ Consider alternatives to carpet and relocate switchboards and power points to well above previous flood levels (using a licensed contractor), if you live in a cyclone/severe storm-prone area.
- ☐ If your property is in a low-lying area, prepare sandbags. Sandbag internal drains and toilets to prevent sewage backflow. Sandbag areas at risk from flooding, such as doors and windows, where possible.
- ☐ Consider opportunities to dry-proof the external spaces of an existing house to prevent floodwaters from entering a building by using either permanent or temporary flood barriers.
- ☐ Wet-proof internal and external spaces of an existing house to enable floodwaters to enter and leave quickly without causing significant damage.
- ☐ Raise your house above the defined flood event level.
- ☐ Check and fix loose fittings, such as railings. Check windows and install shutters if possible.
- ☐ Monitor your physical and mental health, and those of your family, neighbours and colleagues.
- ☐ Be prepared for it to take some time before you can return to your home after floodwater has receded, for safety purposes.

The above is not an exhaustive list. Additional resources to help you prepare for each wet season can be obtained from your council, or accessed via www.getready.qld.gov.au.

If you are considering renovations or a new house build, the Flood Resilient Building Guidance for Queensland Homes provides detailed design and construction approaches to enhance flood resilience for new and existing homes. This guide can be accessed at www.qra.qld.gov.au/resilient-homes/flood-resilient-building-guidance-queensland-homes.

After an event, guidance on how you can clean your home is available at www.qld.gov.au/community/disasters-emergencies/recovery-after-disaster/cleaning-up/after-a-storm,-flood-or-cyclone/returning-to-buildings.

If you need to repair or rebuild your home following an event, information to assist you is available at www.qbcc.qld.gov.au/home-maintenance/rebuilding-after-natural-disaster.

Image: Get Ready Queensland.

Preparing your property

The following points provide a practical list of considerations to ensure your property is flood-ready.

- ☐ Clean up the yard. This includes moving outdoor equipment, rubbish, chemicals and poisons to a safe location, and disconnecting electrical items.
- ☐ Move livestock, pets, machinery and animal feed to higher ground.
- ☐ Remove water pumps from watercourses.
- ☐ Clear away all loose material. Tie down sheds or other small structures not permanently fixed.
- ☐ Secure caravans, boats and vehicles and locate them such that they are at reduced risk.
- ☐ Remove and store loose furniture or items that could become airborne in strong winds.
- ☐ Trim trees and overhanging branches close to the house (be aware of any overhead powerlines).
- ☐ Check and fix any corrosion, rotten timber, termite infestations and loose fittings around the property.
- ☐ Empty standing water from any containers and paddling pools in the yard that are not frequently emptied to prevent mosquito growth, which can lead to disease.

Preparing your business

The following points provide a practical list of considerations to ensure your business is flood-ready.

- ☐ Anticipate flood events and have a plan ready for before, during and after.
- ☐ Ensure insurance policies cover flood damage.
- ☐ Develop a fit-for-purpose business continuity plan to avoid disruption, not just from flood. By understanding the critical functions of the business, mitigation steps can be taken before and during a disruption event, including contingencies, to reduce the level or duration of any disruption to the critical functions of the business.
- ☐ Prepare your place of business for flood events ahead of each wet season. This may include making stock and appliances easy to raise off the ground, preparation of sandbags, or relocating equipment to higher ground for the season.
- ☐ Consider supporting business infrastructure such as maintaining electronic records and servers off-premises or in a flood-resilient location, or use cloud-based services.
- ☐ Be familiar with where to obtain important and reliable flood emergency information to support decision-making, and how to get assistance if needed.
- ☐ Develop and maintain an emergency response plan for the business and for employees. This will help guide preparations for impending events, and ensure staff are managed in a safe manner. This may include arrangements to evacuate the premises, and instructions on turning off appliances, equipment and potentially hazardous services such as gas and electricity.
- ☐ Identify supply chain risks and work with suppliers and partners to identify mitigation measures and contingencies.
- ☐ Prepare for recovery by recording any damage and loss, including video and photo records to support insurance claims, and ensure claims are lodged as early as possible.

Support for business risk management is available at www.business.qld.gov.au/running-business/protecting-business/risk-management.

Get Ready Queensland

When it comes to extreme weather events in Queensland, including the Burdekin and Haughton region, it is not a matter of 'if' but 'when'.

Get Ready Queensland is a year-round program helping all Queenslanders to prepare for disaster events. Being prepared before a disaster occurs could be the difference between staying safe and putting yourself and those you love in danger.

A significant range of information to assist with preparation, response and recovery from natural hazard events is available via www.getready.qld.gov.au/.

Image: Get Ready Queensland.

Enhancing our community-led resilience

Resilience is a mindset and process that is about encouraging sustainability and adaptability of people and the places they live, work and play. The ability for self-sufficiency and resilience starts with communities. Likewise, it is important to recognise the vast differences in communities across the catchments, including their identities, challenges and opportunities. No two places are the same. As such, what it means to be resilient for each may not be the same.

The focus on self-sufficiency across Queensland is necessary due to the size of the state, with disparate communities and a high frequency of serious weather events. We must accept these events will continue and likely increase in intensity into the future, and take steps to prepare, and avoid, significant impacts from occurring by being ready.

This strategy and its focus on grassroots, community-led approaches to maintaining and enhancing resilience provides a framework for local actions and areas of focus that contribute toward broader regional resilience goals and aspirations. This approach recognises that resilience is not a commodity and cannot be manufactured.

The Queensland Strategy for Disaster Resilience (QSDR) provides an overarching framework to empower Queenslanders to factor in resilience measures and activities as they anticipate, respond and adapt. As Queenslanders, we are not strangers to serious weather, and in North Queensland in particular, we are robust in our experiences with flood events.

The pathways and directions of this strategy each map back to the four objectives of the QSDR, articulating our local and regional approach to how we will continue our resilience journey in the face of increasing climate-related risks.

Image: Echo Hole on the Upper Burdekin (courtesy of F.Ramsay).

A shared strategy

The strategy draws upon the spectrum of existing resilience efforts both undertaken and underway across the region, acknowledging the integrated, complex and far-reaching concepts of resilience.

The framework of this strategy, and its implementation, is underpinned by three components, as outlined below.

The elements are formulated through extensive regional engagement and collaboration with each local government within the catchment areas, and calibrated against the wealth of existing studies, reports, plans and strategies in place, and strategic observations drawn from the QERMF assessment across the region. This enables the consideration of relevant strategic vulnerabilities and locally identified community needs, which contributes to bolstering community-led resilience initiatives across the region.

Strategic pathways

A range of strategies to inform collaborative approaches to the diversity of resilience goals and aspirations across the region are identified and aligned to our vision of resilience for the region. These strategic pathways form a regional 'blueprint' for coordinated resilience action across the Burdekin and Haughton catchments.

These strategic themes represent potential pathways to meet the aspirations of the region from social, township and infrastructure, transport, economic and environmental perspectives.

The strategic pathways each align with the various objectives of the Queensland Strategy for Disaster Resilience. This establishes a direct 'line of sight' from local, on-the-ground actions, which contribute toward supporting community-led resilience, through state-level strategy and policy, and ultimately to the achievement of national and international resilience objectives. This contributes towards ensuring the communities within the Burdekin and Haughton region remain among Australia's most resilient, with the ability to face future challenges with the least level of disruption or loss.

Action plan

An action plan has been developed to steward the implementation of local directions and regional actions, which links directly to the Queensland Strategy for Disaster Resilience, aligning with the Queensland Government's statewide priorities and commitments for disaster resilience.

These strategic pathways and actions will be moved forward under the direction of each of the local governments within the Burdekin and Haughton catchments, as well as individual stakeholder groups. The action plan includes activities relating to, but not limited to:

- additional flood modelling data
- critical infrastructure resilience
- community education, information and media
- environmental programs to enhance resilience and reduce impact on the Great Barrier Reef
- township-scale business and economic continuity planning
- governance arrangements
- psychological and mental health
- data and evidence collation to support informed decision-making
- drainage activities
- flood gauge assets and governance.

Diagram: The four objectives of the QSDR.

Queenslanders are disaster resilient when...

Image: Belyando Floodplain in the Barcaldine Region

Regional strategic pathways

These strategic pathways form a regional 'blueprint' for coordinated resilience action across the Burdekin and Haughton catchments. Action and efforts at the local level are calibrated to work toward the achievement of these regional goals. Each strategic pathway is mapped to a corresponding QSDR objective, referenced by the colour at the top right of each strategic pathway.

