

**Australian Government** 





# Reef 2050 Wetlands Strategy

A strategy to manage wetlands in the Great Barrier Reef and its catchments

#### Prepared by: Queensland Wetlands Program, Department of Environment, Science and Innovation

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The Department of Environment, Science and Innovation acknowledges Aboriginal peoples and Torres Strait Islander peoples as the Traditional Owners and custodians of the land. We recognise their connection to land, sea and community, and pay our respects to Elders past, present and emerging.

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#### Acknowledgments

This Strategy has been developed with the assistance and input of many stakeholders, including the Queensland, Australian and local governments, the Great Barrier Reef Marine Park Authority, members of the Great Barrier Reef Wetlands Network and Queensland Wetlands Governance Group, First Nations representatives, and many other organisations involved in catchment and wetlands activities to improve the Great Barrier Reef.

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### First Nations acknowledgement

We acknowledge the continuing management and custodianship of Country across the Great Barrier Reef Region by its Traditional Owners whose rich cultures, heritage values, traditions, enduring connections and shared management efforts continue to protect land, sea and sky Country for future generations. We pay our respect to their Elders, past, present and emerging.

We recognise the continuous living culture of Aboriginal and Torres Strait Islander peoples – their diverse languages, customs and traditions, knowledges and systems – and the deep relationship and responsibility to Country as integral to their identity and culture.

We thank Traditional Owners for their enduring stewardship and protection of the Great Barrier Reef for thousands of generations – and for their ongoing guidance and partnership in the shared efforts to protect the Great Barrier Reef.

Aboriginal people and Torres Strait Islander people are the first peoples of Australia. An Aboriginal or Torres Strait Islander is a person of Aboriginal or Torres Strait Islander descent who identifies as an Aboriginal or Torres Strait Islander and is accepted as such by the community in which he or she lives. In this Plan, the terms 'Aboriginal and Torres Strait Islander' and 'Indigenous' are used interchangeably, depending on context, but mean the same thing.

Traditional Owners are the Aboriginal and Torres Strait Islander people who have ongoing traditional and cultural association with the land and sea Country of the Great Barrier Reef, and possess rights and interests under Traditional Laws, Customary Lore and Australian and Queensland government laws.

### Ministers' Foreword

The Great Barrier Reef (Reef) is one of the most biologically diverse and valuable ecosystems on Earth and is recognised as being globally significant for its outstanding universal value. The Reef is visited by over a million people each year who experience its amazing sea-life and natural beauty. It is culturally important as sea Country for the Reef's First Nations Peoples and is a treasured Australian icon.

The Reef is intimately connected to adjacent Queensland landscapes. Reef catchment ecosystems play a critical role in maintaining the high biodiversity, aesthetic and cultural values of the Reef. This is particularly true for its wetlands which connect the Reef and its catchments. Wetlands play a significant role in capturing and processing pollutants from water flowing into the Reef lagoon, provide pathways for fish and other aquatic species to migrate and habitat for species including birds and turtles. Wetlands are also valued by people for their livelihood, health, recreation and appreciation.

Climate change is altering the natural processes and conditions that the Reef and its species rely on. Changes to ocean temperatures and acidification, increased sea levels, altered fire regimes and more intense weather events are impacting the health of the Reef, its corals, fish, plants and many other species. In addition to addressing climate change, we need to reduce other pressures on the Reef to increase its resilience.

The Australian and Queensland governments are committed to ensuring the Reef is conserved for future generations. The *Reef 2050 Long-Term Sustainability Plan (Reef 2050 Plan)* provides the overarching direction to improve the Reef's health. It highlights the value of wetlands in contributing to Reef resilience and ecosystem health.

The revised *Reef 2050 Wetlands Strategy* continues to provide the framework for the improved management of wetlands in the Great Barrier Reef catchments. It adopts a whole-of-system, values-based approach that recognises how the various parts of the system work together to provide services that are valued by people and needed to maintain a healthy catchment and healthy Reef.

The *Reef 2050 Wetlands Strategy* will guide the work of a network of dedicated landholders and managers who are undertaking coordinated, efficient and effective actions to improve wetland management. We thank them for their conservation efforts and commitment to improve wetland and Reef health.

-urbenl

**The Honourable Tanya Plibersek** Australian Government Minister for the Environment and Water

**The Honourable Leanne Linard** Queensland Government Minister for the Environment and the Great Barrier Reef, Minister for Science and Innovation

### Contents

First Nations acknowledgement
Ministers Foreword
Part A.   Introduction and context
Purpose6
Implementation11
Governance13
Vision13
Wetlands definition14
Outcomes15
Principles
Importance of wetlands in Reef catchments
Pressures on wellands
whole-of-system, values-based framework23
Part B.   Wetlands and treatment systems for improving water quality
In Reef catchments
Water quality of the Great Barrier Reef
Treatment train approach to improve water quality.
Wetland processes to improve water quality
Information tools and mechanisms
Dert C   There exists and incentions and estivities
Part C.   Themes, goals, objectives and activities
Theme 1   Improving wetlands information for decision making and action
Theme 2   Wettallu plaining
Theme 4   Engagement education communication and capacity building
Theme 5   Monitoring evaluation reporting and improvement
A due suide deservate
ACKNOWledgements
Glossary65
References

### Part A. | Introduction and context

#### **Purpose**

The Reef 2050 Wetlands Strategy: A strategy for managing wetlands in the Great Barrier Reef and its catchments (Strategy) provides the overarching direction for wetland science, planning, coordination and management in the Great Barrier Reef (Reef) and its catchments (see figure 1). It promotes a coordinated approach among the many government and non-government organisations, Traditional Owners and Custodians of Country, landowners and managers, businesses and industries involved in wetland and catchment management activities. It draws on the strengths of the previous Wetlands in the Great Barrier Reef Catchments Management Strategy 2016-2021 and its ongoing implementation through the Queensland Wetlands Program.

The Strategy supports the objectives and outcomes of the *Reef 2050 Long-Term Sustainability Plan* (Reef 2050 Plan). Developing and implementing the Strategy is a key action under the Reef 2050 Plan (action 2.2) to increase effective land management practices with a focus on the values of wetlands and their catchments. It sits alongside the *Reef 2050 Water Quality Improvement Plan* and helps drive progress towards the water quality targets (see figure 2).

The Strategy also seeks to provide wider benefits to the environment and communities. It adopts a whole-of-system, values-based approach to wetland management which considers management at multiple scales, including the catchment scale, and the services and values wetlands provide. It recognises people as central to decision making and promotes management responses and practices that achieve multiple benefits. By adopting this approach, the Strategy assists to implement many other International, National, State and local policies and agreements. These include international wetland and migratory bird bilateral agreements, Australia's Strategy for Nature 2019-2030, the National Climate Resilience and Adaptation Strategy 2021 – 2025, **Queensland's Environmental Protection (Water** and Wetland Biodiversity) Policy 2019 (EPP Water and Wetland Biodiversity), Queensland's Climate Action Plan, and Conserving Nature: a Biodiversity Conservation Strategy for Queensland. The Strategy supports outcomes for the Reef as well as the catchment and provides opportunities for wetland management activities to align with the Great Barrier Reef Marine Park Authority priorities.



The Great Barrier Reef (Reef) is an international icon and valued as Australia's most acclaimed natural asset for its unique biodiversity, cultural significance, and immense ecological scale.

The Reef is the largest coral reef in the world. It contains an abundance of marine life with over 3000 individual reef systems and coral cays. It includes more than 2000 square kilometres of mangroves and about 6000 square kilometres of seagrass beds. Photograph: Gary Cranitch  $\ensuremath{\mathbb{C}}$  Queensland Museum

A wide range of animals rely on the Reef, including over 1600 fish, more than 450 species of coral, six of the world's seven species of marine turtle and one of the world's most important dugong populations. The Reef has been listed as a World Heritage Area in recognition of its Outstanding Universal Value.

The *Reef 2050 Wetlands Strategy* contains three parts. Part A provides the background and context for the Strategy, the overarching vision, outcomes, principles, governance and implementation advice.

Part B outlines how natural wetlands and constructed wetland treatment systems can play a large role in improving poor water quality, and how wetland rehabilitation and engineered solutions can enhance this role. Part C identifies the goals, objectives and activities that will contribute to achieving the vision and outcomes.



Figure 1. Great Barrier Reef catchments.

#### Reef 2050 Long-Term Plan

The Great Barrier Reef is sustained as a living natural and cultural wonder of the world



Improving and integrating knowledge about the flow of water across the catchment, and connections between land and sea, is important for minimising impacts. This helps to give a more complete understanding of how the catchment functions in a whole-of-system sense. (Reef 2050 Plan)



"natural wetlands have an important function of nutrient processing and can reduce pollutants before they reach the sea."

