

Mackay Region Flood and Stormwater Management Strategy

November 2016 - FINAL



Prepared for

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Executive Summary

This Flood and Stormwater Management Strategy (the Strategy) demonstrates Mackay Regional Council's (Council's) ongoing commitment to protecting the region's infrastructure against flooding. The Strategy contributes to ongoing land use planning efforts as well as sustainable development and growth of the city. The Strategy assists with asset management activities in flood affected areas and supports Council's flood emergency efforts by creating and maintaining appropriate flood emergency decision support tools.

The Strategy prioritises areas most at risk, explores community expectations, focuses on cost-effective solutions and balances growth planning with responsible asset management.

This strategy delivers a strategic support system to assist decision making and will guide Council's actions for flood and stormwater risk management during the next ten years, fulfilling its strategic vision as follows. - - - - -

"Flood and stormwater risks in the Mackay Region are actively managed to minimise the consequences to life, assets, community wellbeing, the environment and the economy."

Objectives of the Strategy are outlined below:

- Manage flood and stormwater infrastructure in an integrated way, ensuring the sustainable use of physical resources.
- Ensure flood and stormwater management considerations are integrated into Council's decision making and future projects are prioritised based on defined criteria using a transparent process.
- Ensure flood and stormwater asset renewals are proactively managed at reducing risk, using current condition data and agreed levels of service.
- Understanding and meeting the demands of growth through demand management and infrastructure investment.
- Continuous improvement in asset management practices.
- Cost effective collection, storage, analysis and sharing of data throughout the organisation, external stakeholders and the community.
- Educating and raising the awareness in the community about flood / stormwater management and potential flood risk.
- Build capacity and capability within Council and the community to develop an understanding of flood risk, risk management and response and recovery that will reduce the social, economic and environmental impacts of flood events.



This strategy primarily deals with inundation due to storm surge, localised urban catchment flooding and creek / riverine flooding. It has been developed following extensive consultation with key stakeholders involved in planning, response and recovery aspects of flood and stormwater management in the Mackay region.

This Strategy outlines the current flood risk in the Mackay region, the current assets managed by Council, existing management practices and emergency response processes and a strategy for avoiding, reducing and managing flood risk into the future. The identification and prioritisation of future flood management, planning and mitigation works are also covered.

Further discussion is provided on the implementation of this Strategy, monitoring of its progress and evaluation of the strategy's effectiveness. Urban growth and the predicted impacts of climate change will increase the flood risk faced in the Mackay region, which highlights the importance of ongoing review and updates to this strategy into the future.

1 Introduction

1.1 What is Flood and Stormwater Management?

Flood and stormwater management is the term used for planning and implementing actions that manage the uncertainty of flood and protect people against its adverse impacts. State and Federal Acts, policies and plans outline Council's responsibilities on protecting people and their properties against flooding. A management strategy should also outline the processes required to sustain flood and stormwater management infrastructure by matching future maintenance and renewal expenditures with future income projections.

There is a distinction between flood hazard and flood risk. Flooding only presents as a hazard where it exceeds the coping capacity of the environment or community. Flood risk refers to (and is a measure of) the likelihood and consequence of the hazard eventuating. Flood and stormwater management is about identifying means of reducing the likelihood and consequence of flooding.

It is important to note that flood and stormwater risk management cannot totally eliminate the adverse impacts of flooding everywhere, anytime and for all land use types. Each land use type can be managed to a level of hazard that is determined through community expectations and Council's Planning Scheme.

This strategy is focussed on flood and stormwater management and does not cover the management and planning principles related to stormwater quality. This will be covered in a separate document.

1.2 About the Mackay Region

The Mackay Regional Council local government area encompasses approximately 7,300km², including 320km of coastline across numerous beach and inland communities. The region supports a population of approximately 124,000, with the majority of those located in the City of Mackay. The remainder of the population is spread throughout the region across Sarina, Marian, Mirani, and Walkerston and multiple smaller settlements such as Koumala, Hay Point, Sarina Beaches, Finch Hatton, Eungella, Farleigh, Seaforth, Cape Hillsborough, Calen, Bloomsbury, and Midge Point.

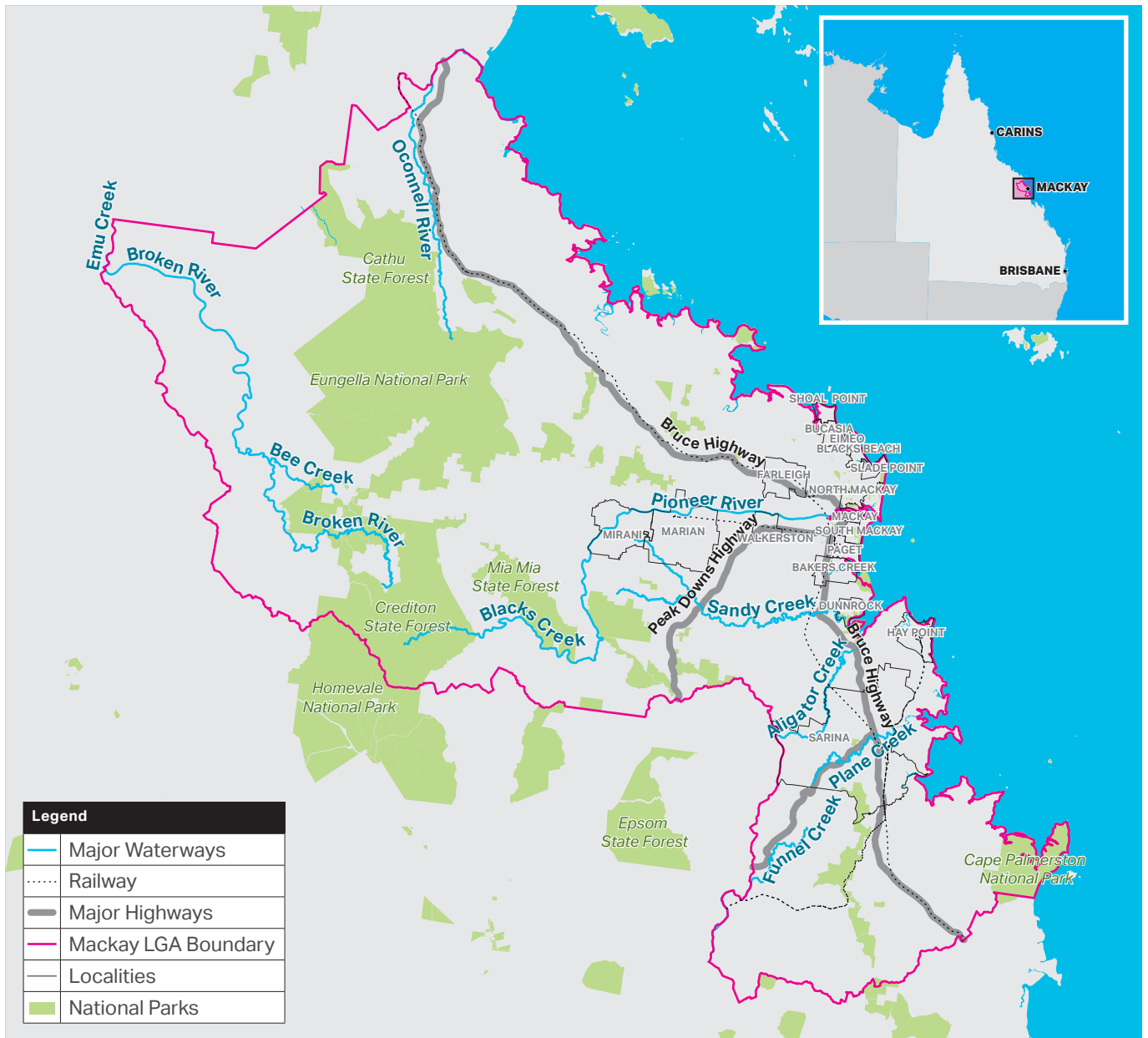
The City of Mackay was originally established on the southern banks of the Pioneer River in the 1860's and has spread out over the floodplain near the mouth of the River since that time. The majority of the urban land is low-lying, having an average elevation of less than 10 metres AHD with parts of Mackay up to 300 mm below the Highest Astronomical Tide (HAT) level of 3.64 m AHD.

The Pioneer River is the largest drainage feature in the region with a total catchment area (excluding the Bakers Creek catchment) of approximately 1,560 km². Its catchment and upper tributaries originate on the relatively steep eastern slopes of the Clarke Connors Range before it flows through the townships of Mirani and Marian and then through the City of Mackay to the Coral Sea. One dam and three weirs have been constructed on the river or its tributaries;

- Teemburra Dam located on Teemburra Creek, which has a storage capacity of 147,500 ML, and captures less than 1% of the total catchment area of the Pioneer River
- Mirani Weir located on the Pioneer River 46 km upstream of the Pioneer River mouth stores approximately 4,660 ML
- Marian Weir located on the Pioneer River 30 km upstream of the Pioneer River mouth stores approximately 3,830 ML and
- Dumbleton Rocks Weir located on the Pioneer River 16 km upstream of the Pioneer River mouth stores approximately 6,000 ML.

Each of the storages was constructed as water supply infrastructure and are operated as such, with limited ability to attenuate the large flows which impact Mackay. Levee banks have been constructed on the southern and northern banks of the river and along Gooseponds Creek to protect the city and suburbs.