	STRATEGIC PATHWAYS		
Resilient society	**Every flood is different** 2 We know each flood is different, and are not complacent. Flooding comes naturally to the Burdekin and Haughton, we are robust and take it in our stride. We take action to anticipate and prepare for flooding. We prepare our households, and ensure we pass our local knowledge on to others.	**Embracing technologies** 3 We invest in new technologies and skills development to sustainably steward the landscape and anticipate serious weather, including monitoring, Internet of Things (IoT) and drone capabilities which can be leveraged to support situational awareness in addition to business automation.	**Understanding and avoiding cascading risk** 1 We identify and communicate the flow on and cascading risks associated with flooding, with a focus on potential impacts. We coordinate messaging and seek to deliver continuously maturing disaster preparedness messaging over time.
Resilient towns & infrastructure	**Harnessing the strength of infrastructure networks** 3 Opportunities to partner across providers and share assets, access and information can offer enhanced interconnectedness and potential cost savings. We leverage efficient and effective systems opportunities and understand asset and network limitations.	**Recovering for resilience** 4 Our depth of experience in dealing with post-disaster recovery enables us to identify vulnerabilities and opportunities for improved resilience. We strive not only to build back better, but to build to last through recovery and design opportunities.	**Adapting to live with hazard** 4 Adapting our built environment to accommodate flood resilience is key. This includes the allocation of land uses that are appropriate to the risk context, an adaptive built form and engineering opportunities to support resilient outcomes.
Resilient transport	**Mitigating repeated impact hotspots** 4 We collaborate to investigate new options for improved network resilience, having regard to known locations where repeat event impacts highlight potential transport network vulnerability.	**Strengthening supply chain and resupply networks** 4 The nature of industry across the region involves both micro and macro supply chain networks. We work to bolster local supply chains to support communities and strengthen regional networks that support employment and the economy.	**Working together towards network resilience** 2 We collaborate and coordinate to prepare for and respond to natural hazard events to safely manage transportation networks. We take action to implement the resilience objectives of the Regional Transport Plans across the catchment.
Resilient economy	**A culture of continuity** 3 We embrace continuity processes within corporate cultures, from small businesses to large industries across the region. Embedding continuity in daily business operations helps our communities to maintain and support one another when we need it most.	**Pre-planning for post-disaster recovery** 4 We consider our risk in advance of each annual disaster season and explore opportunities to pre-plan should loss or damage occur. We consider the vulnerabilities, and identify opportunities to accelerate recovery or betterment.	**Resilience as part of the greater good** 2 We acknowledge and understand the relationships and interdependencies between economic activities and businesses that support community continuity. We work together to identify, prepare for and respond to hazard events.
Resilient environment	**Supporting evidence-based decision-making** 3 Data collation and monitoring will help us to build a strong evidence base to make informed and sustainable decisions. This has flow on benefits to support economic, transport, built environment and social resilience.	**Harnessing natural functions** 4 Enhancing and reintroducing natural processes as part of broader environmental systems supports environmental resilience. We recognise the dynamic history of the catchments and their flows, and use this knowledge to strengthen the linkages between environmental, economic and infrastructure resilience.	**Contributing to reef protection** 2 We appreciate the relationship between the catchments and the Great Barrier Reef, and coastal processes more broadly. We take action to implement sustainable practices and manage water quality and discharge to highly sensitive receiving waters.
	Local resilience actions (refer to community snapshots)		

Climate adapted flood resilience

Image: A swollen Belyando River on the Capricorn Highway, 2020.

Place-based community snapshots

A shared responsibility model

Local resilience actions require a multidisciplinary and shared responsibility approach that includes state agencies, non-government organisations and not-for-profits, community groups and individuals.

The local resilience directions are identified using a place-based approach for townships and communities across the Burdekin and Haughton catchments. The community snapshots that follow provide a quick reference guide to the local resilience directions relative to a series of communities across the region. These snapshots include intelligence derived from local disaster management plans and QERMF processes.

Additional shared regional actions will span the entire catchment area, articulated by the shared regional opportunities for collaboration. These are embedded within the action plan which is supplementary to this strategy.

NOTE: The statistics outlined in the following place-based community snapshots contain gaps where data has not been collected, or Census answers have not been provided. These statistics therefore should be interpreted as approximate only.

Each local resilience action outlined within the following community snapshots aligns with an element of resilience and strategic pathways. These are identified as per the following indicators:

- Resilient society
- Resilient towns & infrastructure
- Resilient transport
- Resilient economy
- Resilient environment

Image: Historical flooding in the township of Alpha.

ALPHA

Location

Belyando sub-catchment

Local government

Barcaldine Regional Council

Township characteristics

The township of Alpha is located on an inside bend on the western side of Alpha Creek. It supports a town-based population as well as a larger grazing community in the surrounding area. The town experiences significant flood impacts that include substantial inundation. The Alpha Hospital, aged care facility and emergency services facilities were recently relocated out of the floodplain to higher ground within town.

Demographics

- The township of Alpha has a population of approximately 335 people.
- Approximately 28.7 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 years, which represents 10.7 per cent of the population.
- The Barcaldine local government area (LGA) achieves better averages than Queensland for medical dependency, unemployment, rental homes and income.
- Couple families, with and without children, represent the largest family composition, accounting for 90.4 per cent of households.
- Approximately 48.8 per cent of the population earns a weekly income of between $500 and $1749 and 34.5 per cent earn less than $500.
- Of private dwellings in Alpha, approximately 46.4 per cent are owned outright, 32.9 per cent are rented and 13.6 per cent are owned with a mortgage.

Key infrastructure

- The town operates on a domestic septic system; loss of power for long periods may test the capacity of holding pits.
- Alpha Hospital is co-located with the aged care facility, and both were recently relocated to higher ground in town.
- The police, fire, SES and ambulance stations are co-located, and were recently relocated to high ground in town.
- The Alpha aerodrome is located to the west of town and is subject to isolation and potential partial inundation.
- The railway station and associated facilities are subject to flood inundation.
- The Capricorn Highway crosses Alpha Creek via a bridge. A separate railway bridge also crosses the creek.
- Town services include a bank, a supermarket and a town hall.
- A flood levee was previously constructed around the town, but was damaged in the 1990 flood and has not been reconstructed.

Environmental features

- Alpha Creek skirts the town to the east and north.
- Land use in the broader area is largely associated with grazing and other agricultural activities.

Local resilience actions

Local resilience actions identified include:

- Undertake a strategic analysis of engineering, land use planning and economic aspects of flood impacts in Alpha to develop options and pathways for long-term adaptation of the town.
- Contemplate establishing a panel of preferred suppliers for flood recovery needs.
- Obtain a fleet of portable water purifying stations for evacuation centres.
- Consider the implementation of a five-year strategic get ready strategy, including a focus on insurance.
- Partner with Department Of Transport And Main Roads to successfully implement intelligent transport systems on the Capricorn Highway to improve council's situational awareness, decision-making and safe working practices.
- Continue to engage with service providers to support rural resilience and recovery.
- Via the local disaster management group, discuss medical arrangements for flood events with Alpha Hospital, having regard to isolation of the town for long periods.
- Continue to work with Isaac Regional Council in relation to flood warnings on the Belyando River, downstream of its confluence with Alpha Creek and Native Companion Creek.

Image: An aerial view of Alpha.

GLENDEN

Location

Suttor sub-catchment

Local government

Isaac Regional Council

Township characteristics

Glenden is a mining town that was established in the 1980s to provide accommodation for workers and their families from the nearby Newlands Coal Mine. The township is elevated and largely avoids the floodplain, but does experience isolation from surrounding communities.

Demographics

- The township of Glenden has a population of approximately 620 people.
- Approximately 38.5 per cent of the population is aged between 25 and 44 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged 65 years and over, which represents 1.9 per cent of the population.
- This is consistent with the dominance of the mining-related employment profile of the town.
- The Isaac LGA achieves better averages than Queensland for medical dependency, unemployment and income. However, the rental home market in Glenden is double the state average. Again, this is largely associated with the mining-related employment profile of the town.
- Couple families with children represent the largest family composition, accounting for 60.9 per cent of households.
- Approximately 34.7 per cent of the population has a reported weekly earning of $1750 or more, and 24.6 per cent earn between $500 and $1749.
- Of private dwellings in Glenden, approximately 91.3 per cent are rented, 4.7 per cent are owned with a mortgage and 2.3 per cent are owned outright.

Key infrastructure

- Glenden is accessed by a key bridge connection, the Collinsville Elphinstone Road Bridge.
- The town is serviced by a police station, fire station and ambulance station, none of which are on the floodplain.
- Two health clinics service the community.
- The Glenden community has access to three community halls.
- The Glenden water treatment plant is also located off the floodplain.