(Reef 2050 Plan)

Wetland and treatment systems contribute to improved water quality

Improved water quality supports wetland function and their capacity to maintain Reef ecosystem health Reef 2050 Water Quality Improvement Plan (Reef WQIP)

"Wetlands connect catchments to the Reef. They reduce the impacts of floods and help to filter catchment run-off."

(Reef WQIP 2017-2022)

Figure 2. Relationship between the Reef 2050 Long-Term Sustainability Plan, Reef 2050 Water Quality Improvement Plan and the Reef 2050 Wetlands Strategy.

Photograph: Gary Cranitch © Queensland Museum





Photograph: Gary Cranitch © Queensland Museum

#### Reef 2050 Plan and the Reef 2050 Wetlands Strategy

The Reef 2050 Plan's vision is supported by goals and strategic actions under five work areas:

- 1. Limit the impacts of climate change
- 2. Reduce impacts from land-based activities
- 3. Reduce impacts from water-based activities
- 4. Influence the reduction of international sources of impact
- 5. Protect, rehabilitate and restore.

The Reef 2050 Wetlands Strategy objectives and activities support the delivery of the Reef 2050 Plan. The Strategy seeks to reduce impacts from a range of threats, pressures and activities occurring in the Reef and its catchments by adopting a wholeof-system, values-based approach to wetland management.

Consistent with the Reef 2050 Plan, effective delivery of the Strategy will be supported through:

- Collaboration and Partnerships
- Science and Knowledge
- Monitoring, Evaluation and Adaptive Management
- Investment.

#### Implementation

The Strategy provides guidance for all levels of government, non-government organisations, Traditional Owners and Custodians of Country, landowners and managers, industry and individuals involved in land use activities associated with, or impacting, wetlands. It applies to all wetlands within the Reef, its catchments, and the associated systems that relate to wetlands (see figure 1 and Wetland Definition).

The Strategy should be used to inform:

- developing and implementing operational and land use plans and programs, and strategic planning documents such as Water Plans, Natural Resource Management Plans and Regional Plans
- planning for, and undertaking, on-ground works and activities
- research programs and projects, monitoring frameworks and continual process improvements.

The Strategy's objectives and activities seek to embed nature-based solution approaches into wetland management across a range of Reef, climate change, water quality improvement, biodiversity and offsets programs. The outcomes support multiple environmental benefits which may be of interest to the private sector and investors. Funding bodies should consider the Strategy when assessing proposals for projects that deliver multiple benefits including improved wetlands. Wetland management activities within the Reef and its catchments will be recorded and regularly updated with information from wetland managers and stakeholders. It is a key process to track progress on the Strategy's activities and identify implementation gaps.

The Strategy is an adaptive document and will be reviewed every five years, following reviews of the *Reef 2050 Plan*. Updates may be required in response to new information or priorities for wetland protection and management.

Photograph: Gary Cranitch © Queensland Museum





Photograph: Gary Cranitch  $\ensuremath{\mathbb{C}}$  Queensland Museum

### Great Barrier Reef Marine Park Authority and the Reef 2050 Wetlands Strategy

The Great Barrier Reef Marine Park Authority (the Reef Authority) is Australia's lead management agency for the Great Barrier Reef. The Reef Authority works with government, industry and community on programs and projects to build reef resilience and manage and protect the Reef.

The Reef Blueprint for Resilience, the primary output of the 2017 Reef Summit, signals the actions the Reef Authority and its partners will take to strengthen the Reef's resilience. The Blueprint identifies 10 key initiatives which fall under four broad categories:

- Building a resilience network
- On-ground actions
- Empowering people
- Fostering change.

The Reef Authority's roles extend to regulating activities that can occur in the Reef, undertaking compliance, policy development and on-ground projects to improve reef health. The Reef Authority also has a key role leading research, monitoring and reporting on Reef health. The Reef 2050 Integrated Monitoring and Reporting Program provides a knowledge system to support management of the Reef and its catchments. The Great Barrier Reef Marine Monitoring Program surveys and reports on the health of inshore coral, seagrass and water quality each year. Every five years, the Reef Authority publishes an Outlook Report that examines the Great Barrier Reef's health, pressures and likely future.

The Strategy provides a range of objectives and activities for managing wetlands within the Reef's catchments to improve Reef health. As many of the inshore reefs, seagrass beds, mud and sandflats and other reef ecosystems are also wetlands, the Strategy aligns and has strong links with achieving the outcomes sought by the Reef Authority and can assist in achieving activities to address pressures on the Reef.

#### Governance

This Strategy is a whole-of-government initiative. It has been developed through the Queensland Wetlands Program, which is overseen by the Queensland Wetlands Governance Group (QWGG). The QWGG includes members from key Queensland Government agencies, the Australian government, and non-government stakeholder groups. The purpose of the QWGG is to provide strategic advice and support implementing, monitoring and reporting on the Strategy. The QWGG also raises awareness of the Strategy and the need to improve wetland values in the Reef and its catchments.

#### Photographs: Gary Cranitch © Queensland Museum

#### Vision

Wetlands are managed throughout the Reef and its catchments by a network of landowners, managers, Traditional Owners, Custodians of Country, scientists, government officials, industry and volunteers to:

- maintain sustainable, healthy ecosystems
- support ongoing production and prosperity
- contribute to healthy communities
- support the Great Barrier Reef to be a living natural and cultural wonder of the world.







#### Wetlands definition

Wetlands are areas of permanent or periodic/ intermittent inundation, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres. To be a wetland the area must have one or more of the following attributes:

- at least periodically, the land supports plants or animals that are adapted to and dependent on living in wet conditions for at least part of their life cycle, or
- the substratum is predominantly undrained soils that are saturated, flooded or ponded long enough to develop anaerobic conditions in the upper layers, or
- the substratum is not soil and is saturated with water or covered by water at some time.

Lakes, swamps, marshes, billabongs, rivers, creeks, fens, peat bogs, saltmarshes, mudflats, and mangroves are all wetlands. Queensland even has underground wetlands. Wetlands can include marine plants (e.g. seagrass), coral and other Reef species and form part of the wider Reef area.



#### **Outcomes**

The Strategy will contribute towards the following outcomes:

- Wetlands that connect to the Reef lagoon are healthy, functioning ecosystems due to proactive and shared management, contributing to healthy landscapes, a sustainable economy and a healthy Reef.
- There is a community of well-connected landowners and managers across all Reef catchments, working consistently towards collective goals to protect, manage and improve the health of wetlands for the many intrinsic values and ecosystems they provide.
- Management is informed by integrated and available scientific, economic and cultural information, gathered by different sectors working collaboratively to increase knowledge.

- Traditional Owner knowledge informs management programs and on-ground activities, and cultural values are celebrated and managed respectfully.
- Information and knowledge informs the development of management tools and program, policy, legislation and investment decisions to ensure the wise use of resources and achieve value for money.
- The community understand the benefits they receive from wetlands and supports wetland conservation and management.
- Improvements to the health of Reef catchments, wetlands and the quality of water entering the Reef are measured and understood through ongoing monitoring programs.

Photograph: Gary Cranitch © Queensland Museum



#### **Principles**

The following principles underpin the vision, outcomes, goals, objectives and activities of the Strategy and will guide effective wetland management.

- Freshwater wetlands, Reef catchments and the Reef lagoon form an interconnected natural and cultural system. The condition, functioning and targeted rehabilitation of the entire system is important for the long-term health of the Reef.
- Wetlands play numerous roles including connecting species from catchments to the Reef lagoon, providing protection from wave action and storms, sequestering carbon, reducing the impacts of floods, buffering from sea level rise and providing habitat for fish and other species.
- Wetlands are valued for a range of beneficial services they provide to different people, such as for recreational activities, fisheries, clean water supply and agricultural production.
- For millennia wetlands have been highly valued by Traditional Owners and Custodians of Country for diverse uses and their cultural and spiritual significance
- Wetlands have values in their own right, independent of human uses (intrinsic values) and are valued purely because they exist (existence values).
- Avoiding and managing threats to wetlands helps maintain their intrinsic values, existence values and the services they provide to people.
- Reducing the adverse impacts of pollutants on wetlands (including the Reef) and their services can be improved through constructed treatment systems, and by increasing the extent, management and rehabilitation of natural wetlands.
- The use of wetlands for water quality improvement should not impact their intrinsic and existence values and other ecosystem services they provide.
- A holistic approach to protecting, maintaining and rehabilitating wetland systems should consider biophysical, social, economic and cultural requirements at a catchment scale, integrated with an understanding of how catchments function, together with ecosystems in their receiving waters (i.e. a whole-of-system, values-based framework).