The Pioneer River catchment is bordered by the Leila Creek and Murray Creek catchments to the north, the Bowen River catchment to the west and Sandy Creek, Bakers Creek and the Isaac River catchments to the south. The Bakers Creek catchment area is approximately 170 km² which includes the southern floodplain of the Pioneer River which drains the townships of Walkerston and Bakers Creek to the Coral Sea about 8 km south of the Pioneer River mouth. The catchment is bordered by the Sandy Creek catchment to the west and south.



The Sandy Creek catchment is also significant although the population density of the floodplains adjacent to the creek is much lower. Kinchant Dam is located in the upper catchment of the Creek. However, the dam has a relatively small direct catchment and was constructed as an off stream storage to harvest flows from the Pioneer River.

Sarina is the other major settlement in the region and is located adjacent to Plane Creek. Middle Creek Dam is located in the upper catchment of Plane Creek, while a small weir was also constructed on the creek adjacent to the sugar mill. The catchment area of Plane Creek is much smaller than that of the Pioneer River, Bakers Creek and Sandy Creek.

Outside of the City of Mackay and the townships of Sarina, Walkerston, Bakers Creek, Mirani and Marian, population density decreases significantly and the catchment areas draining to these communities are also generally much smaller than the major catchments identified above, however, this does not mean that the risks posed by flash flooding or coastal inundation can be disregarded.

As well as the Pioneer River, the region comprises other rivers and streams such as the O'Connell River, Bakers Creek, Sandy Creek, Alligator Creek and Plane Creek which passes through the township of Sarina with numerous other small streams discharging to the coast.

Prior to the coal mining boom commencing in the late 1960's, the Mackay region supported a stable population based around the sugar industry which covered a large proportion of the region due to its favourable topography and climate. Population growth was steady with most mining personnel being housed in their local townships, however, with the demand for coal dictating expansion in the industry (existing mines, new mines and port expansions), new operational and industrial strategies have turned the focus to utilising Mackay as the residential centre and maintenance hub for the industry.

1.3 Current Management Practices

Council has undertaken flood risk planning and management over many years. Important management measures undertaken to date include:

- Investment in a number of flood risk studies for creeks, rivers, coastal storm tide and urbanised catchments throughout the region.
- Introduction of a flood code in the Planning Scheme to ensure new developments will not increase flood risk in the city, and mitigate existing risk where possible.
- Development of emergency management plans, procedures and other support systems.

Existing assets can be broadly divided into three types:

- **Pioneer River flood levees** in Mackay and Finch Hatton with a total length of approximately 11km. The system primarily consists of earthen levees, however, short lengths of structural flood walls and temporary demountable barriers are also used.
- **Underground stormwater network** consisting of inlets, access chambers and pipes (of various type, age and condition). Flood gates, backflow prevention devices and other ancillary infrastructure are also used throughout the region. Council currently manages approximately 630 kilometres of stormwater culvert infrastructure and approximately 24,000 stormwater pits.
- **Open channels and drains** generally concrete lined or grass lined. Council currently manages approximately 143 kilometres of open channel network, across approximately 840 sections.

These measures have contributed to the management of flood and stormwater risk within the Mackay region. However, review and re-evaluation is prudent in light of new technologies in assessment, planning and construction of mitigation options and changing adaptive capacities of the community.

Significant investment has been made in flood and stormwater management assets over a number of years. Council currently manages approximately \$500M worth of flood and stormwater infrastructure assets that provide a level of flood protection across the region and reduce the incidence of nuisance flooding in some areas during local catchment events.



1.4 Why does the Mackay Region need a Strategy?

Flooding is a natural event in the Australian environment and an inevitable occurrence in the Mackay region. Climate change is predicted to increase flood risk, frequency and intensity. While we cannot stop floods from happening, we can reduce the consequences of flooding, manage the risk and plan for the future.

The three potential mechanisms of flooding (outlined in Section 2.1) present a complex situation for Council in trying to consistently manage flood hazards within the Mackay region. In addition, infrastructure used to reduce the impact of flooding, such as levees and drainage systems, may also pose a risk due to poor condition and uncertain design criteria and construction methods.

To respond to these challenges, Council initiated various planning reform initiatives with the objective: - - - - -

This process has helped Council understand possible appropriate service outcomes for infrastructure in the region. It also helps the region towards a more sustainable path, by utilising existing and planned infrastructure capacity; providing a wider range of housing and lifestyle choices, and moderating the total transport task for the region within the constraints of the budget and funding process.

In undertaking planning reform initiatives, it was recommended that Council invest funds into understanding and identifying key issues relevant to stormwater drainage to allow Council to make more informed decisions on planning policy and infrastructure investment required to more effectively mitigate the risk and impact of flooding. The development of a Flood and Stormwater Management Strategy is one outcome of this process, and documented in the 'Our Alternative Future' report.

"To develop a clear, coordinated and unambiguous long term strategy for the sustainable development of the whole Mackay Region"

The benefits of a Strategy are clear:

- An overarching vision for the long term management of flood and stormwater drainage infrastructure.
- A consistent and transparent approach to identify and prioritise future expenditure. This will ensure a balanced approach is used to progressively reduce risk.
- Collation of asset data and condition assessments, offering Council a reliable database for future use.
- Governance provisions and accountabilities clearly outlined to ensure the overarching vision is maintained.
- Budget expenditure can be forecast over the next ten years. This will provide more certainty and ensure high risk assets are targeted first and overall risk reduced over time.



2 Understanding the Risks

2.1 What is Flooding?

Flooding generally relates to the inundation of usually dry areas of land and can refer to a variety of flood mechanisms, which may occur in isolation or concurrently with other mechanisms. These include:

- River and creek flooding as a result of excess runoff overtopping the banks of the river or creek.
- Urban catchment flooding during localised rainfall events.
- Coastal inundation as a result of sea water inundation due to high tides, storm surge and the like.

2.1.1 Likelihood of Flooding

Rainfall events, storm surge and the floods that result from them are categorised by the frequency at which events of a given size are likely to occur. Annual Exceedance Probability (AEP) is the statistical likelihood of the occurrence of a flood of a given size or larger in any one year, usually expressed as a percentage. For example, floods with a discharge equal to the 1% AEP event has a 1% probability of occurring each year.

Average Recurrence Interval (ARI) is a statistical estimate of the average period in years between the occurrences of a flood of a given size or larger. For example, floods with a discharge as large as the 100 year ARI flood event will occur on average once every 100 years. The ARI of an event gives no indication of when a flood of that size will occur next. The 1% AEP event is equivalent to the 100 year ARI event.

Small events generally occur frequently (e.g. 39% AEP or 2 year ARI) and large events quite rarely (1% AEP or 100 year ARI).

The 1% AEP flood, is the generally accepted event on which current guidelines and standards are based to protect new development. However, flood and stormwater management and emergency response requires the consideration of a range of lesser and greater events.

2.2 Existing Flood Risk in the Region

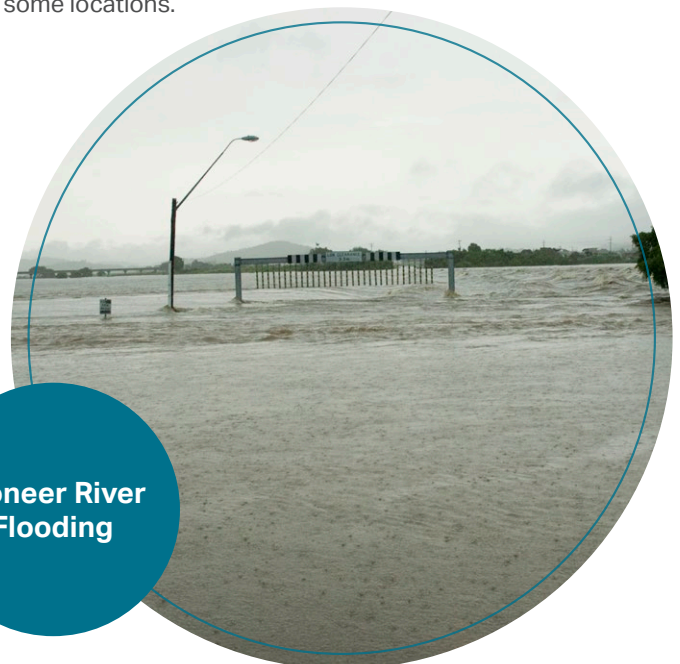
Most flooding in the region is caused by rainfall, either in the form of riverine flooding or overland flows. Other types of possible flooding are coastal tidal flooding, storm surge and tropical cyclones.

2.2.1 Riverine and Creek Flooding

Riverine and creek flooding is caused when the runoff from major storms exceeds the channel capacity of a river or creek and overflows onto the surrounding floodplain.

With adequate rainfall monitoring and flood warning systems: riverine and creek flooding can be predicted in terms of extents and timing. It can generally be known in advance when and where a river or creek is likely to overflow its banks, so advance warnings and preparations can be made accordingly.

The City of Mackay is built on the banks of the Pioneer River, as are the satellite townships of Finch Hatton, Mirani, Mariani and Walkerston. Levee systems have been implemented to provide a level of flood protection from the Pioneer River in some locations.