Environmental features

- Glenden is surrounded by Suttor Creek to the east and north, and Sandy Creek to the west.
- Land use in the broader area is largely characterised by mining, grazing and other agricultural activities.

Local resilience actions

Local resilience actions identified include:

- Continue collaboration of flood warning network improvements.
- Improve community understanding of flood awareness and risk stemming from flood warning network improvements.
- Explore opportunities to combine level 3 flood models prepared by mining companies across the catchment, prepared by a diversity of interest groups, to collate a repository of flood data.
- Work with communities and community champions to enhance situational awareness.
- Support vulnerable members of the community, particularly those who may not reside in town.
- Explore opportunities to build further telecommunications redundancy in the area.
- Encourage small business resilience, continuity and diversification. This could include investigations into renewable energy industries.

Image: An aerial view of Glenden.

MOUNT COOLON

Location

Suttor sub-catchment

Local government

Whitsunday Regional Council

Township characteristics

Mount Coolon is located on Police Creek, a tributary of the Suttor River. It forms part of the Whitsunday region, and is one of the most western townships in the LGA. It is approximately 130 kilometres south-west of Collinsville and 200 kilometres north of Clermont. The town serves a broader grazing community in the surrounding area.

Demographics

- The township of Mount Coolon has a population of over 64 people.
- Approximately 64.8 per cent of the population is aged between 25 and 65 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24, which represents 10.9 per cent of the population.
- Couple families, with and without children, represent the largest family composition of households.
- Approximately 36.5 per cent of the population has a reported weekly earning of between $500 and $1749, with 25 per cent earning less than $500.
- Of private dwellings in Mount Coolon, approximately 59.1 per cent are owned outright, 27.3 per cent are rented and 13.6 per cent are owned with a mortgage.

Key infrastructure

- Mount Coolon is located on the Bowen Developmental Road.
- An unsealed airstrip services the community, located on the western side of town.
- The Mt Coolon State School is closed.

Environmental features

- There is a weir constructed on Police Creek, immediately upstream of the township.
- The Koala Golden Bar Mine is located to the south of town.
- Land uses in the surrounding area are largely characterised by grazing and other agricultural activities.

Local resilience actions

Local resilience actions identified include:

- Work with communities and community champions to enhance situational awareness.
- Explore opportunities to build further telecommunications redundancy in the area.
- Undertake a strategic review of the need for satellite communications and generator equipment for essential services in Mount Coolon to support community continuity.

Image: An aerial view of Mount Coolon.

PENTLAND

Location

Cape-Campaspe sub-catchment

Local government

Charters Towers Regional Council

Township characteristics

Pentland is located approximately 100 kilometres south-west of Charters Towers, on the Flinders Highway. It is situated on the western bank of Betts Creek, which flows into the Cape River, and is subject to periodic inundation. The Townsville–Mt Isa railway line transects the town, adjacent to the Flinders Highway. Pentland services a broad agricultural community across the surrounding area. Pentland is a multi-generational community, with a high number of retirees in the area.

Demographics

- The township of Pentland has a population of approximately 300 people.
- Approximately 23.9 per cent of the population is aged between 25 and 44 year, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 years, which represents 9.2 per cent of the population.
- The Pentland community exceeds the state averages for proportion of the population who are medically dependant, and for unemployment.
- Couple families without children represent the largest family composition, accounting for 44.4 per cent of households. This is followed by couple families with children at 38.9 per cent and one parent families at 16.7 per cent.
- Approximately 50.8 per cent of the population has a reported weekly earning of less than $500, with 35.1 per cent earning between $500 and $1749.
- Of private dwellings in Pentland, approximately 50.4 per cent are owned outright, 27.6 per cent are rented and 11 per cent are owned with a mortgage.

Key infrastructure

- Electricity supply to Pentland is provided by the Cape River substation, which in turn is supplied by two 66 kV sub-transmission lines from Charters Towers and Millchester.
- The town water supply is pumped from bores approximately 5 kilometres from the township.
- All properties are on septic services.
- Pentland is serviced by one state school.
- There is one railway siding (no station, although buildings remain), SES, Rural Fire Service and one fuel station.
- There is one police station in Pentland.
- Pentland has two community halls, a post office store and a caravan park.
- The Pentland aerodrome landing strip is located on the western side of the town, and the Royal Flying Doctor Service visits Pentland on a regular basis for clinics.

Environmental features

- The township adjoins a large wetland to the north-west.
- Pentland is located on the western bank of Betts Creek, a tributary of the Cape River.
- Land use in the broader area is characterised by grazing and other forms of agriculture.

Local resilience actions

Local resilience actions identified include:

Enhance education and information aimed at the travelling public, including freight companies, transport companies, community members and tourists, to increase awareness of access and other issues during the wet season.

Continue to collaborate with Department of Transport and Main Roads on flood locations across the Flinders Highway.

Partner with special interest and stakeholder groups to enhance support to vulnerable community members to have a plan, and know what to do before, during and after a flood event.

Bolster resupply options, acknowledging the potential for longer term isolation of the community irrespective of the flood levels of Betts Creek.

Image: An aerial view of Pentland.

HOMESTEAD

Location

Cape-Campaspe sub-catchment

Local government

Charters Towers Regional Council

Township characteristics

The community of Homestead is located approximately 70 kilometres west of Charters Towers, and is situated on the western bank of Homestead Creek. Homestead Creek flows into the Campaspe River to the south. Homestead is a multi-generational community, with a high number of retirees in the area.

Demographics

- The township of Homestead has a population of approximately 50 people.
- Approximately 33.3 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 years, which represents 8.3 per cent of the population.
- The Homestead community exceeds the state averages for proportion of the population who are medically dependant, and for unemployment.
- Couple families, with and without children, represent the largest family composition, accounting for 50 per cent of households.
- Approximately 57.1 per cent of the population has a reported weekly earning of less than $500, with 14.3 per cent earning between $500 and $1749.
- Of private dwellings in Homestead, approximately 40.9 per cent are owned outright, 36.4 per cent are rented and 13.6 per cent are owned with a mortgage.

Key infrastructure

- Electricity supply to Homestead is provided by the Cape River substation, which in turn is supplied by two 66 kV sub-transmission lines from Charters Towers and Millchester.
- Water supply in town is not provided by reticulated services.
- The grounds of Homestead State School are subject to inundation.
- Homestead has access to one community hall.

Environmental features

- Homestead is located on the western bank of Homestead Creek, a tributary of the Campaspe River.
- Land use in the broader area is characterised by grazing and other forms of agriculture.
- Wetland areas are situated to the south of the township.
- The town is located approximately 43 kilometres from Great Basalt Wall National Park.

Local resilience actions

Local resilience actions identified include:

Enhance education and information aimed at the travelling public, including freight companies, transport companies, community members and tourists, to increase awareness of access and other issues during the wet season

Continue to collaborate with Department of Transport and Main Roads on flood locations across the Flinders Highway

Partner with special interest and stakeholder groups to enhance support to vulnerable community members to have a plan, and know what to do before, during and after a flood event

Bolster resupply options, acknowledging the potential for longer term isolation of the community irrespective of the flood levels of Homestead Creek.

Image: An aerial view of Homestead.

HIDDEN VALLEY

Location

Upper Burdekin sub-catchment

Local government

Charters Towers Regional Council

Township characteristics

Hidden Valley is the most northern community within the Charters Towers and Burdekin catchment region. It is located 20 kilometres west of Paluma and provides a modest service centre to station owners along the Seaview Range.

Demographics

- The community of Hidden Valley has a population of approximately 26 people.

Key infrastructure

- Hidden Valley is not connected to an electricity grid. Electricity is self-generated.
- The community is not serviced by reticulated water supply.
- The township is not serviced by the telecommunications network, but access to satellite services is possible.
- Telstra services in Hidden Valley are fixed services delivered by radio from the 100 m high Hidden Valley RT off Ewan Road. Due to the remote nature of the area, this is a solar-powered facility. The batteries installed are not a mains power back-up, but instead an integral part of the daily operation of the facility.
- There is localised copper cable distribution in the region that is also fed by solar-powered nodes that communicate back to Hidden Valley.

Environmental features

- Hidden Valley is surrounded by pockets of subtropical rainforest vegetation.
- Paluma Dam is located upstream, and is a referrable dam.
- Land in the area is largely in its natural state due to the topography of the area, with surrounding land uses including grazing and agricultural activity.

Local resilience actions

Local resilience actions identified include:

Explore opportunities to build further telecommunications redundancy in the area.

Continue to operate across jurisdictional boundaries to support communities that may be isolated from council access during or following an event.