This is critical to develop appropriate, effective ecological rehabilitation and management activities.

- Scientifically robust, systems based, culturally aware information is needed to effectively understand and manage all aspects of wetlands.
- Information and data on wetlands should be based on FAIR (findable, accessible, interoperable, reusable) principles.
- A combination of statutory and non-statutory mechanisms and a shared management approach among management agencies and stakeholders is needed to achieve maximum environmental, social and economic benefits and ensure activities within the catchment to support Reef resilience.
- Ongoing investment through a range of mechanisms is needed to deliver wetland management activities that achieve effective and multiple benefits within Reef catchments and for the Reef lagoon.
- Communicating and connecting with, supporting and educating the many landowners, groups and community members involved in wetland activities is essential to achieving coordinated, effective and value for money outcomes.
- An adaptive management approach incorporating monitoring, evaluation, reporting and improvement is needed to assess the adequacy of wetland management activities. It can also help identify if different approaches are needed, identify new threats and appropriate management responses early.

#### How this Strategy was developed

The Strategy was developed collaboratively with stakeholders involved in activities related to wetlands in the Great Barrier Reef catchments. It was informed by recommendations from an independent review of the Wetlands in the Great Barrier Reef Catchments Management Strategy 2016-2021. Input was sought from Australian and Queensland governments, the Great Barrier Reef Marine Park Authority, local governments, the Queensland Wetlands Governance Group, natural resource management groups, the Great Barrier Reef Wetlands Network (Network) and Reef 2050 Advisory Committee. Independent advice was sought on Traditional Owners and Custodians of Country interests and activities. This included input from Reef Traditional Owner Steering Group members and Traditional Owner and Custodians of Country representatives on the Network.

Stakeholder groups with an interest in wetland and land management within the Reef catchment including conservation and environment organisations, universities, scientists, the agricultural industry and ports representatives were also involved in the Strategy's development.



Photograph: Gary Cranitch © Queensland Museum

#### **Importance of wetlands in Reef catchments**

Freshwater and coastal (estuarine and marine) wetlands in the catchments of the Great Barrier Reef play a vital role in the overall health and condition of the broader Reef ecosystem. The Reef is closely connected to the adjacent lands and its ecosystems which help maintain the high biodiversity, aesthetic and cultural values of the Reef. Much of the Reef lagoon is also a wetland.

Wetlands are made up of many parts that interact with the surrounding environment to create functioning ecosystems. These, in turn, provide important ecosystem services that are valued by the community including for economic, social, cultural and ecological purposes. Wetlands have values in their own right, independent of the benefits they provide to people, and are also valued by people purely for their existence.

Wetlands provide important habitat and valuable refuges for birds and other wildlife including nurseries for fish and other freshwater and marine species. They provide pathways for species to migrate and maintain ecological connectivity throughout catchments.

Wetlands buffer the impacts of extreme weather such as storms, cyclones and extreme high tides. Wetlands also reduce the impacts of floods, slowing the speed of water and delaying water rising in lower catchment areas. Wetlands can respond to climate change impacts by providing a buffer for rising ocean and estuarine water levels, reducing carbon in the atmosphere, providing pathways for species migration Environmental values (EVs) and water quality objectives (WQOs) are being progressively determined for Queensland waters. EVs define how water can be used (e.g. for drinking water, irrigation, aquaculture, recreation etc). WQOs define objectives for the physical, chemical and biological characteristics of water (e.g. nitrogen content, dissolved oxygen, turbidity, toxicants, fish etc).

EVs and WQOs are listed in the Environmental Protection (Water and Wetland Biodiversity) Policy 2019. They ensure that Queensland's water environment is clean and healthy while allowing for ecologically sustainable development. Protecting Queensland wetlands is also important. The wetland environmental values established under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 relate to the:

- processes and components that support the biological integrity of wetlands
- biological diversity within and between wetlands
- biological diversity of wetland types.

Water quality and ecosystem health | Environment | Department of Environment, Science and Innovation, Queensland (des.qld.gov.au)

Photograph: Gary Cranitch © Queensland Museum



from temperature changes and storing water for times of drought. Potential changes in the frequency and intensity of extreme weather events highlight the value of wetlands in reducing climate change impacts.

Wetlands improve water quality which provides a range of benefits to people and the environment including clean drinking water, water for stock and crops, places for recreation and habitat for native species. Wetlands do this by trapping and reducing or removing pollutants such as nutrients and pesticides from the aquatic system. Some wetlands and treatment systems help capture run-off from urban or



Photograph: Gary Cranitch © Queensland Museum

agricultural areas, enabling it to be treated to remove or significantly reduce pollutant loads. Wetlands and riparian areas also reduce soil erosion and sediment loads flowing downstream and into the Reef lagoon by slowing the flow of water, stabilising banks and binding the soil. More information on how wetlands contribute to improved water quality is provided in Part B.

Many wetlands and their species have cultural values for Traditional Owners and Custodians of Country and are embedded into their cultural identity. They exist within their Lore or Law systems and their song lines, which signify rights and obligations to care for Country. Wetlands are used and valued for many reasons and activities including for living and camping, hunting, as inspiration for creative pursuits, for their spiritual significance and other cultural practices.

Wetlands are also valued for social, recreational, economic and aesthetic reasons such as fishing, swimming and nature appreciation. Wetland tourism is important across Reef catchments with highly visited board walks and boating tours. Wetlands provide areas for volunteers to work on enhancing the health of the wetlands system. This improves awareness of wetlands and personal wellbeing while also providing environmental outcomes. More information about the values and services of wetlands can be found at Wetland*Info* Wetland services. **Ecosystem services** are the many and varied benefits provided to humans by the natural environment.

These include such things as natural pollination of crops, clean air and water, extreme weather mitigation and mental and physical well-being.

Ecosystem services provide benefits that support human life including food and drinking water and decomposing waste.

Ecosystem services provided by wetlands worldwide are valued in the trillions of US dollars every year, making a vital contribution to human health and well-being.

With the global population set to increase to nine billion people by 2050, increasing pressure on water resources and the threats posed by climate change, the need to maximise these benefits has never been greater.

Wetland services and values (Department of Environment, Science and Innovation)

#### **Pressures on wetlands**

Freshwater and coastal wetlands in Reef catchments have been extensively modified or lost over the past 100 years. Wetlands have been impacted by changes in land use including agricultural production, industry and urban development. This has led to extensive losses of freshwater wetland and forested ecosystems, particularly in floodplains. Increased demand for agricultural production, access to resources and urban expansion compete with retaining wetlands and adjacent riparian vegetation. As the demand for alternative land use and impacts of climate change increase, there is a risk of further declines in wetlands extent and health.

Pressures on wetlands vary depending on factors including the type of wetland, intensity or frequency of the pressure, landscape setting and the management practices for mitigating impacts. Pressures affecting a wetland may be located a long way from the wetland itself. For example, a dam at the top of a catchment may significantly alter the hydrology of a downstream wetland. Pressures on wetlands include:

- weeds and invasive animals
- land development including land clearing and irrigated agriculture leading to changes in salinity
- drainage and water extraction
- excessive land-based run-off of nutrients, pesticides and sediments
- altered fire regimes
- pollutants, plastics and other rubbish
- climate change.



Photographs: Gary Cranitch © Queensland Museum

Wetland modifications within a catchment generate multiple, compounding impacts that have flow on repercussions to the Reef. Clearing wetlands and exposing soil allows sediment and nutrients to enter the Reef and increases the risk of generating acid sulphate soil. Sediment can smother coral and seagrass, while increased levels of phosphorus and nitrogen in run-off can promote the growth of algae that compete with Reef ecosystems and change the life cycle of wetlands. Suspended sediment restricts the light that coral and seagrass ecosystems need for photosynthesis and harms filter feeding organisms such as clams and the gills of fish. Increased sediment and nutrient run-off also impacts the reproduction and early growth cycle of many Reef flora and fauna.

Clearing or modifying wetlands can change or remove habitat for species that are important for maintaining wetland health throughout the catchment. Fallen timber, rocks and submerged aquatic vegetation are important aquatic habitats providing shelter, spawning sites and habitat diversity and removing habitat puts pressure on aquatic species density and diversity.