Pioneer River Flooding

2.2.2 Overland Flooding

Overland floods, or flash floods, occur when runoff from storms exceeds the capacity of the underground and overland drainage systems. When this occurs, water begins to flow over the surface of the land along natural flow paths or valleys towards the nearest creek or river.

Overland flows usually occur with little or no warning following intense rainfall, often associated with short duration thunderstorm activity. They can be localised or widespread depending on the path or extent of storm activity.



**Urban
Catchment
Flooding**

2.2.3 Coastal Tides and Storm Surge

Ocean tides can affect normal sea levels and cause flooding along the coastline and lower reaches of the Pioneer River and other creek systems, especially when combined with high rainfall.

However, the tidal effects along an estuary or river diminish with distance inland.

Storm surge is another mechanism that can affect water levels along coastal areas. Storm surge occurs through a combination of low barometric pressure, strong winds and large waves. It is generally uncommon for extreme rainfall events and extreme storm surges to occur simultaneously, albeit the 1918 event in Mackay is an example of this occurring.



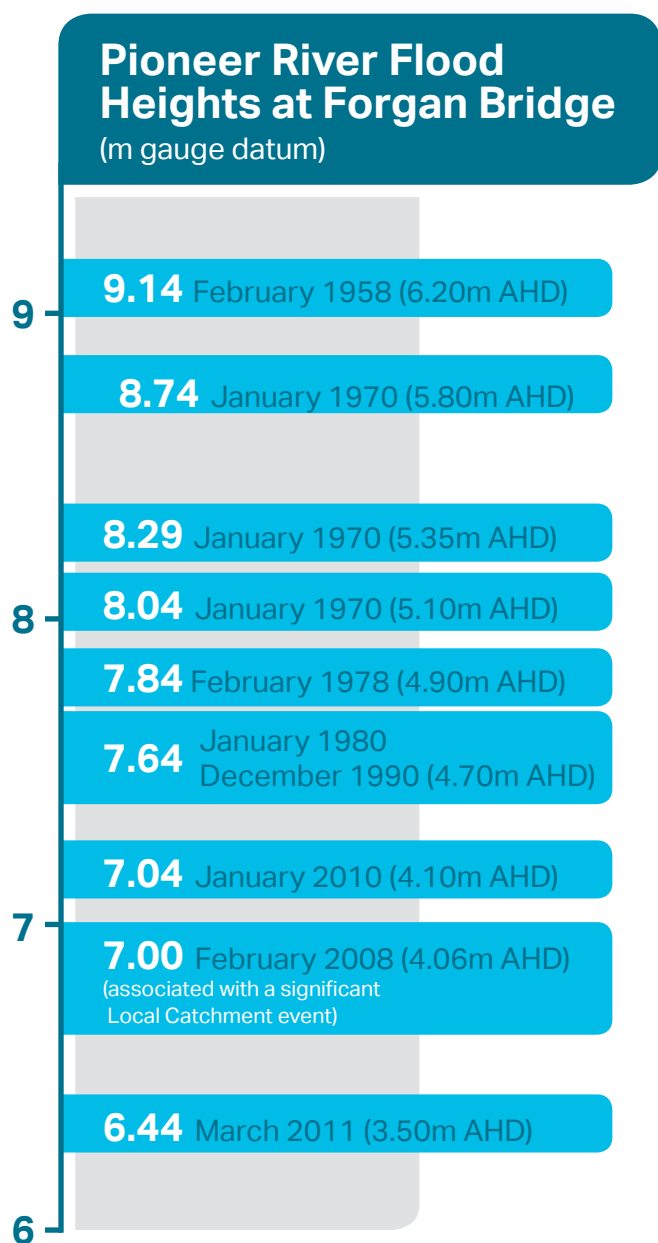
**Coastal
Inundation at
Slade Point**

2.3 Region's Flood History

The Mackay region has a long history of flooding dating back to the 1860's, caused by each of the three aforementioned flooding mechanisms;

- Riverine and Creek Flooding – Typically extended, high intensity rainfall in the upper catchment of the Pioneer River with widespread impacts.
- Overland/Flash Flooding – Very high intensity local rainfall events which vary considerably in duration and extent, although generally impacts are most severe at a 'suburb' level.
- Coastal Tides and Storm Surge – Generally associated with the presence of a tropical cyclone near the coast.

A sample of notable events are summarised below.



2.3.1 1918 – Storm Surge

The storm surge of 1918 remains widely regarded as the most significant natural disaster in the regions history, claiming 22 lives and causing hundreds of injuries whilst destroying approximately 75% of the building stock in Mackay (Wright, B. 2008).

The event was caused by the coincidence of heavy rainfall, 55 inches (1397 mm) in 3.5 days, with an intense tropical cyclone crossing the coast causing a storm surge of approximately 3.7 m combined with tide to produce a storm tide level of approximately 5.4 m AHD. The impacts of the event were exacerbated by extreme winds and the lower engineering and building standards of the time.

2.3.2 1958 – Riverine Flood

The Pioneer River has experienced a number a significant floods, including Cyclone Eline which caused a major shift in the location of the mouth of the river in 1898 (Wright, B. 2008). The 'Foulden Flood' which occurred on 18, February 1958 is regarded as the largest documented flood in the Region. In terms of river height at Mackay city, the event is significantly larger than any other on record, as shown on the Pioneer River Flood Heights at Forgan Bridge (refer to image to the left).

The size of the flood was caused by heavy rainfall in the upper catchment, 34.58 inches (878mm) at Finch Hatton in the 24 hrs to 9am on 18/02/1958. More than half of the regions average annual rainfall fell in one day and generated large flows in the Pioneer River and its tributaries. These flows reached Mackay which was already saturated having received 30.74 inches (781mm) of rain in the three days leading up to the event.

South Mackay was severely flooded when the river broke its banks at the Shakespeare Street/Nebo Road corner (Wright, B. 2008). However, the flood is most well known for removing the entire settlement of Foulden, which occupied the northern bank of the Pioneer River roughly downstream of Edmund Casey Bridge. 136 people were rescued from Foulden and Cremorne, while ultimately two lives were lost to drowning and one person was declared missing (Wright, B. 2008).

2.3.3 Recent Floods – Overland Floods

Historically, Pioneer River flooding has been well documented due to the concentration of the population adjacent to the River. Local catchment floods are not as well documented as the impacts from these floods are generally not as widespread. As the population has expanded away from the river, these events are becoming well documented and their impacts more severe. Two 'recent' events, the 1990/1991 flood, and the 2008 flood in the Gooseponds Creek catchment both caused significant flooding, however, were a result of very different rainfall patterns.

The 1990/1991 flood occurred when Cyclone Joy brought heavy rainfall to the region which lasted over ten days. The event saw significant rises in the level of the Pioneer River; however, the river did not break its banks. The event did however cause widespread flooding including the suburb of Bucasia, which due to the sandy soils of the area is generally not affected. However, the relentless, persistent heavy rainfall saturated the ground and eventually overwhelmed the drainage network.

The 2008 flood, which occurred on 15 February 2008, was very different with 736 mm of rainfall unofficially recorded in less than six hours, and flood waters receding by midday the next day. The most intense rainfall fell over the Gooseponds Creek catchment with severe flooding impacting the suburb of Valetta Gardens. Less severe flooding was widespread over Mackay urban areas. While no lives were lost, more than 4,000 houses were flood damaged, contributing to a total estimated insured loss of \$410 Million (Historical Disaster Statistics, ICOA).

The flood history of Mackay demonstrates the diverse nature of potential flood patterns in the region, and the requirement for robust flood and stormwater management strategies which consider all flooding mechanisms.

2.4 The Impact of Flooding

Floods can be dangerous to people. Drownings and injuries can occur, and floodwaters can become contaminated with sewage and other pollutants that pose health risks to the community.

The economic impact of flooding is generally measured by the amount of damage caused, which includes the following damage types:

- Direct tangible damages → structural damage to buildings and building contents for residential, commercial and regional infrastructure.

- Indirect tangible damages → losses associated with community disruption including economic and social activities. Costs associated with emergency response, clean up and community support is included in indirect tangible damages, as are the costs attributed to disruption to employment and transportation etc.
- Intangible damages → despite their significance, these damages are not able to be measured in financial terms, as they include social aspects such as trauma, stress etc.

Tangible damage from flooding can be measured in monetary or other quantifiable terms, i.e. dollar costs, numbers of houses or businesses affected or destroyed. Data on tangible damage is relatively easy to determine from insurance claims and replacement costs.

Large floods can cause damage that runs into the hundreds of millions of dollars. However, they rarely occur. Smaller floods that occur more frequently don't cause as much damage individually, but collectively the damage is significant. To better understand the risks of damage to areas identified as subject to flooding, the likelihood and consequences of flooding need to be considered.

By standardising or averaging damage, unit losses can be assigned to enable an estimation of damage. Flood damage significantly increases once flooding occurs above floor level, causing damage to household contents such as floor coverings, curtains, furniture, plaster, particleboard and painted surfaces.

During this strategy high level tangible flood damages were calculated for independent flood mechanisms (where all required data was available). Only a limited number of design events were assessed (i.e. 1% AEP for the majority of areas, with the 0.5% AEP being assessed for the Alligator Creek catchment and the 2% AEP also being completed for the Pioneer River).

High level estimates of Tangible Flood Damage for separate flood mechanisms are shown below. This estimate takes into account all potential direct and indirect tangible damage – that is, the level of damage that would occur if no remedial action of any kind were undertaken to reduce exposure to damage. It does not include the intangible impacts of flooding.