Enhance education and information aimed at the travelling public, including freight companies, transport companies, community members and tourists, to increase awareness of access and other issues during the wet season.

Bolster resupply options, acknowledging the potential for longer term isolation of the community.

Image: An aerial view of Hidden Valley.

GREENVALE

Location

Upper Burdekin sub-catchment

Local government

Charters Towers Regional Council

Township characteristics

Greenvale is located in the northern area of the Charters Towers region, inland from Ingham. While the township itself is not prone to flooding, it is subject to isolation by virtue of its location near the confluence of three major rivers – the Burdekin, Star and Clarke. Greenvale is more than 200 kilometres north of Charters Towers, on the Gregory Developmental Road.

Demographics

- The township of Greenvale has a population of approximately 230 people.
- Approximately 29.7 per cent of the population is aged 65 and over, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24, which represents 14.2 per cent of the population.
- The Greenvale community significantly exceeds both the Charters Towers LGA and state averages for proportion of the population aged over 65 years.
- Couple families without children represent the largest family composition, accounting for 62.5 per cent of households. This is followed by couple families with children at 31.2 per cent of households.
- Approximately 40.4 per cent of the population has a reported weekly earning of between $500 and $1749, with 38.4 per cent earning less than $500.
- The above is consistent with the employment characteristics and age of the Greenvale population.
- Of private dwellings in Greenvale, approximately 40 per cent are owned outright, 31.3 per cent are rented and 17.5 per cent are owned with a mortgage.

Key infrastructure

- Electricity supply to Greenvale is facilitated vi a 66 kV line from a connection at Helens Hill near Ingham, via Mt Fox, to the Greenvale substation, which is just north of town.
- Electricity to the Greenvale rural area is supplied by a single-wire earth return (SWER) line.
- The town's water is pumped from bores in the Burdekin River approximately 21.5 kilometres from town to a small filtration and disinfection unit, prior to storage in a hilltop reservoir located approximately 3 kilometres from town.
- Reticulated sewerage is connected to all households in town. Most rural properties are on septic systems.
- A police station, SES and an ambulance station are located in town in a joint emergency services building.
- Greenvale has one community hall and one fuel station.
- The town is serviced by a telecommunications tower that may be subject to flood hazard in some events.
- The Greenvale airstrip is located to the east of town.
- The Royal Flying Doctor Service visits Greenvale on a regular basis for clinic services.

Environmental features

- Land use in the broader area is characterised by grazing and other forms of agriculture.
- The Lava Plains are located approximately 80 kilometres north of Greenvale.

Local resilience actions

Local resilience actions identified include:

Enhance education and information aimed at the travelling public, including freight companies, transport companies, community members and tourists, to increase awareness of access and other issues during the wet season.

Partner with special interest and stakeholder groups to enhance support to vulnerable community members to have a plan, and know what to do before, during and after a flood event.

Bolster resupply options, acknowledging the potential for longer term isolation of the community.

Continue to work with the Department of Transport and Main Roads on the flood resilience and immunity of key bridge crossings on the Gregory Developmental Road, as a key secondary inland freight linkage.

Implement additional flood totem and gauge assets at the Clarke and Basalt River crossings.

Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.

Partner with natural resource management and land care groups to enhance erosion mitigation, land management and water quality improvement practices and activities throughout the Upper Burdekin sub-catchment.

Image: An aerial view of Greenvale.

HERVEY RANGE

Location

Upper Burdekin sub-catchment

Township characteristics

The Hervey Range township is located at the top of the Hervey Range, approximately 40 kilometres west of Townsville. Despite its location within the Charters Towers local government area, it is most easily accessed via Townsville, particularly during flood events. It is accessed from Charters Towers via the Gregory Developmental Road and Hervey Range Developmental Road.

Demographics

- The township of Hervey Range and immediate surrounds has a population of approximately 280 people.
- Approximately 31.2 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 years, which represents 9 per cent of the population.
- Couple families without children represent the largest family composition, accounting for 47.4 per cent of households. This is followed by couple families with children at 43.6 per cent of households.
- Approximately 43.3 per cent of the population has a reported weekly earning of between $500 and $1749, with 35.1 per cent earning less than $500.
- Of private dwellings in the Hervey Range township, approximately 47.9 per cent are owned with a mortgage, 43.8 per cent are owned outright and 5.2 per cent are rented.

Key infrastructure

- Electricity supply is serviced by a SWER line from Townsville.
- Reticulated water supply is not available.

Environmental features

- In the 2019 Monsoon Trough event, Hervey Range was affected by a landslip.
- Hervey Range township is located at the top of the Hervey Range.
- Land in the area is predominantly in its natural state due to topography, with some grazing and agricultural activity.

Local resilience actions

Local resilience actions identified include:

- Bolster resupply options, acknowledging the potential for longer term isolation of the community.
- Continue to operate across jurisdictional boundaries to support communities that may be isolated from council access during or following an event.
- Partner with natural resource management and land care groups to enhance erosion mitigation, land management and water quality improvement practices and activities throughout the Upper Burdekin sub-catchment.
- Implement flood warning gauge assets (i.e. automated gauge, camera, etc.) on the Hervey Range Developmental Road crossing of the Keelbottom River.
- Explore opportunities to build further telecommunications redundancy in the area.

Image: An aerial view of Hervey Range.

CHARTERS TOWERS

Location

Upper Burdekin sub-catchment

Local government

Charters Towers Regional Council

Township characteristics

Charters Towers is the primary economic and services centre for the Charters Towers region. It is one of the larger townships within the Burdekin and Haughton catchment area. The township is located more than 20 kilometres from the Burdekin River, but does experience localised flood impacts from overland flow in high-intensity rainfall events.

Demographics

- The township of Charters Towers has a population of approximately 8,120 people.
- Approximately 24.3 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24, which represents 13.5 per cent of the population.
- Couple families without children represent the largest family composition, accounting for 40.8 per cent of households, followed by couple families with children at 35.4 per cent.
- Approximately 51.1 per cent of the population has a reported weekly earning of less than $500, with 29.3 per cent earning between $500 and $1749.
- Of private dwellings in Charters Towers, approximately 33.5 per cent are owned outright, 35.1 per cent are rented and 27 per cent are owned with a mortgage.

Key infrastructure

- Two electricity substations service Charters Towers, including the Charters Towers substation, opposite All Souls and St Gabriels School, and the Millchester substation, which is situated approximately 5 kilometres south of the township on Bluff Road.
- Electricity is supplied to these substations via a 132 kV transmission line from the Ross substation Townsville.
- Town water supply is pumped from the Burdekin River via a weir approximately 13 kilometres from town, to a reservoir on Towers Hill.
- Sewerage is connected to households in the township area. Most rural properties in the surrounding area rely on septic systems.
- The town is supported by the Charters Towers Airport, which includes a landing strip capable of landing a large aircraft in an emergency (e.g. a Hercules).
- Charters Towers has one railway station, and is situated on the Townsville–Mt Isa railway line.
- The township is serviced by a large police station, SES, fire and rescue and rural fire service, and an ambulance station.
- There are several health clinics and one hospital with 23 beds in Charters Towers.
- The community is serviced by five banks and two community halls.

Image: An aerial view of Charters Towers.

Environmental features

- There are a number of hazardous materials manufacturers and storage facilities around the township of Charters Towers.
- Land uses in the surrounding area are largely characterised by grazing and other agricultural activities.

Local resilience actions

Local resilience actions identified include:

- Enhance education and information aimed at the travelling public, including freight companies, transport companies, community members and tourists, to increase awareness of access and other issues during the wet season.
- Partner with special interest and stakeholder groups to enhance support to vulnerable community members to have a plan, and know what to do before, during and after a flood event.
- Bolster resupply options, acknowledging the potential for longer term isolation of the community.
- Consider a whole-of-township approach to business and economic continuity planning for Charters Towers.
- Continue to work with the Department of Transport and Main Roads on the flood resilience and immunity of key bridge crossings on the Gregory Developmental Road, as a key secondary inland freight linkage.
- Continue to collaborate with Department of Transport and Main Roads on the flood locations across the state controlled road network.
- Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.
- Implement flood totem network across the region for flood awareness.
- Review flood classifications across the region.

RAVENSWOOD

Location

Lower Burdekin sub-catchment

Local government

Charters Towers Regional Council

Township characteristics

The heritage township of Ravenswood is situated almost 90 kilometres south-east of Charters Towers, and has a history steeped in gold mining. This industry continues today, supporting a bustling town and tight-knit community situated on Suhrs Creek. Ravenswood is a key township on the access route to Burdekin Falls Dam.