Photograph: Gary Cranitch © Queensland Museum



#### Wetlands and climate change

A changing climate is a significant long-term threat to wetlands, potentially altering wetting and drying cycles and increasing fire frequency and intensity. Climate change impacts, such as rising sea levels, can also lead to losses and changes in wetland type such as the loss of freshwater wetlands from salt water intrusion and changes of saltmarsh wetlands to mangroves. This has flow on impacts to wetland flora, fauna and ecosystem function.

There are many different wetland types, but all depend on the water cycle. Any changes to the water cycle through altered rainfall patterns (distribution, time of the year, quantity), extreme weather events, greater evaporation rates and rising temperatures will affect the hydrology of individual wetlands. This also affects the wetland's structure and functionality. Climate impacts are likely to exacerbate changes in the water cycle.

Wetlands have a critical role in capturing and storing carbon. Globally, wetlands are estimated to store over a third of the world's terrestrial carbon, with blue carbon potentially being one of the most important stores in Australia. Their degradation or destruction often results in major releases of greenhouse gases to the atmosphere.

#### Queensland climate action and the Reef 2050 Wetlands Strategy

"Climate impacts will severely compromise the ability of the ecosystem to provide services to humans including water, health, adaptation, food, resilient ecosystems." Queensland Climate Adaptation Strategy 2017-2030

The Queensland Climate Action Plan 2020-2030 is the overarching plan which sets out priorities for action over the next decade to respond to climate change. This includes action to reduce emissions, transition to renewable energy and remove carbon from the atmosphere.

The Queensland Climate Adaptation Strategy 2017-2030 (Q-CAS) provides the overarching framework for climate adaptation planning and action under Queensland's Climate Action Plan. It contains actions to respond to the challenges and opportunities from climate change.

The *Biodiversity and Ecosystems Climate Adaptation Plan*, developed under the Q-CAS, identifies principles and actions to guide planning and on-ground action to minimise negative impacts of climate change on Queensland's biodiversity and ecosystems. Carbon farming is a central component of Queensland's response to climate change. The Queensland Government's Land Restoration Fund aims to expand carbon farming in the state by supporting land-sector projects that deliver additional environmental, socio-economic and First Nations co-benefits.

The *Reef 2050 Wetlands Strategy* aligns with the Queensland Climate Action Plan and associated strategies and policies through objectives and activities that support:

- removing carbon from the atmosphere through wetland retention and rehabilitation
- research into quantitative and financial benefits of wetlands in removing carbon from the atmosphere
- undertaking wetland and water quality actions that achieve co-benefits
- planning for and managing changes to wetlands from a changing climatic regime.

Climate change considerations are also embedded within the whole-of-system, values-based framework.

#### Whole-of-system, values-based framework

**Many management frameworks** focus on managing the parts of the ecosystem individually (e.g. economic or biophysical), rather than using an integrated approach that incorporates all parts of a social-ecological system.

This traditional, single issue focussed approach can lead to poorly designed management activities that fail to achieve positive outcomes, do not maximise multiple outcomes, do not maximise resources and, in some cases, lead to perverse outcomes.

The whole-of-system, values-based framework (the framework – see figure 3) provides an integrated approach to catchment management and protecting, maintaining and rehabilitating wetland systems. The framework uses a holistic management approach that considers the biophysical environment alongside social, economic and cultural outcomes. This is integrated with an understanding of how catchments function. Threats can then be identified to prioritise options for management intervention.

For example, mangroves (components) provide storm protection (services) for people who have property on the coast (beneficiaries) who may also value the mangroves for fishing and crabbing (see figure 4). The framework provides the foundation for a comprehensive approach to day-to-day wetlands management activities and prioritising investment that will help deliver more effective and sustainable management of the catchment. It underpins the Strategy and supports achieving the vision, outcomes, objectives and activities. More information on the framework, including details on how to apply it, can be found at Wetland*Info* whole-of-system, values-based framework.

Photograph: © Jaragun EcoServices









Figure 4. An illustration of the relationship between the ecological and social parts of an ecosystem that underpin the whole-of-system, values-based framework.

#### Russell River Catchment Sustainability Plan, 2020–2025

The Russell River catchment in the Wet Tropics is rich in biodiversity with crystal clear mountain streams, vibrant rainforest and coastal wetlands. Many of its rainforests and wetlands form part of the Wet Tropics World Heritage Area, and its mangroves, estuary and offshore waters, seagrass beds and reefs form part of the Great Barrier Reef World Heritage Area. While much of the catchment remains forested, former land clearance and modification for agriculture and other land uses contribute to poor water quality discharged to the Reef. This includes dissolved organic nitrogen, a *Reef 2050* priority for improving water quality because of its cumulative impact on coral and seagrass beds.

Jaragun EcoServices is a Traditional Owner owned and operated natural resource management organisation that applies nature-based and other solutions to restore and improve the Russell River catchment's environmental values and water quality flowing to the Reef. Jaragun recognises that restoration depends on sustainable solutions achieved through involving industry, landowners and community in holistic, landscape-scale solutions. Jaragun's *Russell River Catchment Sustainability Plan, 2020–2035* is delivering this through integrated catchment-to-Reef management. Jaragun applied the whole-of-system, values-based framework to develop the *Russell River Catchment Sustainability Plan, 2020–2025*. Comprising a Technical Report and Management Plan, these documents guide sustainable management of the catchment. Jaragun's approach to developing the Plan involved collaborating with a range of wetland and water quality stakeholders including natural resource management organisations, the sugarcane industry, Traditional Owners and Custodians of Country, academia, scientists, conservation and other organisations and community members. These stakeholders formed an Advisory Committee to implement the Plan.

Jaragun drew on the Russell River catchment walking the landscape process for baseline information on how the whole-of-system functioned and provided services in the catchment. The walking the landscape process brought together stakeholders, experts and community members to share their knowledge of the catchment's components (parts), processes and values. Jaragun also undertook research in partnership with experts, scientific institutions and government agencies to fill key knowledge gaps on system components and identify promising interventions that can contribute to solutions.



Jaragun then applied the whole-of-system, values-based framework themes to develop the *Technical Report*. The report describes the Russell River catchment's environmental systems and community values, comprising climatic, geological, ecological and human system components, and how the system works. It also details the provisioning, regulating, cultural and supporting ecosystem services; community values; legislative and policy drivers; threats, pressures and risks; and potential management opportunities. Jaragun then developed the Five-Year Management Plan that contains priority interventions and timeframes.

The whole-of-system, values-based framework adopted for the *Russell River Catchment Sustainability Plan, 2020–2025* provides a logical, evidence-based approach to setting objectives, goals and priority interventions for improving water quality to the Reef. By adopting a catchmentscale management approach, the Plan aligns with the *Reef 2050* goal of integrated catchment-to-Reef management to reduce cumulative impacts. The Russell River Catchment Sustainability Plan, 2020– 2035 demonstrates the power of the framework in identifying investment opportunities to achieve the *Reef 2050* water quality targets.

Photographs: © Jaragun EcoServices



### Part B. | Wetlands and treatment systems for improving water quality in Reef catchments

#### Water quality of the Great Barrier Reef

Each wetland, waterway or estuary has its own values and provides ecosystem services, such as water quality improvement and carbon storage, that benefit the receiving marine environment. Pollutant run-off from catchments affects the condition of many of the key Reef ecosystems and ecosystem services (Waterhouse et al 2017). Reef water quality report cards indicate positive but slow progress toward meeting the *Reef 2050 Water Quality Improvement Plan (Reef WQIP)* target for dissolved inorganic nitrogen through improved onfarm practices and gully and streambank remediation. However, modelling suggests that even full adoption of industry best management practices is not expected to achieve the sediment and nutrient targets (Eberhard et al 2017). This indicates that additional management interventions are needed to remove pollutants from water.

Photograph: Gary Cranitch © Queensland Museum



# Wetlands role in improving water quality

Wetlands are unique in their dual role in contributing to the outstanding universal values of the Great Barrier Reef World Heritage Area, while also contributing to improving water quality. They form some of the critical Reef ecosystems and provide direct connectivity through water flows, fish and bird movement.

Knowledge of the effectiveness of wetlands and other treatment systems at removing nitrogen and other pollutants has increased significantly in recent times. Research confirms that vegetated wetlands are effective at removing nitrogen and that most of the nitrogen is permanently removed through the process of denitrification. Denitrification rates are highest in wetland soils associated with plants and the characteristics of wetlands that maximise nitrogen removal have been identified (Adame et al. 2019, Adame et al. 2021, Kavehei et al. 2021). Some wetlands have also been shown to be highly effective at reducing pesticides in water (Vymalzl 2014) and sequestering carbon (Serrano et al. 2019, Costa et al. 2021). Wetland management objectives will depend on the outcome sought (e.g. if nitrate removal is the objective, then a wetland can be designed and managed accordingly; however, if biodiversity or fish habitat is the objective, management will be different).