The initial findings highlight that the Pioneer River is the key driver for tangible flood damage within the Mackay region. The significant reduction in flood damages between the 1% AEP and 2% AEP Pioneer River flood events is, in part, due to the flood protection benefits provided by the Pioneer River levee system up to the 2% AEP flood magnitude.

2.5 Future Flood Risk

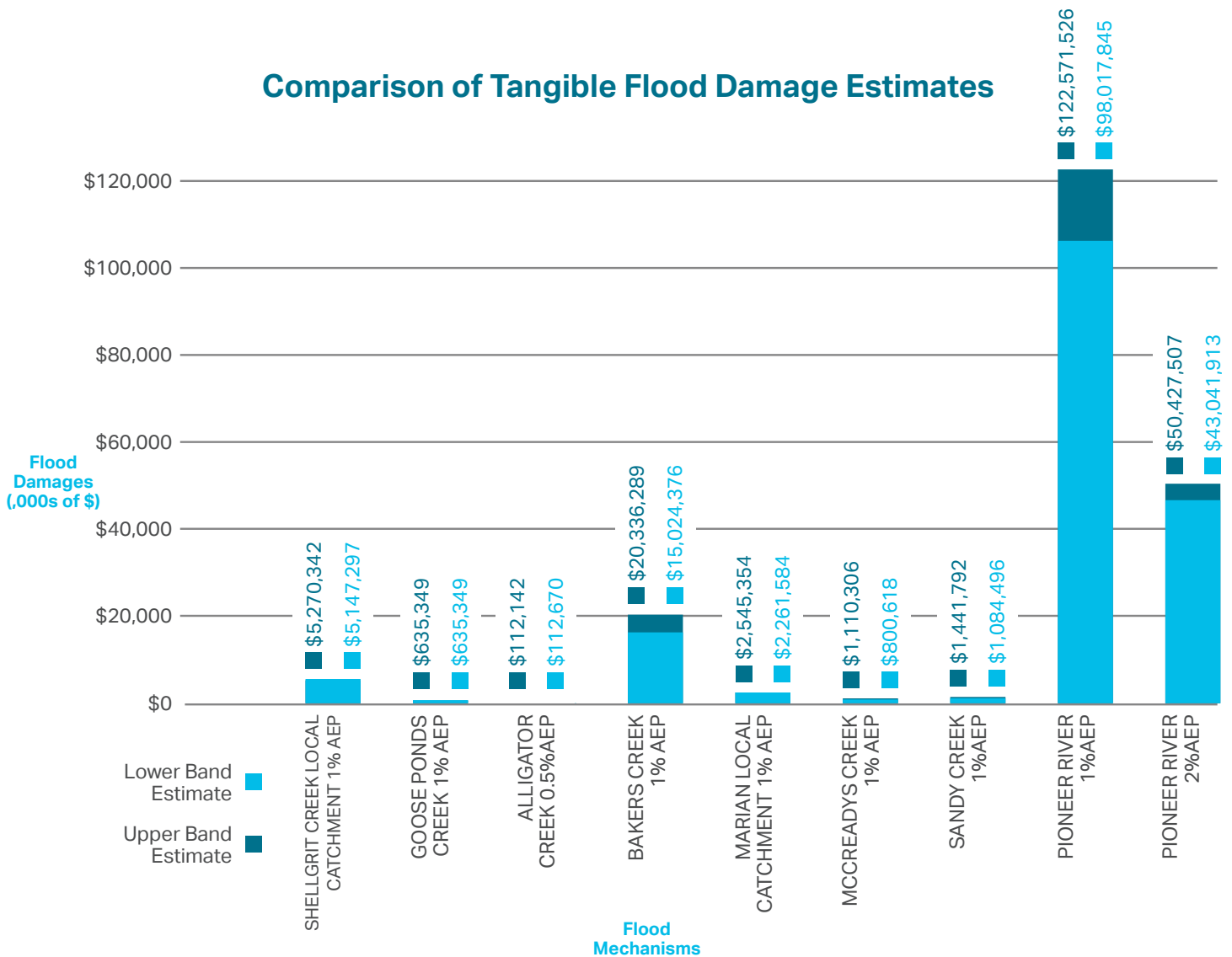
Prediction of future flood risk in the Mackay region is directly linked to the projected impacts of climate change. Increases in rainfall intensity, sea level rise, storm tide levels and extreme weather may impact the frequency, magnitude, duration and damage caused by flooding in the future.

This means that extreme flood events may occur more frequently which, when combined with predicted increases in sea levels and storm tides, clearly shows that a flexible strategy is required. It is imperative that this Strategy be capable of incorporating new data and technology, as our understanding of climate change impacts improves into the future.

2.6 Residual Flood Risk

Generally the aim of flood mitigation strategies is to protect people against a design level of flooding. The risk of flooding above this design level of protection, or the Defined Flood Event (DFE), is referred to as 'Residual Risk'. For example, residential buildings in the Mackay Regional Council area are required to design their habitable floor level above the 1% Annual Exceedance Probability (AEP) flood level plus a nominal amount of freeboard. The risk of flooding above this level would be the residual risk for residential buildings in the Mackay region.

Comparison of Tangible Flood Damage Estimates



2.7 Emergency Management

There are a number of key organisations who have a role in flood and stormwater risk management, including prevention, preparation, response and recovery activities. Council is the floodplain manager for the Mackay region and is supported by:

- Emergency services (Police, Fire, Ambulance);
- State Emergency Service (SES);
- Local Disaster Management Groups;
- Urban Development Institute of Australia (UDIA);
- State Government departments, such as Department of Natural Resources and Mine (DNRM) and Department of Infrastructure, Local Government and Planning (DILP);
- The Federal Government, particularly during the recovery phase; and
- Communities, individuals and businesses.

2.8 Current Trends

2.8.1 Flood Hazard Trends

While future flood predictions are generally based on historical flood data, climate change is likely to change the frequency, magnitude, extent and duration of flooding. Therefore future flooding is likely to differ in behaviour from historic flooding.

With the application of currently accepted ranges of climate change characteristics to flood estimation and prediction, an improved prediction of future flood trends can be realised. It is however important to understand that there is a fundamental degree of uncertainty in future flood predictions, as a result of unforeseen and largely uncontrollable influences.



2.8.2 Flood Exposure Trends


With flood hazard trends showing an increased potential for larger magnitude and more frequent flooding, exposure to flooding is likely to increase in the future, particularly as the population rises. The extent of increased flood exposure is dependent on land use intensification, particularly in areas susceptible to flooding.

There is also likely to be an increase in vulnerability as property values increase, in conjunction with increased assets that are kept on those properties. However, advances in engineering design have reduced structural vulnerability during flood events.

2.8.3 Community Expectations and Council's Role

Council have previously undertaken Community Attitude Surveys in 2009 and 2014 which provide information on residents' expectations in relation to Management of Emergency Events. Data collated in each survey suggests that residents' satisfaction in Council's management of emergency events has risen significantly between 2009 and 2014.

While the community's expectations of Council to predict, mitigate and respond to flooding are likely to exceed Council's capacity, it is important for Council to apply sound floodplain management principles to adapt to the challenge of flooding into the future.



Flooding is a naturally occurring phenomenon and Council have taken a leading role in floodplain management in the Mackay region.

2.8.4 Population Estimates and Development Projections

As at June 30, 2015 the estimated resident population within the Mackay Regional Council local government area was approximately 123,700 persons. The population has grown by approximately 34,000 persons from 2001 to 2015, with the region experiencing historic high annual population growth above 2% between 2002 and 2013. From mid-2013, the population growth has stabilised due to a decline in migration to the region. Refer to the figure below.

The Mackay region population is projected to grow from 123,700 (2015) to approximately 171,000 persons by 2036 (Queensland Government population projection, 2015 Edition, medium series).

Mackay Regional Council's draft planning scheme proposes to accommodate the projected population growth through focused urban expansion in the 5 key urban areas of Mackay, Walkerston, Sarina, Marian and Mirani. This includes urban expansion in the north and south of the Mackay urban area, northern Sarina, and southern Marian and Mirani.