Demographics

- The township of Ravenswood has a population of approximately 255 people.
- Approximately 28.2 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 years, which represents 6.7 per cent of the population.
- Couple families without children represent the largest family composition, accounting for 54.2 per cent of households. This is followed by couple families with children at 32.2 per cent, and single parent families at 13.6 per cent.
- Approximately 40.8 per cent of the population has a reported weekly earning less than $500, while 31.5 per cent earn between $500 and $1749.
- Of private dwellings in Ravenswood, approximately 54.7 per cent are owned outright, 20.8 per cent are owned with a mortgage and 19.8 per cent are rented.

Key infrastructure

- Electricity supply to Ravenswood is provided by a 66 kV sub-transmission line from the Clare substation.
- Town water supplies are pumped from the Burdekin River to Suhrs Creek Dam (a referrable dam), located almost 3 kilometres upstream from Ravenswood, before being pumped to a water treatment plant for storage and distribution.
- All properties are on septic systems, with a small number of mine properties serviced by sewerage infrastructure managed by Carpentaria Gold.
- Ravenswood State School has recently been renovated with new buildings.
- The town is serviced by one police station and SES.
- A post office, store and fuel station are located in town.
- The Ravenswood airstrip measures 1000 metres in length. The Royal Flying Doctor Service visits the town on a regular basis, providing clinic services.
- Ravenswood has one community hall.

Environmental features

- Ravenswood is located near White Blow National Park.
- Land use in the area largely comprises gold mining and grazing activities.

Local resilience actions

Local resilience actions identified include:

- Bolster resupply options, acknowledging the potential for longer term isolation of the community.
- Partner with natural resource management and land care groups to enhance erosion mitigation, land management and water quality improvement practices and activities throughout the Lower Burdekin sub-catchment tributaries.
- Explore opportunities to build further telecommunications redundancy in the area.
- Consider local knowledge-sharing programs to enhance resilience of transient mining communities.

Image: An aerial view of Ravenswood.

EUNGELLA

Location

Bowen sub-catchment

Local government

Mackay Regional Council

Township characteristics

The hinterland township of Eungella is situated almost 700 metres above sea level on the Clarke Range, approximately one hour inland from Mackay. It is located at the headwaters of the Broken River system, which flows north into the Bowen River before discharging into the Lower Burdekin below Burdekin Falls Dam. Eungella itself is not particularly prone to inundation due to its geographic context, but can experience isolation and localised flood impacts.

Demographics

- The township of Eungella has a population of approximately 190 people.
- Approximately 40.2 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 years, which represents 3.1 per cent of the population.
- Couple families without children represent the largest family composition, accounting for 60 per cent of households. This is followed by couple families with children at 34 per cent.
- Approximately 39.1 per cent of the population has a reported weekly earning of less than $500, and 29.1 per cent earn between $500 and $1749.
- Of private dwellings in Eungella, approximately 45.6 per cent are owned outright, 26.5 per cent are owned with a mortgage and 19.1 per cent are rented.

Key infrastructure

- Eungella can experience isolation when the Eungella Dam Road is cut at the bridge.
- Eungella has two community halls and is serviced by one state school.
- Electricity supply to Eungella can be interrupted during and immediately following flood events.
- Eungella Dam is located to the west of the township.

Environmental features

- The area can be subject to landslips as a result of major rainfall events.
- Eungella is surrounded by Eungella National Park to the north, east and south.
- The township also adjoins Crediton State Forest to the west.
- Land in the area is largely in its natural state by virtue of topography, but land use includes some agricultural and grazing activity surrounding the town and further to the north-west.

Local resilience actions

Local resilience actions identified include:

- Enhance education and information aimed at the travelling public, including freight companies, transport companies, community members and tourists, to increase awareness of access and other issues during the wet season.
- Work with camping and caravan facility operators to ensure appropriate emergency plans for flood are in place.
- Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.
- Partner with special interest and stakeholder groups to enhance support to vulnerable community members to have a plan, and know what to do before, during and after a flood event.
- Bolster resupply options, acknowledging the potential for isolation.
- Explore opportunities to build further telecommunications redundancy in the area.
- Undertake a flood study which includes the Eungella area of the Broken River sub-catchment.

Image: An aerial view of Eungella.

COLLINSVILLE AND SCOTTVILLE

Location

Bowen sub-catchment

Local government

Whitsunday Regional Council

Township characteristics

Collinsville and Scottville are located approximately four kilometres apart, over 80 kilometres west of Bowen within the Whitsunday LGA. Both towns were originally established as mining communities and continue to support these industries today. A significant solar farm is also located nearby.

Demographics

- The townships of Collinsville and Scottville have a resident population of approximately 1500 people, which increases as a result of mining activities.
- Approximately 32.2 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 years, which represents 8.5 per cent of the population.
- Couple families without children represent the largest family composition, accounting for 50.7 per cent of households. This is followed by couple families with children at 36.7 per cent and single parent families at 12.1 per cent.
- Approximately 41.1 per cent of the population has a reported weekly earning of less than $500, and 33.3 per cent earn between $500 and $1749.
- Of private dwellings in Collinsville and Scottville, approximately 45.4 per cent are owned outright, 27.6 per cent are rented and 25.3 per cent are owned with a mortgage.

Key infrastructure

- Water supply is serviced by a reticulated system sourced from sand beds in the Don River (external to the catchment), which is pumped to a holding facility and fed to a treatment plant. Water is then pumped to reservoirs.
- The townships are serviced by a reticulated sewerage system, which includes a network of pump stations. Treatment is undertaken at a plant between Collinsville and Scottville.
- Electricity services are supplied from the Collinsville North substation, which is supplied at 275 kV by two substations, being Strathmore and Nebo.
- Collinsville and Scottville have access to a police station, SES, a fire station and ambulance services.
- There are four health clinics and one hospital in Collinsville and Scottville.
- A general aviation aerodrome is located between Collinsville and Scottville.

Environmental features

- The Bogie and Clarke Ranges separate the towns from Whitsunday townships along the coast.
- Collinsville is adjacent to Pelican Creek to the east, which drains into the Bowen River to the west.
- Land use in the area is largely characterised by mining activities, solar farms, grazing and other agricultural activities.

Local resilience actions

Local resilience actions identified include:

- Undertake a strategic review of the need for satellite communications and generator equipment for essential services in Collinsville to support community continuity.
- Bolster resupply options, acknowledging the potential for longer term isolation of the community.
- Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.
- Work with camping and caravan facility operators to ensure appropriate emergency plans for flood are in place.
- Partner with natural resource management and land care groups to enhance erosion mitigation, land management and water quality improvement practices and activities throughout the Bowen sub-catchment.
- Explore opportunities to build further telecommunications redundancy in the area.
- Undertake a strategic analysis for the provision of emergency housing in town following disaster events.

Image: An aerial view of Collinsville.

DALBEG

Location

Lower Burdekin sub-catchment

Local government

Burdekin Shire Council

Township characteristics

Dalbeg is a small rural community in the Burdekin Shire, located immediately west of the Burdekin River. It is located downstream of the Burdekin Falls Dam, and downstream of the river's confluence with the Bowen River. It is known as a multi-generational community.

Demographics

- The community of Dalbeg has a population of approximately 80 people.
- Approximately 44.7 per cent of the population is aged between 25 and 44 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged 65 years and over, which represents 6.6 per cent of the population.
- Couple families without children represent 61.1 per cent of households, and couple families with children represent 38.9 per cent of family composition in Dalbeg.
- Approximately 71.2 per cent of the population has a reported weekly earning of between $500 and $1749, and 24.2 per cent earn less than $500.
- Of private dwellings in Dalbeg, approximately 61.1 per cent are owned outright, 22.2 per cent are rented and 16.7 per cent are owned with a mortgage.

Key infrastructure

- Dalbeg is accessed by the Ayr Dalbeg Road, which is subject to inundation.
- Dalbeg is serviced by an unsealed airstrip on Foreman Walsh Road.
- Reticulated water supply (non-potable) is available in town, provided by SunWater.
- All properties are on septic services.
- A Sunwater river pumping station is located near town on the Burdekin River, with associated constructed supply channels.
- School students attend school in either Millaroo, Ayr or Home Hill.
- Electricity supply is serviced by a substation located in Millaroo.
- Irrigation and private railway infrastructure transect the landscape.

Environmental features

- Pink Lily Lagoon is a freshwater wetland to the immediate west of the township and provides on- and off-stream flood storage.
- Land use in the area is largely characterised by agricultural activity, including sugarcane production and vegetables.

Local resilience actions

Local resilience actions identified include:

- Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.
- Enhance community education on aspects of preparedness.
- Bolster resupply options, acknowledging the potential for isolation.