The *Reef 2050 Plan and Reef WQIP* recognise natural wetlands are important for reducing pollutants and the benefits of applying a whole-of-catchment approach to improve water quality and the health of Reef ecosystems.

## Treatment train approach to improve water quality

While wetlands can treat catchment run-off, poor quality water can also impact wetland values and services. Excess sediment can impact wetlands and, in some cases, destroy them by filling them up. Excess nutrients such as nitrogen and phosphorus can stimulate weed growth and alter ecological cycles. While natural and constructed wetlands can trap pesticides and speed their decomposition, they can also damage wetland functions (Eberhard et al 2017).

Treatment systems are designed to use natural wetland hydrologic, physical, biological or chemical processes and components (e.g. soil, vegetation etc.) to remove specific pollutants from water. No single treatment system will treat all pollutants, however, multiple treatment systems can remove pollutants in sequence from coarse-medium sediments to fine sediments and dissolved pollutants.

Therefore, it is important to use different treatment systems in a sequence to maximise water quality improvements while maintaining wetland function and health.

The recommended approach which can be applied under the whole of system, values-based framework is a treatment train. This involves:

- 1. Preventing and minimising pollutants at the source through best management practices including efficient use of nutrients and water, preventing erosion and minimising stormwater volume and velocity.
- 2. Intercepting and treating run-off close to the source through one or more treatment systems suited to small-to-medium rainfall or irrigation events.
- 3. Final polishing of larger flows and floodwaters through natural or restored floodplain wetlands.



Photographs: Gary Cranitch © Queensland Museum

Treatment systems for small to medium-sized flows or events and/or shallow groundwater are best located close to the source of pollutants, such as adjacent to the urban development or agricultural crop. These smaller events generally have relatively high pollutant concentrations and smaller volumes of water, that treatment systems can retain long enough to treat. They can be used to improve water quality from different sources or land uses including diffuse runoff from agriculture and urban land uses and pointsource discharges from sewage treatment plants and aquaculture.

Larger flows and flood events generally bypass treatment systems and enter floodplains. These flood events are important for aquatic and terrestrial productivity. Where there are healthy, vegetated floodplain wetlands, water can slow down and spread out, providing ideal conditions for fine sediment and nitrogen removal (Adame et al 2019). Healthy wetlands with native vegetation (trees or reeds and sedges) are effective at removing nitrogen from floodwaters. Wetlands that are degraded by weeds or pests, drained or channelised are less able to improve water quality. For example, wetlands choked with weeds can become stagnant, reducing their potential to remove nitrogen, creating conditions unsuitable for fish and potentially contributing to greenhouse gas emissions (Kavehei et al 2021).

#### Cost-effective nitrogen removal through well designed and managed treatment wetlands

Studies in north Queensland have demonstrated that constructed treatment wetlands and natural wetlands can be effective at reducing nitrogen in Reef catchments with denitrification being the main removal process. Denitrification rates were also shown to be highest in wetlands with plants.

A study of eight treatment wetlands and two vegetated drains on farms identified most systems reduced dissolved inorganic nitrogen (DIN) concentrations throughout the wetland. Densely vegetated, elongate wetlands were most effective at DIN removal. Wetlands were less effective when DIN concentrations were low (below 0.2mg/L). The results show that well designed and managed treatment wetlands which promote slow, uniform water flow through the right balance of vegetation, built in the right location, with relatively consistent DIN inputs can achieve cost-effective DIN removal.

The studies provide a basis for designing cost effective, efficient water treatment systems based on monitoring and evaluation using on-ground examples to test assumptions and outcomes.

Photographs: © Terrain NRM



#### Wetland processes to improve water quality

Many processes occur in natural or restored wetlands and treatment systems to slow water and trap, filter and remove nutrients, sediments and other pollutants. The components of a wetland, including the vegetation, microbes and soil, together with the water regime, shape (dimensions and profile) and landscape characteristics influence the effectiveness of removing pollutants.

Systems can be engineered or wetlands restored or managed to maximise removal of a target pollutant following the processes described below and summarised in figure 5.

#### Coarse-medium sediments

Coarse to medium sediments, such as sand, can settle out of water if the water flow is slow enough. The best way to manage sediment is by avoiding erosion such as through good ground cover and farm or site layout. Simple structures that slow water flow, such as sediment basins or sediment barriers, can be used to trap sediment. These should be located outside of natural waterways. Coarse-medium sediment must be removed first as it can smother or damage systems downstream that are designed to treat finer particles.

#### Fine sediments and particulate nutrients.

Nutrients bound to particles (i.e. particulate nitrogen and phosphorus) and fine sediments, such as silts and clays, need to be removed through different processes such as enhanced sedimentation and filtration and adsorption (i.e. sticking to a surface). Vegetation can help remove fine sediment and particulate nutrients by slowing water flow and helps to minimise resuspension of trapped sediment.

#### **Dissolved nutrients**

Nitrogen occurs in the atmosphere, water, soils and biota. It cycles through the environment in different forms depending on physical, chemical and biological conditions. Plants can take up nutrients and store them in their leaves and timber for a time but when they die nutrients are returned to the system, resulting in a cycling of nutrients.

Nitrogen can be permanently removed through the nitrification – denitrification process. Treatment systems are designed and managed to maximise dissolved inorganic nitrogen removal by providing a source of carbon and waterlogged environment to promote nitrification-denitrification. Natural vegetated tree swamp and grass swamp wetlands can also remove large amounts of nitrate. Many coastal freshwater wetlands are dominated by weeds causing water to stagnate and interfering with the nitrification-denitrification process. Removing weeds will maximise their water quality function.

#### Pesticides and other pollutants

Pesticides and other pollutants have different properties and half-lives which will determine the most appropriate treatment processes. Some attach to sediments or organic matter and can be removed through enhanced sedimentation, adsorption or filtration. Others can be taken up by plants or treated by microbes or light. Sufficient detention time and vegetation or filter media is generally needed to slow water and enable these processes to occur.

Main pollutants removed	Processes	Key components	Management intervention examples
Coarse-medium sediment	Sedimentation	Open basin or feature to slow water flow	Engineered solutions – sediment basins
Particulate nutrients and fine	Filtration	Filter media or vegetation	Engineered solutions – vegetated drains, treatment wetlands
sediments	Enhanced sedimentation	Flocculant or vegetation	Engineered solutions – high efficiency sediment basins
	Adsorption	Sticky surface (biofilm, soil etc)	Engineered solutions – treatment wetlands
Dissolved nutrients	Nitrification- denitrification	Carbon source (vegetation, woodchip, etc) Oxygenated and low oxygen areas	Engineered solutions – treatment wetlands, bioreactors Systems repair – wetland restoration and management
	Uptake/biomass accumulation	Vegetation or algae	Engineered solutions – algae treatment, treatment wetlands Systems repair – wetland restoration and management
Pesticides and other pollutants	Degradation via microbes, light or other processes	Availability of microbes, light or other relevant components	Engineered solutions – treatment wetlands

#### Figure 5. Treatment train approach for removing pollutants

Note these all rely on a sufficient retention time for the process to occur.

#### Information, tools and mechanisms

Information, tools and mechanisms to support planning, decision making, engineering, construction, rehabilitation and management of wetlands and treatment systems to effectively treat water and maintain wetland health is available on Wetland/*nfo* Management, Rehabilitation, and Treatment systems.)

# Part C. | Themes, goals, objectives and activities

This section identifies five broad themes with goals, objectives and activities to guide actions for protecting and sustainably managing wetlands in the Reef and its catchments, to achieve the vision and outcomes of the Strategy.

Objectives and activities may achieve outcomes under multiple themes. They have been grouped according to the primary outcome sought.

Activities can be a specific program or project, address several different objectives and themes or be achieved by a number of approaches. Some existing activities are recognised for the important role they provide for wetland management, and their inclusion in the Strategy supports their ongoing implementation. The activities are not exhaustive and include existing and potential projects or programs.

This section has been developed using Specific, Measurable, Achievable, Realistic and Timely (SMART) principles, applying steps for adaptive management and underpinned by project logic. The whole-of-system, values-based framework enables the logic of the Strategy's themes, goals, objectives and activities to reflect the holistic way the socio-ecological system operates.

# Theme 1 | Improving wetlands information for decision making and action

Up-to date, scientifically robust and integrated information is available for evidence-based decision making and informing best practice protection and management of wetlands.