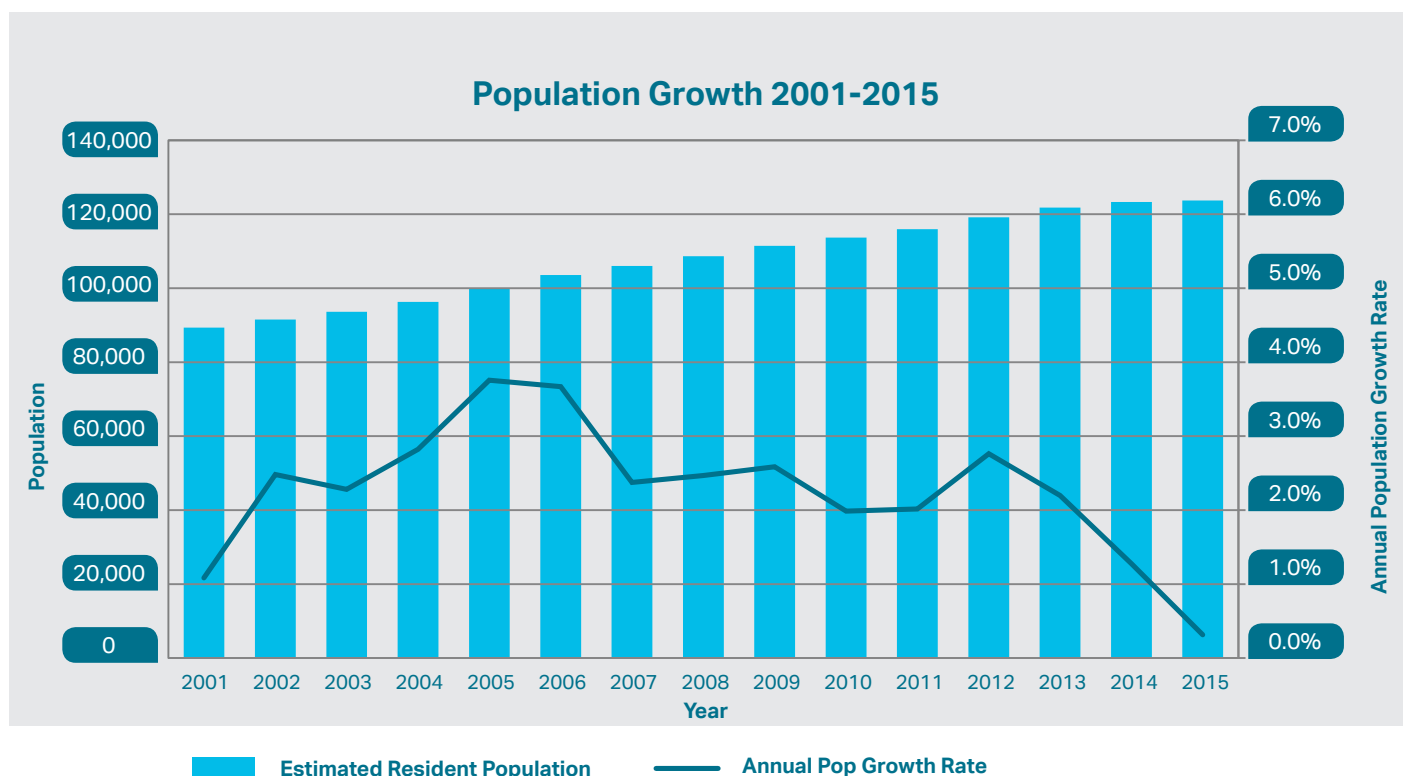
2.8.5 Flood and Stormwater Management Asset Trends

Significant investment has been made in flood and stormwater management assets over a number of years.

As a result of the Mackay Region's long history and continued growth, these assets vary in age from those recently constructed to the many significant facilities originally constructed as brick line sewer pipes, which may be up to 100 years old. In addition, Council also manages and maintains a variety of stormwater assets that are located on state controlled land and under state controlled roads.

Since approximately 1990, significant growth in assets from approximately 150 kilometres to 529 kilometres of stormwater culvert has occurred.

This growth and the demands of aging infrastructure stock means that this infrastructure needs to be continually maintained and renewed. This is to ensure that it continues to meet the service delivery and safety requirements of the community, now and for future generations.



2.9 Best Practice Management

Commonwealth, State, regional and local authorities, as well as local communities and individuals all have a vital role to play in flood and stormwater management.

The scope of flood management is described within the context of three overlapping activity clusters: prevention, response and recovery.

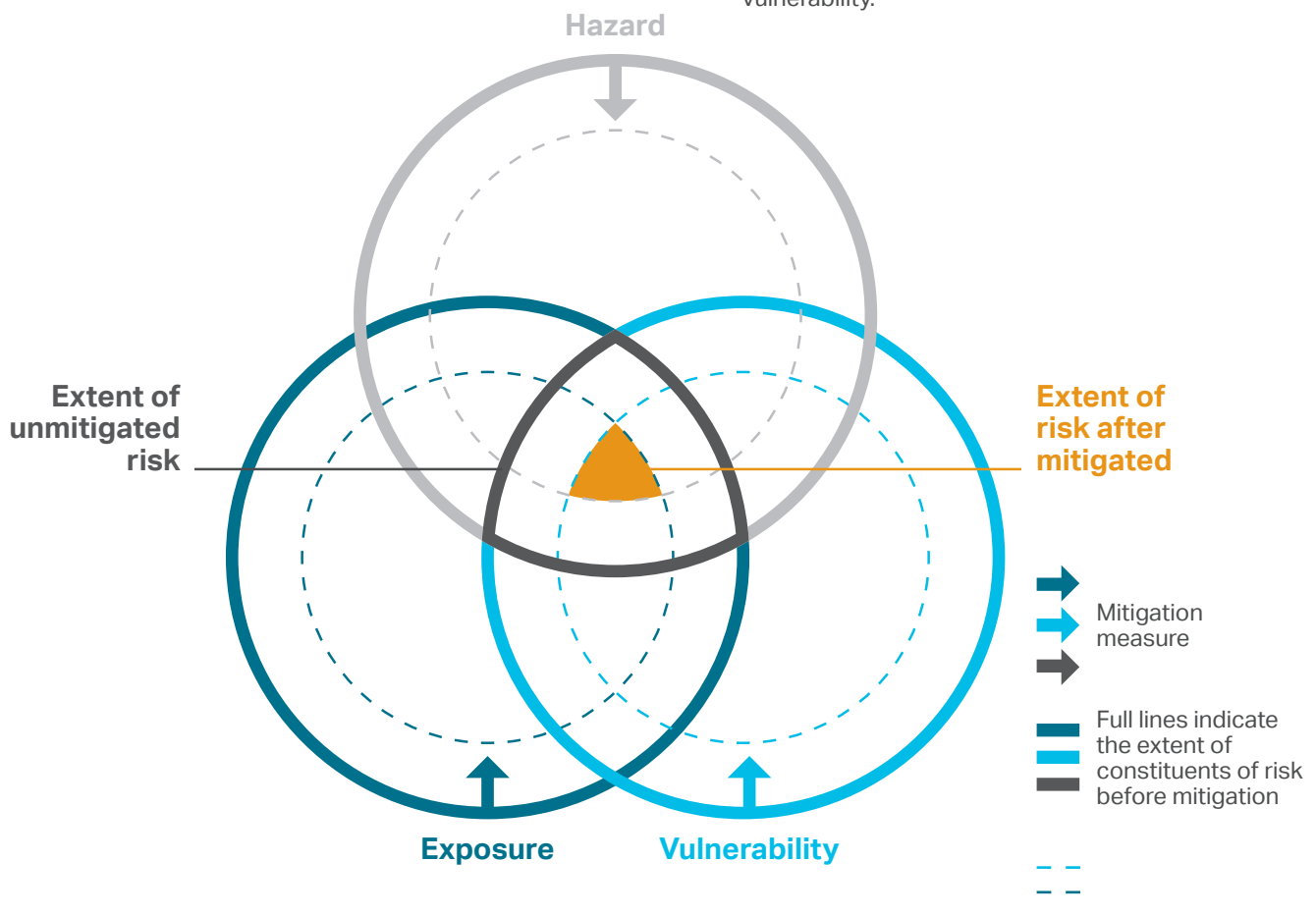
Prevention: Activities aimed at eliminating or reducing the incidence or severity of emergencies and the mitigation of effects.

Response: Activities undertaken to combat emergencies and provide rescue and immediate relief services.

Recovery: Activities aimed at providing assistance to people and communities affected by emergencies to enable them to achieve a proper and effective level of functioning.

Best practice flood risk management has been incorporated into this strategy, as follows:

- All facets of flood risk are to be managed including **existing, future** and **residual** risk.
- Flood management measures are to be technically sound and sustainable, environmentally, socially and financially.
- Flood risk will change over time, dependent on changes in hazard, exposure and vulnerability to future risk.
- Understanding of natural processes will drive flood management measures, which are to be interconnected with these processes where practicable.
- Disturbance of natural processes will be minimised, with engineered intervention utilised only where there is a risk to human life or significant infrastructure.
- There is a role for the broader community in managing flood risk.
- Flood management not only addresses risk but also water resource utilisation and catchment management principles.
- Flood risk mitigation will focus on reduction of the three elements of risk, namely hazard, exposure and vulnerability.





3 The Strategy

3.1 Overarching Vision

Mackay's vision for the future is to:

- boast an active, healthy community that is resilient
- manage and deliver infrastructure that enhances the region.

The flood and stormwater strategy is an integral component that will help Council to understand and identify key issues relevant to flood and stormwater management to allow Council to make more informed decisions on planning policy and infrastructure investment required to more effectively mitigate the risk and impact of flooding.

The Strategy prioritises areas most at risk, explores community expectations, focuses on cost-effective solutions and balances growth planning with responsible asset management.

This strategy delivers a strategic support system to assist decision making and will assist Council's actions for flood and stormwater risk management during the next ten years, fulfilling its strategic vision as follows.

Flood and stormwater risks in the Mackay Region are actively managed to minimise the consequences to life, assets, community wellbeing, the environment and the economy.