Image: An aerial view of Dalbeg.

MILLAROO

Location

Lower Burdekin sub-catchment

Local government

Burdekin Shire Council

Township characteristics

Millaroo is a small rural community in the Burdekin Shire, located immediately west of the Burdekin River. It is located downstream of Dalbeg on the western bank of the Burdekin River.

Demographics

- The community of Millaroo has a population of approximately 100 people.
- Approximately 33.3 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 year, which represents 11.5 per cent of the population.
- Couple families without children represent the largest family composition, accounting for 48 per cent of households. This is followed by couple families with children at 40 per cent.
- Approximately 51.4 per cent of the population has a reported weekly earning of between $500 and $1749, with 34.7 per cent earning less than $500.
- Of private dwellings in Millaroo, approximately 44.8 per cent are owned outright, 37.9 per cent are rented and 17.2 per cent are owned with a mortgage.

Key infrastructure

- Millaroo is accessed by the Ayr Dalbeg Road, which is subject to inundation.
- The town is serviced by Millaroo State School, which also services Dalbeg and the surrounding area.
- Reticulated water supply (non-potable) is available in town, provided by SunWater.
- All properties are on septic services.
- An electricity substation is located in Millaroo, which also feeds Dalbeg.
- An unsealed airstrip on Newman Road services the town.
- A Sunwater river pumping station is located near town on the Burdekin River, with associated constructed supply channels.
- Irrigation and private railway infrastructure transect the landscape.

Environmental features

- The town is bound to the east by the Burdekin River and to the west by Lagoon Creek.
- Land use in the area is largely characterised by agricultural activity, including sugarcane production and vegetables.

Local resilience actions

Local resilience actions identified include:

- Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.
- Bolster resupply options, acknowledging the potential for isolation.
- Enhance community awareness on aspects of preparedness.

Image: An aerial view of Millaroo.

CLARE

Location

Barratta sub-catchment

Local government

Burdekin Shire Council

Township characteristics

Clare is a rural township near Ayr, within the Burdekin Shire. While technically located within the Barratta sub-catchment of the Haughton system, it is located on the banks of the Burdekin River.

Demographics

- The community of Clare has a population of approximately 200 people.
- Approximately 32.7 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24, which represents 13.8 per cent of the population.
- Couple families with children represent the largest family composition, accounting for 62.3 per cent of households, followed by couple families without children, which account for 37.7 per cent of households.
- Approximately 38.6 per cent of the population has a reported weekly earning of between $500 and $1749, with 31.3 per cent earning less than $500.
- Of private dwellings in Clare, approximately 36.8 per cent are owned outright, 35.3 per cent are owned with a mortgage and 27.9 per cent are rented.

Key infrastructure

- Clare is serviced by a police station, SES and a rural fire brigade.
- Reticulated water supply is available in town, provided by SunWater.
- All properties are on septic services.
- A refuse transfer station is located in Clare.
- Clare has access to one community hall.
- An electricity substation is located in Clare.
- An unsealed airstrip is located in town, at the corner of Dunn Road and George Road.
- A Sunwater river pumping station is located near town on the Burdekin River.
- Channels have been developed on both sides of the Lower Burdekin, and each section is served by major pump stations located on Clare weir.
- Irrigation and private railway infrastructure transect the landscape.

Environmental features

- The Clare weir is situated on the Burdekin River, upstream from the township.
- Land use in the area is largely characterised by agricultural activity, including sugarcane production and vegetables.

Local resilience actions

Local resilience actions identified include:

- Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.
- Bolster resupply options, acknowledging the potential for isolation.
- Continued roll out of the ‘Our Town, Our Future’ program.

Image: An aerial view of Clare.

AYR

Location

Barratta sub-catchment

Local government

Burdekin Shire Council

Township characteristics

Ayr is a principal service and civic centre in the Burdekin Shire. While identified within the Barratta sub-catchment, Ayr is subject to flooding from the Burdekin River via Plantation Creek, which has inundated large areas of the town in the past. Ayr is also susceptible to localised flooding, as well as coastal hazards and tropical cyclones.

Demographics

- The community of Ayr has a population of approximately 8750 people.
- Approximately 26.4 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 years, which represents 11.7 per cent of the population.
- Couple families, with and without children, represent the largest family composition, accounting for 81.7 per cent of households.
- Approximately 45.1 per cent of the population has a reported weekly earning of between $500 and $1749, with 37.2 per cent earning less than $500.
- Of private dwellings in Ayr, approximately 37.7 per cent are owned outright, 32.1 per cent are rented and 26 per cent are owned with a mortgage.

Key infrastructure

- Ayr is located on and accessed via the Bruce Highway.
- There is one landing strip servicing Ayr, which is located in Brandon.
- Ayr is serviced by a railway station.
- Ayr connects with Home Hill via the Burdekin Bridge.
- The community is serviced by a police station, fire station, ambulance service and SES.
- There are 12 health clinics and one hospital in Ayr.
- The town is serviced by a refuse transfer station.
- Electricity supply is serviced by zone substations located in Ayr and East Ayr.
- The Burdekin Shire is supplied from north and south by a 132 kV transmission line owned and operated by Powerlink.
- Reticulated water supply is available in town, which is sourced from underground bores.
- Ayr is connected to a reticulated sewerage system.
- Standby power generation is available for water supply and sewerage services for Ayr.
- Land use in the area is characterised by urban activities within town, and agricultural activities across the broader area.

Environmental features

- Ayr is adjacent to Plantation Creek to the south.
- The Burdekin Shire is adjacent to the Great Barrier Reef coastal zone and Bowling Green Bay, a Ramsar-listed wetland.
- The township of Ayr is located on the coastal delta floodplain of the Burdekin and Haughton Rivers.
- Lilliesmere Lagoon adjoins the township of Ayr to the north.

Local resilience actions

Local resilience actions identified include:

- Consider local knowledge-sharing programs to enhance resilience of newcomers to the community.
- Partner with special interest and stakeholder groups to enhance support to vulnerable community members to have a plan, and know what to do before, during and after a flood event.
- Consider local flooding and drainage infrastructure network opportunities to enhance resilience to localised flooding.
- Examine a business case for a water treatment facility for Ayr to treat water turbidity and increase access to supply post-flood.
- Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.
- Enhance education and information aimed at the travelling public, including freight companies, transport companies, community members and tourists, to increase awareness of access and other issues during the wet season.
- Continue to work with the Department of Transport and Main Roads on the flood resilience of the Bruce Highway and other state-controlled roads in the region.
- Consider the implementation of digital noticeboards in town as central points of public information.
- Consider potential wastewater treatment facility options on the floodplain to mitigate impacts on the Great Barrier Reef.

Image: An aerial view of Ayr.

HOME HILL

Location

Lower Burdekin sub-catchment

Local government

Burdekin Shire Council

Township characteristics

Home Hill is situated to the immediate south of the Burdekin River, and is a principal service and civic centre in the Burdekin Shire. Home Hill is subject to significant inundation and flood impact from the Burdekin River. It is also susceptible to localised flooding and coastal hazards, including tropical cyclones.

Demographics

- The community of Home Hill has a population of approximately 3000 people.
- Approximately 27.5 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 years, which represents 11.7 per cent of the population.
- Couple families without children represent the largest family composition, accounting for 46.5 per cent of households. This is followed by couple families with children at 36.2 per cent, and single parent families at 15.8 per cent of households.
- Approximately 42.4 per cent of the population has a reported weekly earning of between $500 and $1749, with 39.3 per cent earning less than $500.
- Of private dwellings in Home Hill, approximately 42.9 per cent are owned outright, 26.9 per cent are rented and 26.4 per cent are owned with a mortgage.

Environmental features

- The Burdekin Shire is adjacent to the Great Barrier Reef coastal zone and Bowling Green Bay, a Ramsar-listed wetland.
- Land use in the area is characterised by urban activities within town, and agricultural activities across the broader area.

Local resilience actions

Local resilience actions identified include:

- Consider local knowledge-sharing programs to enhance resilience of newcomers to the community.
- Partner with special interest and stakeholder groups to enhance support to vulnerable community members to have a plan, and know what to do before, during and after a flood event.
- Consider local flooding and drainage infrastructure network opportunities to enhance resilience to localised flooding.
- Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.
- Enhance education and information aimed at the travelling public, including freight companies, transport companies, community members and tourists, to increase awareness of access and other issues during the wet season.
- Continue to work with the Department of Transport and Main Roads on the flood resilience of the Bruce Highway and other state-controlled roads, including Ayr-Dalbeg Road.
- Consider the implementation of digital noticeboards in town as central points of public information.