Scientifically robust information is needed to effectively understand, appreciate and manage wetlands. This includes information about wetland ecosystem components (living and non-living characteristics) and processes, the services they deliver and how people value them, and how to manage and monitor wetlands. Improving wetland information involves building on existing information, developing and integrating new information and making that information readily available for decision making.

Information needs to be tailored for the purpose it will be used for and the outcomes it is trying to achieve. For example, a solid science-base for management depends on knowing where wetlands are, understanding their nature (types and key attributes), how they function, how these factors interact to deliver wetland services and how they are valued. Information can also be used to monitor management activities and inform improvements. A need for new research or information may be identified in response to an emerging issue or to address a gap in knowledge.

Information may be used to achieve many other outcomes such as informing management action locations and activities, targeting investment, assisting with land use planning, educating and developing a wider understanding and appreciation of wetlands. Information needs to be readily accessible, integrated, easy to find and in formats that meet the needs of those using it.



Photograph: © Reef Catchments

#### Table 1. Improving wetlands information for decision making and action

Objec	tives	Activities
1.1	Information is available on the extent and characteristics	Map changes in the extent of regional ecosystem and freshwater wetlands regularly.
	of freshwater wetlands.	Improve the scale and ecological detail of wetland mapping.
		Improve attributes of riverine wetlands.
		Map and classify waterholes.
1.2	Information is available on the location, type, extent and	Map groundwater dependent ecosystems and changes in extent for all Reef catchments.
	dependent wetlands.	Improve the scale and ecological detail of groundwater dependent mapping.
1.3	Information is available on the extent and characteristics	Map and classify seagrass, coral and other ecosystems (intertidal and subtidal wetlands).
	of seagrass, coral and other ecosystems (referred to in this	Map and classify intertidal and subtidal regions and sub-regions.
	document as intertidal and	Identify the physical, chemical and biological characteristics of tidal
	subtidal wetlands).	wetlands (e.g. nitrogen content, dissolved oxygen, turbidity, toxicants,
		objectives under the Environmental Protection (Water and wetland biodiversity) Policy 2019.
1.4	Expand knowledge on	Identify and describe a set of priority ecological processes of wetlands
	ecological processes of wetlands.	including their physical, chemical and biological properties, spatially and temporally.
		Develop hydrological models of wetlands with key processes to understand water quality improvement by wetlands, including groundwater processes.
		Identify potential changes to ecological processes from climate change.

Obje	ctives	Activities
1.5	1.5 Expand the knowledge of ecosystem services and environmental, social, cultural and economic values	Develop an understanding of how wetlands provide key ecosystem services based on their components and processes including services they provide for climate resilience, fish productivity and carbon sequestration.
	of wetlands.	Undertake ecosystem service assessments in key locations to support an understanding of biophysical, social, cultural and economic values of wetlands.
		Update aquatic conservation assessments for all Reef catchments (riverine and non-riverine).
		Support the development of environmental accounting frameworks, including the development of regional accounts.
1.6	Tools are available to identify pressures on wetlands and	Update existing models on pressures to wetlands including pressures exacerbated by climate change.
understand ł wetland serv	understand how they affect wetland services (condition).	Develop wetland condition assessment tools for different wetland systems.
1.7	Information is available to manage wetlands and other	Maintain and improve information on the whole-of-system values- based framework and walking the landscape processes.
	coastal ecosystems from a whole-of-system perspective.	Develop and maintain up-to-date information on climate change considerations for the whole-of-system, values-based framework.
		Explore and capture Traditional Owners and Custodians of Country knowledge systems and cultural connection values.
1.8	1.8 Information on best practice standards for wetland and	Develop best practice and up-to-date wetlands and water quality management tools and guidelines.
water qualit available.	water quality management is available.	Use evaluation, reporting and case studies to inform new and updated tools and guidelines.
		Develop information, including modelling approaches and cost effectiveness analyses, to assess the feasibility of using constructed wetlands or treatment systems to improve water quality while maintaining natural wetland values across a range of land use activities.
		Update Paddock to Reef Integrated Monitoring, Modelling and Reporting Program models to include changes in water pollutant loads from the use of natural or constructed wetland treatment systems for a wide range of agricultural activities.

Obje	ctives	Activities
1.9	Information is available to deliver value for money	Maintain an up-to-date system that identifies the location and type of wetlands-related projects to guide investment priorities and decisions.
	investments, encourage collaboration and avoid duplication in wetlands- related projects.	Develop a decision support tool using the whole-of-system, values- based framework to guide prioritising the location, type and amount to invest on wetland management projects that maximise ecosystem service benefits and co-benefits and demonstrate nature-based solutions to wetland management.
		Ensure the motivations of landowners and managers are considered and incorporated when developing best practice management information for wetlands and water quality improvements.
		Support the development of accredited methods for natural capital accounting.
1.10	Information on wetlands is publicly accessible.	Continue to deliver information through the Wetland <i>Info</i> web portal and promote this information and tools to relevant land managers and stakeholders.
		Ensure information is provided in a format that suits its intended audience is accessible and easily located.
		Encourage expanding the delivery of information on other government and non-government websites such as local governments and Natural Resource Management groups.
1.11	Information is available to ensure wetlands used	Map and make available the location and shorebird use of high tide roost site information.
	by shorebirds and other waterbirds are managed with the best available data and	Map and make available the location and shorebird use of shorebird feeding areas.
	information.	Update and expand information on the ecology of shorebirds and
		waterbirds, pressures on waterbirds and shorebirds, and best practice
		management (data and lifecycles), including identifying alternating
		roost sites due to the impacts of climate change, for migratory and other
		waterbinds to help inform decision making and management action.



Objectives		Activities
1.12	Wetland knowledge gaps are identified and addressed through applied research.	Use information platforms that synthesise information for all parts of the social-ecological system, identify gaps and make the information available in a way that managers can easily use, with an ability to delve further.
		Identify research needs and ensure they are incorporated into appropriate research strategies and programs.
		Use walking the landscape processes to synthesise information.
		Consolidate scientific data and information into easy-to-use formats.
		Form partnerships to identify and address research needs.
		Investigate and publish information on how pollutants impact wetlands, including physio-chemical and biological indicators.
		Identify, consolidate and publish information on physio-chemical and biological processes for wetlands.
		Research the development of cultural values, cultural indicators and healthy country indicators, led by Traditional Owners and Custodians of Country.
1.13	Information is available on wetland policy and	Maintain the Wetland <i>Info</i> webpage with up-to date information on legislation and policy related to wetlands.
r	regulations.	Develop guidance material on hydrology and other wetland modeling to assist regulatory decision-making processes.
		Develop guidance material to assist compliance with legislative requirements for wetlands.
1.14	The role of natural and artificial wetlands in water	Encourage research into the role of natural and artificial wetlands in water quality improvement and report on effectiveness.
	quality improvement is understood and incorporated into relevant Reef initiatives.	Develop and update best practice information on water treatment and wise use of wetlands for improving water quality and incorporate into Reef initiatives.
1.15	Information is available on	Maintain mapping of fish bio-passage structures.
	best practice bio-passage to improve ecosystem health, and to identify wetland areas critical to important Reef fish species.	Update guidance material on the best management structures and practices to support fish bio-passage.
		Understand bio-passage effectiveness and develop appropriate monitoring and maintenance tools.
		Encourage and record the assessment of new fishway sites and record assessments that have been conducted.
		Work in collaboration with the Great Barrier Reef Marine Park Authority and other organisations to identify wetland areas critical to important Reef fish and other fish species.

Objectives		Activities
1.16	Up-to-date information is available for bilateral	Ramsar Information Sheets and other documentation is up-to-date on all listed sites.
	agreements for protecting wetlands and wetland biota including migratory birds.	East Asian-Australasian Flyway Information Sheets and other documentation and information, including the location of existing and new sites, is up-to-date on all listed sites.
1.17	Information is available on the ecological character	Promote research and monitoring to assist in identifying the ecological character of Ramsar wetlands and detect change.
	of and changes to Ramsar wetlands.	Address knowledge gaps in the nature and extent of Ramsar wetland components and processes.
1.18	Information and tools are available to plan for and	Update tools for resource planning, management and ecosystem repair to respond to impacts on wetlands from climate change.
	mitigate the impacts of climate change on wetlands.	Synthesise information on how wetlands function under climate change including impacts to wetland nature, extent, attributes and condition.
		Identify coastal wetlands and habitats that are at risk from climate change (e.g. areas that are at risk from sea level rise) and areas suitable for future species refugia (e.g. waterholes, groundwater dependent ecosystems etc).
1.19	Traditional Owner information	Traditional knowledge is recognised and embedded in decision making.
	supports decision making.	Knowledge sharing agreements are established with Traditional Owners and Custodians of Country.
		Collaboration between Indigenous and non-Indigenous scientific researchers following appropriate bio-cultural processes is supported.
1.20	Scientifically robust information is collected	Citizen scientists are empowered to provide information on wetlands to inform scientific research and improved wetland management.
	through citizen science.	Tools are developed and maintained to facilitate citizen science data collection.
		Citizen science data collection and analysis meets best practice standards.
		Citizen science data about wetland flora and fauna is of a standard suitable for inclusion in the Queensland WildNet database.