3.2 Objectives of the Strategy

Objectives of the Strategy are outlined below:

- Manage flood and stormwater infrastructure in an integrated way, ensuring the sustainable use of physical resources.
- Ensure flood and stormwater management considerations are integrated into Council's decision making and future projects are prioritised based on defined criteria using a transparent process.
- Ensure flood and stormwater asset renewals are proactively managed at reducing risk, using current condition data and agreed levels of service.
- Understand and meet the demands of growth through demand management and infrastructure investment.
- Continuous improvement in asset management practices.
- Cost effective collection, storage, analysis and sharing of data throughout the organisation, external stakeholders and the community.
- Educate and raise the awareness in the community about flood / stormwater water management and potential flood risk.
- Build capacity and capability within Council and the community to develop an understanding of flood risk, risk management and response and recovery that will reduce the social, economic and environmental impacts of flood events.



3.3 Strategic Outcomes

Council's strategy for managing flood and stormwater risks focuses on five key themes – governance and leadership, asset management, data sharing and management, emergency management and community engagement and awareness.

Strategic outcomes associated with each focus area are presented below. These present a framework for prioritising future projects as part of Council's wider budget process.

STRATEGIC OUTCOMES	BACKGROUND INFORMATION
Governance and Leadership	
<ol style="list-style-type: none"> 1. Reduced flood risk for the Mackay region community. 2. Continue to review development, building and planning controls to support the management of existing, future and residual risks. 3. Further assessment, evaluation, design and delivery of flood and stormwater management infrastructure projects. 	<p><i>This part of the Strategy directs Council's organisational management of flooding to demonstrate its commitment to the treatment of flood risk through the implementation of a 10 year Implementation Plan.</i></p> <p><i>Council's planning documents and practices continue to respond to the risks posed by flooding. A planned response is required that considers community expectations and meets associated legislative obligations.</i></p> <p><i>Assessing and delivering the best-value flood and stormwater management infrastructure measures is important to address existing flood risk for high hazard areas within the region.</i></p>
Asset Management	
<ol style="list-style-type: none"> 4. Ability to more efficiently manage infrastructure renewal projects using a risk based approach. 5. Integrated data and asset management systems that allow information to be more easily managed and accessed. 6. Better understanding of drainage and flood management infrastructure current condition and liabilities, with clear prioritisation for remediation / renewals. 	<p><i>Council's stormwater and flood management assets require ongoing management and renewals to provide the level of service and flood protection benefits expected by the community. Action is required to ensure that critical infrastructure continues to provide its intended function in the event of flooding.</i></p>
Data Sharing and Management	
<ol style="list-style-type: none"> 7. Flood data and risk information is produced and shared to meet the Mackay region's priorities and needs. 8. Flood decision makers have up-to-date information, and the skills and capacity they need to be effective. 	<p><i>This part of the strategy aims to formalise flood and stormwater information management practices, including data sourcing, storage, communications and data dissemination processes.</i></p>
Emergency Management	
<ol style="list-style-type: none"> 9. Emergency management planning underpinned by high-quality planning and flood information. 10. Integrated warning systems providing flood prone communities with services matched to their risks. 	<p><i>This part of the Strategy aims to ensure specific issues relating to flood response and recovery are addressed in Council's Emergency Planning policies and procedures.</i></p>
Community Engagement and Awareness	
<ol style="list-style-type: none"> 11. Facilitate improved community awareness to enable them to better respond to flooding, and enhance resilience. 12. Provide information to enable more resilient construction and design of property. 	<p><i>A strategic engagement and awareness focus acknowledges that Council cannot manage flood risk in isolation, or without support from other agencies and levels of government. Council and the community will need to be informed and educated to take action in response to flood risks and management.</i></p>



4 Key Actions

This section outlines the actions required to deliver the vision, objectives and strategic outcomes of this strategy and to make progress against key performance indicators.

4.1 Identification of Sub-Strategies

The process undertaken to assess measures that can improve resilience to flooding has identified a number of areas where targeted sub-strategies will assist with the implementation of the Strategy. These strategies include:

- Governance Sub-Strategy
- Asset Management Sub-Strategy
- Data Management Sub-Strategy
- Emergency Management Sub-Strategy
- Community Engagement Sub-Strategy

The standalone sub-strategies (not included in this strategy document) have been developed to provide further information to support Council in completing each action.



4.2 Governance and Leadership Actions

STRATEGIC OUTCOME 1

Reduced flood risk for the Mackay region community.

ACTIONS	
<p>1. Review Council's Corporate Governance Framework and Organisational Structure to embed flood and stormwater risk management principles</p>	<ul style="list-style-type: none"> • Seek to achieve consistency in Council's policies and procedures with regards to flood and stormwater management. • Clearly define roles and responsibilities with respect to flood and stormwater management. • Improve communication processes between key departments delivering flood and stormwater management actions. • Articulate the strategy actions and outcomes to internal stakeholders (including Councillors).
<p>2. Undertake continuous review of Council's legal responsibilities with respect to flood and stormwater management under applicable Federal and State Legislation</p>	<ul style="list-style-type: none"> • Council's legal counsel to regularly liaise with state and federal agencies, as well as the Local Government Association to review legal responsibilities associated with flood and stormwater management.
<p>3. Engage and collaborate with local and regional flood and stormwater management stakeholders.</p>	<ul style="list-style-type: none"> • Collaborate with relevant State and Federal Government Agencies and other key stakeholders (including surrounding Councils) to share knowledge. • Strengthen existing relationships with local stakeholders who contribute to flood and stormwater management. • Review consultative arrangements between State Agencies and Council. • Seek to align Federal, State and Local Government flood and stormwater management initiatives.
<p>4. Ensure the ongoing delivery, monitoring, reporting and evaluation of the Strategy.</p>	<ul style="list-style-type: none"> • Consider the implementation of a Steering Committee to manage the ongoing implementation of the Strategy. • Seek to appoint a Floodplain Management Officer within Council to support the ongoing delivery of the Strategy actions, as well as associated projects and initiatives. • Assess completion of strategy outcomes against agreed performance measures.

STRATEGIC OUTCOME 2

Further assessment, evaluation, design and delivery of flood and stormwater management infrastructure projects.

5. Continue to assess and prioritise investment in flood and stormwater infrastructure projects using the multi criteria frameworks developed.	<ul style="list-style-type: none">• Undertake half yearly reviews of the Prioritisation Framework and utilise the MCA frameworks to score and prioritise new projects / initiatives, as well as re-scoring current projects using additional information available through ongoing technical assessments.• Monitor the delivery of structural management projects, assessing:<ul style="list-style-type: none">- project construction costs against estimated costs,- design and construction periods- the effectiveness of risk management processes and treatments put in place.
6. Develop a project delivery framework to support the ongoing delivery of the 10 year prioritisation framework.	<ul style="list-style-type: none">• Develop a structured project delivery framework which is used to deliver projects and initiatives in the Prioritisation Framework. The framework should outline specific processes in relation to project identification, evaluation, safety, quality assurance and governance arrangements.• Prepare feasibility assessments, business cases, detailed designs, cost estimates and economic appraisals in accordance with the project delivery framework for all major flood and stormwater infrastructure projects outlined in the Prioritisation Framework.

STRATEGIC OUTCOME 3

Continue to review development, building and planning controls to support the management of existing, future and residual risks.

7. Continue to incorporate flood and stormwater management principles into strategic planning decision making.	<ul style="list-style-type: none">• Continue to include flood hazard maps and other relevant information in the planning scheme and planning policies.• Maintain and continually improve planning and development guidelines for flood prone land in high risk areas.• Continue research and modelling to understand the possible flood effects of urban growth and infill development across the region.
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4.3 Asset Management Actions

STRATEGIC OUTCOME 4

Ability to more efficiently manage infrastructure renewal projects using a risk based approach.

ACTIONS	
<p>8. Continue to develop and implement a structured Asset Management Framework for all Council asset classes (including flood and stormwater drainage assets)</p>	<ul style="list-style-type: none"> • A four tier Asset Management Framework should continue to be developed, which includes: <ul style="list-style-type: none"> - Asset Management Policy: a statement of intent and guiding principles that informs the Council's Corporate Business Plan; - Asset Management Strategy: the key component of objectives and measures as the enabler or informing strategy for Asset Management; - Asset Management Plans: individual Asset Class Plans (Tactical and Operational) that inform Business Unit Plans and the Long Term Financial Plan and Corporate Business Plan; and - Evaluation of Process and Plans: Annual business processes that ensure compatibility of all asset management practices to both legislative and business requirements. • Promote and raise awareness of asset management to the Council, staff, users and the community. • Ensure appropriate resources and funding for asset management activities are made available to integrate Asset Management Policies, Asset Management Strategies and Asset Management Plans into the corporate governance framework. • Deliver asset management awareness and targeted training programs across the Council organisation.
<p>9. Develop, implement and undertake periodic reviews of a Flood and Stormwater Asset Management Plan.</p>	<ul style="list-style-type: none"> • Using the International Infrastructure Management Manual as a guide, document required allocation of funding and improvement plans for flood and stormwater management assets, using the principles of lifecycle analysis. • The individual Asset Management Plan should address Risk Management by way of developing, monitoring and reporting on individual Risk Management Plans for respective asset classes as per the Council's Risk Management Framework.

10. Support increased robustness in drainage and flood management asset renewals by developing a 10 year capital budget forecast.

- *Develop and implement maintenance, refurbishment and capital works, (refurbishment/renewal), programs in accordance with the Asset Management Plan.*
- *Undertake periodic reviews, ensuring efficient and effective use of Council funds and optimising "life cycle" cost of all assets.*
- *Utilise ongoing inspection and condition assessment data to prioritise asset renewals and undertake financial projections over a 10 year forward plan.*

STRATEGIC OUTCOME 5

Integrated data and asset management systems that allow information to be more easily managed and accessed.