Image: An aerial view of Home Hill.

BRANDON

Location

Barratta sub-catchment

Local government

Burdekin Shire Council

Township characteristics

Brandon is an urban community within the Burdekin Shire, located several kilometres west of Ayr. It is located within the Barratta sub-catchment, with flood exposure stemming from Sheep Station Creek to the immediate west of town, as well as localised flooding.

Demographics

- The township of Brandon has a population of over 1000 people.
- Approximately 30.5 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24, which represents 9.7 per cent of the population.
- Couple families without children represent the largest family composition, accounting for 48.5 per cent of households, followed by couple families with children at 39.4 per cent.
- Approximately 48.4 per cent of the population has a reported weekly earning of between $500 and $1749, with 36.6 per cent earning less than $500.
- Of private dwellings in Brandon, approximately 41.3 per cent are owned outright, 26.7 per cent are rented and 29.1 per cent are owned with a mortgage.

Key infrastructure

- Brandon is located on and accessed via the Bruce Highway.
- There is one sealed landing strip servicing Brandon and Ayr, located on Aerodrome Road.
- Reticulated water supply is available in town, which is sourced from underground bores.
- Brandon is connected to a reticulated sewerage system.
- Standby power generation is available for water supply and sewerage services for Brandon.
- Brandon State School is located on the western side of town.
- The North Coast railway line transects the town, but railway station facilities are not available in Brandon.
- Irrigation and private railway infrastructure transect the landscape.

Environmental features

- Brandon is located on the coastal delta of the Barratta sub-catchment.
- Sheep Station Creek is located to the west of the township.
- Land uses in the surrounding area are largely characterised by sugarcane production and other agricultural activities.

Local resilience actions

Local resilience actions identified include:

- Consider local knowledge-sharing programs to enhance resilience of newcomers to the community.
- Partner with special interest and stakeholder groups to enhance support to vulnerable community members to have a plan, and know what to do before, during and after a flood event.
- Consider local flooding and drainage infrastructure network opportunities to enhance resilience to localised flooding.
- Enhance education and information aimed at the travelling public, including freight companies, transport companies, community members and tourists, to increase awareness of access and other issues during the wet season.
- Continue to work with the Department of Transport and Main Roads on the flood resilience of the Bruce Highway and other state-controlled roads.
- Explore opportunities for further flood resilience for Brandon stemming from the the Barratta sub-catchment flood study, including drainage options near Brandon State School.

Image: An aerial view of Brandon.

GROPER CREEK

Location

Lower Burdekin sub-catchment

Local government

Burdekin Shire Council

Township characteristics

The township of Groper Creek is a small coastal community situated on one of the many delta waterways draining the Burdekin River to the coast. It is a resilient township with a large retiree population, which has adapted its built form to accommodate regular flood impacts and limit disruption and flood damage to assets and infrastructure. Isolation is common. It is also exposed to coastal hazards, including storm tide inundation.

Demographics

- The community of Groper Creek has a population of approximately 60 people.
- Approximately 53.2 per cent of the population is aged 65 years and older, which represents the largest demographic cohort.
- Couple families without children represent the largest family composition, accounting for 85 per cent of households, followed by couple families with children at a much lower 15% per cent of households.
- Approximately 45.5 per cent of the population has a reported weekly earning of less than $500, and 36.4 per cent earn between $500 and $1749.
- Of private dwellings in Groper Creek, approximately 78.1 per cent are owned outright, 25 per cent are owned with a mortgage and 21.9 per cent are rented.

Key infrastructure

- Reticulated water supply is available in town.
- All properties are on septic systems.
- Electricity is supplied via substations in other communities.
- Access is available via Groper Creek Road, Coppo Road and Charlies Hill Road, which each link back to the Bruce Highway and are routinely inundated.

Environmental features

- The township is adjacent to Sandy Creek to the north and Groper Creek to the east.
- The town adjoins wetlands to the west, through which access is gained to the township.
- Big Patterson Island and Peters Island form the opposite bank of the Groper Creek waterway.
- Land use in the town is urban in nature and surrounded by wetlands, rural and agricultural activities.

Local resilience actions

Local resilience actions identified include:

- Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.
- Exploration of mitigation options to protect public infrastructure.
- Maintain resupply options, acknowledging the potential for isolation.

Image: An aerial view of Groper Creek.

GIRU

Location

Haughton catchment

Local government

Burdekin Shire Council

Township characteristics

Giru is the primary township on the Haughton River and is routinely impacted and isolated. This has bred a level of self-sufficiency and community resilience, which sees residents take living with flood in their stride as part of daily life.

Demographics

- The community of Giru has a population of approximately 350 people.
- Approximately 36.2 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24 years, which represents 8.5 of the population.
- Couple families without children represent the largest family composition, accounting for 52.9 per cent of households. This is followed by couple families with children at 35.3 per cent and single parent families at 11.8 per cent of households.
- Approximately 48.4 per cent of the population has a reported weekly earning of between $500 and $1749, with 37.3 per cent earning less than $500.
- Of private dwellings in Giru, approximately 39.5 per cent are owned outright, 34.9 per cent are owned with a mortgage and 23.7 per cent are rented.

Key Infrastructure

- Giru is accessed by several routes links to the Bruce Highway.
- The town is serviced by a railway station on the North Coast railway line.
- The town is supported by a police station, fire station, SES and ambulance service.
- Giru has one community hall.
- The town is serviced by a refuse transfer station.
- An electricity substation is located in Giru.
- Reticulated water supply is available in town, sourced from the Haughton River, and is treated by Townsville City Council by way of an agreement with Burdekin Shire Council.
- Irrigation and private railway infrastructure transect the landscape.

Environmental features

- Giru is located on the coastal delta of the Haughton catchment, known to be one of the most frequently flooded catchments in Queensland.
- It is adjacent to the Haughton River to the east, and is surrounded by a series of waterholes and lagoons, as well as conservation parks and nature refuges.
- Land use in the town is largely urban in nature, but includes agricultural activities in the surrounding area.

Local resilience actions

Local resilience actions identified include:

- Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.
- Maintain resupply options, acknowledging the potential for isolation.
- Explore opportunities for further flood resilience for Giru stemming from the the Barratta sub-catchment flood study.
- Consider the implementation of digital noticeboards in town as central points of public information.
- Relocation of helipad, adjacent to the SES building.
- Recruitment of additional SES volunteers.
- Work collaboratively with Townsville City Council in relation to water turbidity following flooding.

Image: An aerial view of Giru.

JERONA

Location

Barratta sub-catchment

Local government

Burdekin Shire Council

Township characteristics

Jerona is a small coastal community near the mouth of Barratta Creek, north-east of Giru. In addition to riverine and localised flood impacts, Jerona is also subject to potential coastal hazards, including tropical cyclones and storm tide impacts. The township is identified as comprising a large retiree community.

Demographics

- The township of Jerona has a population of approximately 40 people.
- Approximately 62.5 per cent of the population is aged between 45 and 64, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 25 and 44, which represents 7.5 per cent of the population.
- Couple families without children represent the largest family composition, accounting for 54.6 per cent.
- Approximately 50 per cent of the population has a reported weekly earning of less than $500, and 25 per cent earn between $500 and $1749.
- Of private dwellings in Jerona, approximately 75 per cent are owned outright and 18.8 per cent are rented.

Key infrastructure

- Static water supply is relied upon in town.
- All properties are on septic services.
- Electricity is supplied via substations in other communities.
- Access is available via Jerona Road, which links to the Bruce Highway and is routinely inundated.

Environmental features

- Jerona is located on the western bank of Barratta Creek.
- It adjoins Bowling Green Bay National Park.
- Land uses in the surrounding area are largely natural, by virtue of the wetland and floodplain geography of the area.

Local resilience actions

Local resilience actions identified include:

Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.

Bolster resupply options, acknowledging the potential for isolation.

Explore opportunities for further flood resilience for Jerona stemming from the the Barratta sub-catchment flood study.

Consider dual hazard resilience opportunities for flood and coastal hazards for Jerona, and other coastal communities in the region including Alva Beach which is not directly impacted by riverine flooding.

Image: An aerial view of Jerona.

RITA ISLAND

Location

Barratta sub-catchment

Local government

Burdekin Shire Council

Township characteristics

Rita Island is located on the northern side of the Burdekin River, where it discharges to the coast. The Burdekin River anabranch separates Rita Island from the mainland. While it is identified within the Barratta sub-catchment, flooding is only caused by the Burdekin River. The frequency of flooding has generated a resilient community, which adapts to conditions to continue daily life.