Photograph: Gary Cranitch © Queensland Museum

Photograph: © Catchment Solutions

#### Aquatic fauna passage (bio-passage) information synthesis

Many Australian native fresh and saltwater fish species and other water-based fauna need to move freely within waters for seasonal and life stage needs (bio-passage). This includes accessing food and shelter, avoiding predators, moving to suitable habitat when water quality or quantity conditions change (such as drying out of waterholes in drought) and to breed and reproduce. Modifying natural wetlands including river systems can restrict the natural flow of water, preventing fish and other aquatic species from moving freely between habitats. This has significant implications for aquatic species, including a decline in species numbers.

Rehabilitation techniques and structures, such as rock ramp fishways, are increasingly used to restore aquatic connections. A wide range of research, data, reports and guidelines is available to inform well designed, effective fish passage structure construction and management but this information was not consolidated.

In 2020 the Queensland Wetlands Program started collating and reviewing research and information on bio-passage. This involved collaborating with many stakeholders including Queensland Government agencies, local governments, natural resource management groups, biologists, fisheries and bio-passage experts.

### *Product: Consolidated information on best practice bio-passage*

The experts prioritised what information was needed and helped develop products to inform best practice management practices for bio-passage planning, construction, management and research. This included case studies and images of Queensland sites. The review also identified information gaps and topics where information could be synthesised or expanded. This information is available on Wetland/*Info* Aquatic Fauna Passage.

### *Product: Techniques to prioritise bio-passage rehabilitation*

The use of prioritisation techniques can inform the most effective location for fishways which is an important first step to restoring bio-passage. Fish barrier prioritisation reports were synthesised to identify the main methods for prioritising rehabilitation of barriers for bio-passage. These can be found at Wetland*Info* Assessment Toolbox.

### *Product: Guidance on bio-passage planning, structure selection and design*

Planning, construction and approval advice was collated to support bio-passage restoration. This includes links to policy and legislative requirements, principles to guide bio-passage structure selection and detailed information on the design and construction of specific structures. Further information can be found at Wetland*Info* Bio-passage Structures.

#### Product: Bio-passage spatial database

Stakeholders across Queensland combined information to enable the first state-wide spatial bio-passage dataset to be published. Information on the location and type of bio-passage structures is available on Wetland*Maps* (Aquatic Fauna Passage) and QSpatial. A data management protocol was developed to ensure the database is continually updated to include new bio-passage information.

#### Theme 2 | Wetland planning

### Statutory and non-statutory planning arrangements are in place to protect, manage and enhance wetlands.

Statutory and non-statutory mechanisms are used to manage, protect, regulate and fund activities related to wetlands. Statutory mechanisms identify legal requirements for land use planning and developments in relation to impacts on wetlands. They also regulate activities related to wetlands including fish habitat and movement, riparian and marine vegetation and coastal development. There are also many-wetland related activities that are not driven by legislative requirements. These activities range from establishing operational plans or criteria to guide management decisions and developing funding programs to designing on-ground activities.

Protecting, managing and rehabilitating wetlands can be improved by considering the role of wetlands in the catchment and the multiple values they support when planning. A strategic approach to identifying the most effective and efficient actions to improve wetland health and restore wetlands is important for prioritising funding and investing in projects that achieve the most effective outcomes.

#### Photograph: Gary Cranitch © Queensland Museum



#### Table 2. Wetland planning

Objec	tives	Activities
2.1	2.1 Natural and near natural wetlands, riparian areas and wetland dependent species are protected effectively and consistently under legislation.	Legislation for protecting and assessing impacts on wetlands, wetland dependent vegetation, species and riparian areas is maintained.
		Ensure statutory planning instruments at all levels include measures to protect and manage wetlands in Reef catchments, including measures to improve water quality and the health of the Reef.
		Review the effectiveness of existing legislative, regulatory and policy frameworks, including processes and practices, in protecting and rehabilitating wetlands, their values and Reef water quality to inform areas for improvements.
		Review the currency, accuracy and representativeness of statutory and regulatory Reef catchment wetland mapping and investigate undertaking regular mapping updates based on up-to-date wetlands data and other tools.
		Ensure development assessment and planning guidelines provide best practice management advice for wetlands.
		Explore options to identify critical migratory bird species habitat <sup>1</sup> for planning and regulatory considerations.
2.2	Statutory planning frameworks enhance opportunities for aquatic	Investigate opportunities to streamline approval processes for projects that deliver ecosystem services and wise use of wetlands outcomes (for example, blue carbon and co-benefits initiatives).
	ecosystem service delivery and wise use.	Identify and support opportunities for aquatic ecosystem rehabilitation and enhancing connectivity in statutory regional and local plans.
2.3	Wetlands and whole-of- system, values-based approaches are incorporated into strategic planning.	Wetlands and whole-of-system, values-based management approaches are incorporated into Natural Resource Management, Water Quality Improvement Plans, water resource planning <sup>2</sup> , coastal planning and urban stormwater planning.
		Encourage the consideration and inclusion of the Reef 2050 Wetlands Strategy's objectives in other relevant plans and policies.

<sup>1</sup> Australia has obligations under several bi-lateral migratory bird agreements and partnerships. See Wetland*Info* Shorebirds and other waterbirds.

<sup>2</sup> Water plans are developed under the *Water Act 2000* to sustainably manage and allocate water resources in Queensland. Further information on water plans can be found at https://www.business.qld.gov.au/industries/mining-energy-water/ water/catchments-planning/planning.

Objec	tives	Activities
2.4	2.4 Wetlands are identified and their values protected and	Recognise and prioritise wetlands in Queensland protected area acquisition guidelines and criteria.
	managed in State protected areas (terrestrial and marine), fish habitat <sup>3</sup> areas and State Forests	Recognise wetland values in the Queensland Parks and Wildlife Services Values-Based Management Framework as high value assets for park management planning.
		Undertake wetland health checks and maintenance as part of protected area management actions.
		Explore, enable and strengthen partnership arrangements between Traditional Owners and Custodians of Country and government agencies/ land managers to plan for and manage land including wetlands.
		Ensure planning and management of State forests protects, maintains and seeks to enhance the condition and values of wetland and water quality.
2.5	Wetlands are incorporated into funding opportunities and initiatives.	Wetland management strategies and prioritisation tools are used to guide investment from funding sources including government and non-government sectors and natural capital markets.
		Facilitate consideration of innovative options for wetland and coastal ecosystem repair including pilot projects and trials of funding sources and programs.
		Facilitate and identify opportunities for co-designed projects with Traditional Owners and Custodians of Country.
		Facilitate and identify innovative funding mechanisms for ongoing catchment management.
		Wetland nature-based solutions are considered and built into climate adaptation and disaster risk reduction plans and investment programs.
		Support the use of natural capital accounting systems to inform funding of projects that achieve enhanced wetland and water quality outcomes.
2.6	2.6 Water allocations, planning and management consider and maintain wetland values and services from a whole-of- systems perspective.	Identify groundwater and flow dependent ecological assets and collect scientific data to determine water requirements.
		Consider threats and water requirements of ecological assets and prioritise their protection in water resource planning.
		Consider and account for climate change impacts and cultural values when developing new water plans.
		Consider and plan for maintaining and improving environmental values when developing new water plans.

Objec	tives	Activities
2.7	Wetland representation is recognised and increased in private protected areas.	Recognise and consider wetlands when selecting new private protected areas and other voluntary conservation arrangements. Include wetland management outcomes in conservation agreements. Wetlands are recognised as a criterion when selecting new private protected areas (e.g. nature refuges, special wildlife reserves).
2.8	Knowledge and understanding of wetlands and their values is available to support offsets, including innovative options to offsetting.	Consider options that include direct benefit management plans to guide offset investments, particularly for coastal and marine wetlands. Support the development of information to determine what may be considered an unacceptable impact to a wetland.
2.9	Traditional Owners and Custodians of Country are engaged in wetlands planning.	Develop a holistic framework for managing wetlands from a Traditional Owners and Custodians of Country perspective.
2.10	Planning for bio-passage is improved.	Bio-passage assessments are undertaken to identify priority areas for improvements to bio-passage.