ACTIONS

11. Develop and implement procedures that ensure Council's Asset Databases are maintained and updated.

- *Fully reconcile Council's Asset Management and GIS systems and implement processes to ensure 'as constructed' information is input into both systems moving forward (i.e. ADAC guidelines).*
- *Implement processes to ensure all capital works projects, planned works and other relevant Council information is spatially mapped and linked to relevant information databases.*
- *Structure both future capital budget planning and expenditure by way of four categories:*
 - *New works;*
 - *Upgrade works;*
 - *Renewal (replacement) works; and*
 - *Expansion works.*
- *Implement procedures aimed at ensuring a structured data checking and verification process is carried out by asset management staff.*

STRATEGIC OUTCOME 6

Better understanding of drainage and flood management infrastructure current condition and liabilities, with clear prioritisation for remediation / renewals.

ACTIONS

12. Continue to undertake an annual program of inspections and condition assessments for open channels and the underground stormwater networks.

- *Undertake, at minimum, an ongoing annual program of CCTV inspections of the existing underground stormwater network (target 5% of the network per annum). Inspections should incorporate a condition assessment in accordance with relevant industry guidelines.*
- *Continue to inspect open channels and drains annually, preferably prior to each wet season. Undertake condition assessments as part of the inspection program.*

<p>13. Implement a formal operations and maintenance plan for the Pioneer River Levee System.</p>	<ul style="list-style-type: none"> • <i>Develop an Operations and Maintenance Manual for the Pioneer River Levee System in accordance with the QLD Levee Regulations and International Levee Handbook.</i> • <i>Establish procedures for periodic visual inspections of the levee system, including ongoing condition assessments.</i> • <i>Establishment of procedures for comprehensive inspections of the levee system at a frequency determined through further risk assessment.</i> • <i>Compilation of all operations and maintenance records, procedures, inspection data and design information in a centralised Data Book.</i> • <i>Establishment of procedures for ongoing maintenance of the levee system. These works should initially target lower risk defects identified in the Flood Levee condition assessment report.</i>
<p>14. Progress high priority asset renewals / remediation works for flood and drainage assets.</p>	<ul style="list-style-type: none"> • <i>Immediately undertake further investigations, design and construction of remedial works to address priority areas identified in the Flood Levee condition assessment report.</i> • <i>Undertake further investigation, design and construction of renewals / remediation of Condition Rank 4 and 5 portions of the underground stormwater network as noted in the Stormwater Network condition assessment report.</i> • <i>Undertake further investigation, design and construction of approximately 800m of open channel bank protection rectification works required in approximately 15 locations.</i>
<p>15. Review tenure arrangements for existing flood and drainage assets.</p>	<ul style="list-style-type: none"> • <i>Review current tenure arrangements for all flood and stormwater management assets – including survey and valuation to establish costs to acquire land to allow Council ongoing access to maintain and operate these assets.</i>

4.4 Data Sharing and Management Actions

STRATEGIC OUTCOME 7

Flood data and risk information is produced and shared to meet the Mackay region's priorities and needs.

ACTIONS

<p>16. Undertake a structured data collection program to ensure up to date information is available for use in future flood hazard and mitigation studies.</p>	<ul style="list-style-type: none"> • <i>Develop a data collection program to collect information, before, during and after flood events, to inform future investigations. The collected data should include: surveys of key infrastructure, residential building floor levels (i.e. terrestrial LiDAR), waterway bathymetry, Aerial Laser Survey, rainfall, waterway discharge, flood levels, stream gauges, rainfall gauges location and features of vulnerable elements (such as community infrastructure and census data).</i>
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<p>17. Identify and deliver priority flood mapping and risk assessment projects for the region, in collaboration with key stakeholders.</p>	<ul style="list-style-type: none"> • Continue to undertake flood hazard studies, initially focussed on existing urbanised catchments such as: Andergrove, Beaconsfield, Mt Pleasant, Glenella, West Mackay, Paget, McCreadys Creek South and Bakers One. • Ensure flood study outputs are consistent with current best practice guidance and are in accordance with Council's existing guidelines. • Undertake a detailed Floodplain Management Plan for the Pioneer River system. The study should include a detailed flood damages assessment using terrestrial LiDAR, feasibility assessments of structural and non-structural mitigation works (including the South Mackay Levee), further levee failure impact analyses and development of a detailed implementation plan which links to the outcomes of this Strategy. • Undertake damage modelling to estimate flood damage to residential/commercial buildings and infrastructure to support the economic evaluation of flood and stormwater management projects.
<p>18. Implement a process for periodic reviews of existing flood hazard studies.</p>	<ul style="list-style-type: none"> • Processes should be implemented to ensure that existing flood hazard studies (and outputs) are regularly reviewed and updated to utilise new data which may be available and reflect updates to industry standards and technologies.
<p>19. Review and update Council's flood modelling and mapping guidelines.</p>	<ul style="list-style-type: none"> • Periodically review and update flood modelling and mapping guidelines and processes, in alignment with state and national standards, and in consultation with key stakeholders.

STRATEGIC OUTCOME 8

Flood decision makers have up-to-date information, and the skills and capacity they need to be effective.

ACTIONS	
<p>20. Review current procedures and processes and make sure that up-to-date information and data is as accessible as possible, and can be used by those who need it.</p>	<ul style="list-style-type: none"> • Review current information sharing processes, in consultation with stakeholders, and identify where the type, format, and timeframe of information sharing could be improved. • Prepare and implement procedures for sharing Council flood hazard study outputs and modelling software with key stakeholders. Ensure these procedures link to the future development of a Public Flood and Stormwater Information Portal.
<p>21. Aim to improving the knowledge and skills of key stakeholder who participate in flood and stormwater management within the region.</p>	<ul style="list-style-type: none"> • Identify and prioritise flood management knowledge and capacity gaps for the region, using stakeholder input. • Lead targeted knowledge and capacity building programs to address priority gaps.
<p>22. Develop a public flood and stormwater information portal.</p>	<ul style="list-style-type: none"> • Continue to develop standards which define terminology, content and database standards for communication to various departments within Council as well as engineering consultants and other external contributors. • Develop an Information Portal through a phased approach, where initial efforts will involve collection and dissemination of currently available and basic information. Future efforts will focus on obtaining and providing access to increasingly robust and diverse data sets developed based on updated guidelines that will be implemented to ensure consistent outputs from future government funded flood studies.

4.5 Emergency Management Actions

STRATEGIC OUTCOME 9

Emergency management planning underpinned by high-quality planning and flood information.

ACTIONS	
23. Develop a formal Emergency Manual for the Pioneer River Levee System.	<ul style="list-style-type: none"> Develop an Emergency Manual for the Pioneer River Levee System in accordance with the QLD Levee Regulations and International Levee Handbook.
24. Review and update business disaster recovery/resilience plans	<ul style="list-style-type: none"> Review LDMP (Local Disaster Management Plan), sub Plans and Council's Departmental Emergency Response Plans annually. Review Council's existing business disaster recovery and resilience plans, ensuring that impacts due to each individual flood mechanism is understood and managed. Ensure that plans are periodically reviewed and updated when new flood hazard information is available.
25. Undertake further investigations and develop strategies around evacuation routes and alternative access for single road access communities.	<ul style="list-style-type: none"> Review the "need to evacuate" or assess whether a "stay in place" strategy be supported in certain areas of the region. Ensure the findings are communicated to the community. Undertake a comprehensive review of key evacuation routes with respect to flood immunity, submergence times and closure heights for all applicable flood mechanisms. Review the need for passive and active road signage to relay warnings, advise of flooded roads, and provide other emergency information for key evacuation routes. Review the need for road upgrades or the development of alternative evacuation routes for isolated communities. Document procedures and triggers for road closures, and communicate these to the community.

STRATEGIC OUTCOME 10

Integrated warning systems providing flood prone communities with services matched to their risks.

ACTIONS	
26. Continue to review flood warning systems across the region to ensure they provide a fit-for-purpose service proportionate with risks, including urban stormwater and flash flooding, and update or expand where appropriate.	<ul style="list-style-type: none"> Continue to support the operation of stream and rainfall gauging networks and data management systems, to support flood prediction and warning services. Review gauging needs for localised urban catchment flooding and develop business cases to support funding decisions. Liaise with BoM to assess the benefits of upgrading the Mackay Rainfall Radar to a Doppler Style radar system to support predictive flood warnings. Undertake a business case for the development of a predictive flood warning system based on river levels and rainfall records. Assess the potential for linkages to other technologic devices (i.e. SMS alerts for the communities at risk). Increase the number of Council staff with a thorough and comprehensive knowledge of the warning and alerting systems to be able to monitor, interpret, analyse and act upon critical rainfall and river height data. Develop formal documentation and training materials to support this action.

27. Review flood warning programs across the region to ensure alignment with updated state and national standards and guidelines.

- Engage with vulnerable groups regarding specific needs in the emergency awareness area.
- Undertake periodic reviews of Council's flood warning system and emergency management procedures against current state and federal guidelines.

4.6 Community Engagement and Awareness

STRATEGIC OUTCOME 11

Facilitate improved community awareness to enable them to better respond to flooding and enhance resilience.