Demographics

- The township of Rita Island has a population of approximately 150 people.
- Approximately 39.5 per cent of the population is aged between 45 and 64 years, which represents the largest demographic cohort. The smallest demographic cohort is those aged between 15 and 24, which represents 8.6 per cent of the population.
- Couple families without children represent the largest family composition, accounting for 60 per cent of households, followed by couple families with children at 40 per cent.
- Approximately 59.5 per cent of the population has a reported weekly earning of between $500 and $1749, with 34.9 per cent earning less than $500.
- Separate houses account for all the dwelling structures on Rita Island.

Key infrastructure

- Rita Island is accessed via Rita Island Road, which includes a bridge across the Burdekin River anabranch.
- All properties are on septic systems.
- Electricity is supplied via substations in other communities.
- Irrigation and private railway infrastructure transect the landscape.

Environmental features

- Rita Island is bound to the south by the Burdekin River and the west and north by its anabranch.
- It adjoins the Great Barrier Reef coastal zone to the east.
- Land uses in the surrounding area are largely characterised by sugarcane production and other agricultural activities.

Local resilience actions

Local resilience actions identified include:

Work to identify opportunities to mitigate key repeated road network hotspots that are frequently impacted.

Investigate the need for temporary infrastructure to embark and disembark boats across the anabranch which safely transport residents during flood events.

Maintain resupply options, acknowledging the potential for isolation.

Image: An aerial view of Rita Island.

Strategy implementation

Working together to implement the strategy

This strategy will be implemented as a partnership across the eight local governments of the Burdekin and Haughton region. The strategy actions will be driven through local leadership action, with appropriate support from other coordinating bodies and entities including District Disaster Management Groups (DDMGs), state government agencies and not-for-profits.

This approach recognises that, while actions are best delivered locally, multidisciplinary regional level support is also required to encourage cross-jurisdictional collaboration, provide technical assistance and proactively assist project implementation. Opportunities that exist to strengthen community and climate-related disaster resilience in the Burdekin and Haughton catchments include:

- supporting a resilient society through community networks and an inherent ability to adapt to changing circumstances
- supporting communities, including individuals and household members, to make their own informed decisions regarding preparation for sever weather and disasters
- enhancing economic resilience through industry involvement and dialogue, supply chain strengthening, focusing on collaboration and partnerships across public and private sectors, enabling infrastructure and business continuity planning
- support for infrastructure through pathways for improved communications and transport linkages for societal and economic benefit
- supporting community-led recovery opportunities and operations following events
- improving funding certainty through proactive planning, prioritisation and coordination for collective benefit.

Enduring governance and funding arrangements

This strategy provides an opportunity to examine and support how local governments, community and service organisations work together to achieve common resilience outcomes across the vast Burdekin and Haughton catchments. It seeks to inform strategic and coordinated approaches to community and climate-related disaster resilience activities across the region so that funding and action can be aligned to a common intent. This includes working locally toward defined regional goals and aspirations.

Under this model, the strategy acts as the regional 'blueprint' for local and regionally coordinated and sustained action. An agreed governance arrangement will support the implementation of the strategy, together with an enduring commitment to championing resilience into the future. Stakeholder-identified key requirements for the successful implementation of this strategy are:

- recognition of the important role of self-sufficient communities
- a broad, multidisciplinary approach to resilience building
- sustaining governance arrangements, funding and resource capability for implementation of resilience actions over time
- a clear understanding of how resilience arrangements interplay with Queensland Disaster Management Arrangements
- greater collaboration between government and non-government organisations to optimise resilience service delivery and efficiency
- clarification of the proposed resilience implementation arrangements at state, regional and local levels so that local actions can be programmed and delivered accordingly.

Image: Grazing activity is a key economic activity within the Burdekin and Haughton catchments.

Local leadership

Local governments and non-government organisations are encouraged to establish their own multidisciplinary resilience working groups to transition community and climate-related disaster resilience to front-of-mind in all local government functions. This could be achieved by combining existing recovery group arrangements with an ongoing resilience focus over the calendar year.

The strategic framework of this strategy supports local governments to act locally, in line with local community need, in the knowledge that each local activity contributes to the realisation of mutually identified regional goals.

Regional coordination and basin working group

Regional coordination is proposed to fall under the governance of each respective local government, and be supported by a Burdekin and Haughton Basin Working Group, the focus of which will predominantly relate to those aspects of the strategy requiring regional coordination and collaboration.

This will provide a strong link to other existing related governance arrangements such as the relevant DDMGs.

The Basin Working Group is intended to provide a forum to collaborate regionally, across jurisdictional boundaries, for whole-of-basin benefits on issues such as asset upgrades, funding opportunities, asset management and maintenance, joint resilience program and project opportunities, and collaborative situational awareness improvements.

The Basin Working Group is anticipated to comprise each local government within the Burdekin and Haughton catchments, and may also include additional flood warning asset owners and those with supplementary infrastructure that may contribute to the broader flood warning network. This may include natural resource management groups, water boards, mining companies and infrastructure providers.

Terms of reference for the Basin Working Group will guide its operation. The Basin Working Group is intended to be the mechanism to drive collaborative implementation of this strategy, in collaboration with the three DDMGs in place across the region.

State facilitation and support

The Basin Working Group is to be supported by the Queensland Reconstruction Authority (QRA) and BoM, as part of the network subcommittee arrangements chaired by the QRA.

As a locally led and regionally-coordinated strategy, the role of the state is intended to be one of providing enabling measures such as administration of grant funding programs, delivery of core government functions that interface with resilience building, and facilitation/coordination of support that can assist implementation.

Implementation of this strategy provides the opportunity to communicate resilience needs to the State Disaster Coordination Group. This is a multi-agency committee that convenes to discuss state-level resilience and disaster-related challenges, activities and opportunities across Queensland.

The Queensland Resilience Coordination Committee, which reports to the Queensland Disaster Management Committee, has also been convened as an implementation action under Resilient Queensland 2018–2021. Its role is to oversee initiatives and measures necessary to enhance disaster resilience.

Image: An aerial view of Home Hill.

Coordinated funding approaches

This strategy seeks to use existing funding streams in a more efficient and strategic way.

A suite of resilience actions have been identified at the local and regional scales, and are provided as part of the action plan supporting this strategy. The action plan is to be delivered to the Basin Working Group and its member local governments, and synthesised against existing strategies prepared by local governments as a means of delivering on the regional strategic pathways and local directions set out in this strategy.

Local governments can work independently towards local directions, or collaborate via the Basin Working Group or relevant DDMGs to develop project business cases based on regional resilience actions in advance of funding rounds so that they are ready to 'pull from the shelf' to assist funding and grant application processes as they become available.

Monitoring and evaluation

A key aspect of this strategy moving forward is to establish a clear standards-based implementation framework for integrated resilience planning. This approach focuses on deriving specific local, regional and fit-for-purpose benchmarks for resilience implementation that are cross-referenced to roles, responsibilities and funding.

A benchmarking approach aims to provide a range of metrics that reflect the diversity of the region. It is proposed that the identification and establishment of maturity benchmarking be further developed as implementation occurs over time.

Supplementary project deliverables

Forming part of this strategy are the following additional elements:

Barratta's sub-catchment flood study

- Delivery of a flood study and flood modelling for the Barratta's sub-catchment within the Haughton catchment. This flood study addresses a key data gap in an area of the catchment with highly complex flood characteristics that are not presently quantified.
- This flood study will enable Burdekin Shire Council to provide more accurate flood warnings and flood information to residents and businesses in the local area, advance community preparedness for future flooding, and ultimately contribute to improved disaster resilience of Burdekin Shire.

Get Ready Queensland – forward program

- The strategy has produced five-year forward plans for each council's Get Ready program into the future. This provides a strategic view over the next few years that builds upon the flooding issues known locally and discussed in this strategy.
- These forward plans provide detailed and annual-based approaches to work towards longer-term disaster preparedness and community knowledge goals, through year-on-year approaches which take the community on the continuous improvement journey of enhancing resilience over time.

Flood warning improvements

- A review and update of flood classification levels for selected information and forecast gauge locations, defined by BoM, where sufficient data is available.
- This review enables BoM and local governments across the catchments to provide more accurante flood warnings and flood information to residents in the area.

Detailed technical evidence reporting and supporting literature reviews have been undertaken as part of the preparation of this Strategy. A complete list of reference documents can be obtained from Council.

Images: (this page) Basalt walls of Echo Hole in the Upper Burdekin sub-catchment.
(Inside back cover) A view towards Mount Elliot across the Haughton catchment.
(Back cover) Rail bridge across the Burdekin River at Sellheim.

www.qra.qld.gov.au/burdekin-haughton