ACTIONS

28. Enhance collaborative partnerships within the community.

- Empower communities in flood risk areas to protect their own safety and to reduce damage to their properties during flood events.
- Facilitate community input into policy formulation and decision making for flood risk management.
- Promote and inform the community about the Pioneer River Levee System and limitations.
- Investigate incorporating 'flood markers' as a part of community infrastructure and artwork to enhance community awareness to flooding risks and what river height gauge means in a community environment.
- Partner with insurance companies and other stakeholder to promote joint community awareness campaigns. Seek out cost sharing initiatives/opportunities and collective benefits.
- Ensure and promote the communication of a consistent message related to flood and stormwater management.

29. Undertake a range of flood and stormwater risk awareness programs and campaigns, with input from relevant stakeholders.

- Develop a rigorous Communication Action Plan for the ongoing delivery of awareness programs and campaigns. Review financial and resourcing requirements to meet the objectives of the Action Plan.
- Use a range of communication and engagement mechanisms to provide ongoing opportunities for stakeholder and community participation in key flood and stormwater management projects.
- Develop and regularly evaluate Council's awareness and preparedness programs, with input from relevant authorities
- Review existing public information sharing processes for accessibility and, where necessary, improve them in consultation with stakeholders.
- Where necessary, deliver targeted education for vulnerable communities with input from community service organisations.
- Promote community self-resilience, self-preparedness and neighbours assisting neighbours.

30. Advocate on behalf of Council and the community for improved flood management outcomes.

- Communicate Council's flood risk management outcomes to the insurance industry with the aim of improved services and acknowledgement of risk mitigation (i.e. levee system).
- Advocate for improved communication between the three levels of government on flood risk management.

STRATEGIC OUTCOME 12

Provide information to enable more resilient construction and design of property.

ACTIONS

31. Clarify and implement planning instruments to include flood resilient materials and design for buildings

- Encourage redevelopment and renovations with more flood resilient materials and design.
- Identify a list of building materials, products and applications that are more flood resilient.
- Partner with key stakeholder to promote flood resilient building products.
- Provide information on using flood-resilient building materials to the development industry, as well as making available to general public.
- Lobby government, statutory authorities and key stakeholders regarding legislating / promoting the use of more resilient building products in building constructions.
- Lobby insurance companies for insurance incentives for residents that build with flood resilient solutions.





5 Delivering the Strategy

5.1 Prioritisation of Supporting Projects and Initiatives

The key actions identified in Section 4 aim to achieve the vision and objectives of the Strategy. The identified actions propose changes to Council's core asset management, design and maintenance activities which will influence current and future improvements to flood and stormwater management. This supports immediate improvement in development, capital works and maintenance outcomes so that future problems are not created and current problems are not exacerbated.

The Strategy aims to place due emphasis on the need to make the changes to the overall planning principles and guidelines to ensure there is consistency of approach to all aspects of flood and stormwater management. Capital works should be undertaken based on a strong foundation of planning, regulatory frameworks and education. — — —

It is noted that the actions outlined in the Strategy are purposely broad and the successful completion of each action will require the delivery of a number of supporting projects and initiatives.

Individual projects and initiatives have been compiled to support the delivery of the key actions, and have been identified by reviewing existing information and consulting with external stakeholders, and individual Council staff. This process resulted in the identification of 158 individual projects and initiatives put forward for consideration.

A robust ranking and prioritisation method was an essential part of the strategy to ensure that the individual projects / initiatives were appropriately prioritised and that the decision making process was transparent. A detailed prioritisation process has been used to capture various benefits and costs associated with each individual project, whilst taking into account other variables deemed to be important by key stakeholders. Assessment frameworks have been developed to support a scoring and ranking process undertaken during the strategy development.

A 10 year prioritisation framework has been developed to support the delivery of the strategy actions, and has been based largely on the outcomes of the scoring and ranking process. The prioritisation framework includes some of the high scoring projects / initiatives in totality, as well as the initial investigative steps in some other higher scoring actions that would take considerable time, resources and potentially funding to implement further, if considered warranted.

The implementation plan includes non-structural and structural management projects as well as potential future development projects. Implementation should generally follow assigned priorities; however it is important not to miss opportunities when they arise because a particular action has not been identified as the next one to be undertaken. Opportunities will arise in a number of circumstances such as:

- Funding becomes available for programs that align with a particular action or group of actions e.g. coastal protection;
- Another program being implemented can absorb or support an identified action, including community-based programs;
- Major developments come on line earlier than anticipated;
- A community priority supports implementing an action; and
- An action is a predecessor to another action that can be undertaken more quickly than originally thought.



5.2 The Prioritisation Framework

Allocating the right resources to the implementing the framework requires finding a balance between Council's obligations, community expectations and other competing demands.

A schedule has been developed by allocating funding to the highest ranked projects. Projects that have longer lead times or are required to enable other projects to be efficiently undertaken have also been allocated funding in the initial stage of the 10 year framework.

It is expected that Council will be able to use the framework to make informed decisions in the future on whether or not to accelerate or defer, or even not implement, noting:

- The short term works and actions have been chosen to give maximum priority benefit while also being readily implementable within envisaged affordable budgets. Implementation is still, however, subject to this albeit limited funding - customarily allocated year by year.
- The longer term initiatives are still needed - to address the assessed gaps and deficiencies of current management. The definition of these longer term initiatives is subject to future review before the short term works and actions are completed. Implementation of longer term flood management initiatives for the Mackay region would be subject to available future funding. It is important that these longer term initiatives are not excluded, since future communities and Governments will then have opportunity to decide what level of funding is appropriate for ongoing implementation – either accelerated or deferred.

5.3 Ongoing Use of the Framework

The framework represent a useful tool to capture benefits and compare and prioritise projects over the next 10 years to support delivery of this strategy. The result of the process is a list of ranked projects that can be worked through systematically by Council.

While the list forms a sound basis for implementing works, it should be continually reviewed to capture:

- Additional information that better informs project costs
- Further analysis that may better define the benefit
- Changing community priorities or expectations
- Implementation of projects that may make other projects redundant
- Projects that may be complementary may be undertaken simultaneously
- New projects as a result of completed projects or newly identified issues.

A framework for delivering projects identified in the MCA is illustrated below and aims to capture key processes around:

- Project identification
- Further assessment and evaluation
- Safety
- Quality assurance
- Program Control Group



5.4 Monitoring, Reporting and Evaluation

The implementation of the Strategy relies on various Council departments and external agencies to, not only implement the actions identified, but to be involved in regular information exchange to support ongoing delivery.

The Strategy has identified a large number of structural and non-structural projects that are aimed at building resilience to flooding through community education, improved preparedness, more efficient management of data and better infrastructure management.

As the Strategy is implemented it will be beneficial to monitor the performance of individual initiatives, rate how well they have met their objectives and, where necessary, modify how future projects are undertaken to improve outcomes. It is recommended that a Steering Committee be put in place by Council to manage delivery of the Strategy. The Steering Committee should set Key Performance Indicators (KPI's) for each Strategic Outcome which is monitored annually. It is suggested that these KPI's be aligned to Council's current Corporate and Operational Plans.

Continual community engagement will form a significant component in assessing the performance of the non-structural projects and to what extent their objectives have been met. This will help inform what initiatives should be continued and what format is more effective in promoting flood awareness.

Monitoring of structural projects will be an important aspect as the Strategy is implemented and should assess:

- Project construction costs against estimated costs.
- Design and construction periods.
- How well construction impacts to the community are limited and what techniques have worked well.

Monitoring of the construction works will help improve how efficiently future works are implemented and provide greater certainty around the cost and timing required to deliver the total Strategy.

The prioritisation framework projects should be routinely assessed and the expected benefit compared to what has been observed from previously completed projects. Importantly, the Strategy is a living document and should be updated and modified as projects are implemented and new priorities emerge.



5.5 Governance Considerations

The Strategy has articulated a series of actions (with associated projects and initiatives) aimed at managing flood and stormwater risk throughout the Mackay Region. Successful implementation of the strategy is key to enabling the organisation to address ongoing risk posed by flooding.

Successful implementation of the Strategy will rely on the implementation of corporate governance elements, such as:

- Clear direction in resource allocation, in terms of long term financial planning and annual budgeting.
- Accountability that is realised through the development of a project delivery framework, and evaluation of outcomes against the relevant performance measures outlined in this document.
- Integration of flood and stormwater risk management into Council business and service delivery.
- Undertaking the required capacity building and ensuring communication within the organisation is conducive to delivering the strategy outcomes.

Abbreviations

AECOM	AECOM Australia Pty Ltd
ADAC	Asset Design and As-Constructed
AEP	Annual Exceedence Probability
AHD	Australian Height Datum
BOM	Bureau of Meteorology
CCTV	Closed Circuit Television
DFE	Defined Flood Event
DNRM	Department of Natural Resources and Mine
DSDIP	Department of State Development, Infrastructure and Planning
GIS	Geographical Information Systems
HAT	Highest Astronomical Tide
LiDAR	Light Detecting and Ranging
LDMG	Local Disaster Management Group
LDMP	Local Disaster Management Plan
MCA	Multi Criteria Analysis
MHWS	Mean High Water Springs
QLD	Queensland
SES	State Emergency Service
UDIA	Urban Development Institute of Australia

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