Photograph: ©Townsville City Council

#### Fairfield freshwater wetlands management plan

Townsville's Fairfield freshwater wetland is a 1.75-hectare wetland within the suburb of Idalia. It is a natural wetland that was modified in 1998 as part of Idalia's urban expansion. Most of the wetland was retained due to its high conservation value as waterbird habitat. Additional sediment retention basis were created to treat stormwater, reducing pollutants entering the natural wetland.

There are many benefits and management challenges from retaining natural wetlands within urban areas. Urban wetlands provide habitat and refugia for native birdlife as well as plants. Importantly, from a human perspective, wetlands provide ecosystem services including recreation opportunities, reduce pollutants in stormwater and run-off, reduce the impacts of floods, recharge groundwater, cool urban areas and remove carbon from the atmosphere. However, natural processes that occur within wetlands can attract ducks and geese and cause unpleasant odours for nearby residents or make wetlands appear unsightly (drying out). Some human interactions with the wetland and wildlife may also be undesirable, such as leaving rubbish, feeding wildlife and introducing species such as dome<u>stic ducks.</u>

The Fairfield freshwater wetland system is a thriving ecosystem that is well used and appreciated by Idalia residents. It has important aesthetic and recreational values, with local community and visitors going there to appreciate its natural setting or wander through environmentally sensitive walking trails. Native vegetation, such as water primrose, duckweed and velvet knot weed, has been retained around and within the wetland and plays an important role in the ecology of the wetland system.

The wetland is home to aquatic creatures like native fish and freshwater turtles and visited by local waterbirds and other birdlife including uncommon regional water birds such as the Rajah Shelduck. The wetland has an amazing array of dry season ducks, geese, herons, cormorants and pelicans. The abundant native wildlife makes Fairfield freshwater wetlands an important ecological and birdwatching area in Townsville.



Photograph: © Townsville City Council

In May 2022 the Fairfield Freshwater Wetlands Environmental Management Plan (2008) was updated to guide the ongoing and sustainable management of the wetland. The management plan focuses on innovative, cost-effective activities aimed at maintaining the natural processes and values of the wetlands. The management approaches and objectives include:

- retaining native vegetation in and adjacent to the wetland
- monitoring water quality, species and wetland health
- informing and educating the local community and visitors on the wetland's values, processes and management
- partnering with community groups and businesses for wetland monitoring and management activities
- identifying annual maintenance operations undertaken by Council.

Sustainable management practices are a focus including harvesting exotic water weeds, managing grassed areas as filters and buffers, and reusing removed vegetation to produce topsoil and mulch in surrounding park garden beds, while managing odour with local biological catalysts.

The Environmental Management of Idalia Wetland Systems (2022) report, developed to investigate community concerns regarding odour, water levels and views, highlighted the performance and benefits of the Fairfield freshwater wetlands. The report recognised the Council's management of the wetland set a national standard for how to practice holistic conservation. It also acknowledged the Environmental Management Plan's role in ensuring the wetland remains a natural oasis in an urban environment that supports a healthy and resilient environment.

Photograph: Wetland Discovery Day October 2022, © Townsville City Council



# Theme 3 | On-ground activities to protect, manage, rehabilitate and restore wetlands

### Implement on-ground activities that improve the health of wetlands and enhance their contribution to Reef resilience.

Protecting, managing, rehabilitating and reducing risk to wetlands ensures the services and values wetlands provide are maintained or expanded. Retaining natural wetlands, whether in public or private ownership, and managing pressures can provide many benefits to landowners, businesses, industry and the community including cleaner water, healthier catchments and a healthier Reef. Undertaking onground works to rehabilitate and restore degraded wetlands assists with reducing impacts on catchment and Reef health and restores services people value. Objectives and activities under theme 3 seek to maintain and enhance intrinsic and existence values of wetlands and ecosystem services. Protecting wetlands and delivering on-ground management and ecological rehabilitation can be supported through existing and new initiatives including nature-based solutions, climate change resilience and incentives for wetland management on private land.

Photograph: Gary Cranitch © Queensland Museum



Objectives		Activities
3.1	Wetland values and services are enhanced through targeted, coordinated and effective rehabilitation and restoration initiatives.	Collaborate with key stakeholders such as Australian (the Great Barrier Reef Marine Park Authority), State and local government agencies, natural resource management groups and other non-government organisations, Traditional Owners and Custodians of Country, groups and volunteers to prioritise on-ground works to achieve maximum benefits and outcomes for wetlands.
		Encourage private landholders to conserve, rehabilitate or restore wetlands through appropriate mechanisms and incentive programs.
		Develop, fund and implement management programs that address threats to wetland services and values, such as from climate change, invasive species and land-based run-off.
		Explore and implement practices to protect people from hazards and risks when accessing and managing wetlands.
3.2	Wetlands are appropriately connected to improve processes and services, environmental outcomes and address barriers to bio- passage.	Develop, fund and implement measures to enhance appropriate connections and improve bio-passage such as removing barriers and restoration and rehabilitation activities. <sup>4</sup>
3.3	Natural wetlands that significantly contribute to improved Reef water quality and/or wetland conservation are protected.	Explore the increased management (possible acquisition) of areas that significantly contribute to improved Reef water quality, carbon sequestration and storage areas, or contain threatened high priority wetlands, for conservation purposes and Reef management.
3.4	Effective and coordinated wetland compliance activities reduce impacts to wetlands.	Undertake compliance activities to enforce development approval and planning requirements for protecting and managing wetlands. Undertake compliance activities on illegal works and activities in, or impacting on, wetlands.
		Increase the awareness, capacity and knowledge base to enable strong and effective wetland compliance.
		Investigate opportunities for collaboration between authorities

#### Table 3. On-ground activities to protect, manage, rehabilitate and restore wetlands

compliance processes.

involved in wetland compliance activities including existing/parallel

<sup>4</sup> Measures to improve bio-passage are to be based on an assessment of any proposed changes or improvements. Regulatory requirements to undertake rehabilitation activities may also apply.

Objec	tives	Activities
3.5	3.5 Wetlands and treatment systems are used for water quality treatment and	Best practice information on water treatment and use of wetlands for improving water quality is used when planning, applying and managing on-ground water treatment systems.
	improvement in ways that do not impact on natural wetland services and values.	Natural wetlands, which have a high potential for improving water quality, are managed to maximise water quality improvement and protect wetland values and services.
		Develop approaches to identify, prioritise and fund wetland rehabilitation to improve water quality and identify areas suitable for water quality treatment systems.
		Implement management and maintenance activities to improve water quality and ensure the effective, ongoing functioning of treatment systems.
		Wetlands and treatment systems are considered for treating polluted run-off or extracted groundwater prior to entering drainage systems, waterways and natural environments.
3.6	Wetlands and their species are managed to best practice standards.	Landowners and managers (including Australian, State and local government agencies, non-government, industries, organisations and individuals) are encouraged to use best practice management tools and guidelines and whole-of-systems values-based framework principles.
3.7	The values of wetlands in protected areas and/or areas identified under international	Implement wetland planning and management actions in accordance with National and State legislation and international conventions, agreements and partnerships.
	conventions (e.g. World Heritage Areas, Ramsar sites) are maintained or enhanced.	Wetlands in declared fish habitat areas and those recognised in the Queensland Parks and Wildlife Service Values-Based Management Framework are managed to maintain their values.
		Implement actions to maintain or enhance the ecological character of Ramsar sites.
3.8	Encourage funding for activities that improve the health and capacity of wetlands to benefit the Reef.	Reef management objectives and activities are considered when prioritising implementation activities, developing programs and funding opportunities.
		New and diverse funding sources such as carbon farming and carbon markets, Reef co-benefit classes, stewardship payments, environmental and natural capital markets and philanthropic investors, are investigated for funding wetlands protection and management activities.
		Explore opportunities to increase resources to enable Traditional Owners and Custodians of Country to undertake wetland management on Country.

#### Violet Vale Station on-ground management to improve water quality

Violet Vale Station is a cattle station that borders Rinyirru National Park on Cape York Peninsula, south of Princess Charlotte Bay.

It contains approximately 1900 hectares of wetlands that are listed as nationally significant in the Commonwealth Government Directory of Important Wetlands (Marina Plains-Lakeland Aggregation). Numerous creeks connect the wetland complex, which provides habitat for several rare and endangered species including the Red Goshawk, Golden-Shouldered Parrot and Cooktown Orchid.

The owners of Violet Vale Station, who purchased the land in 2015, wanted to establish a wellmanaged, quality cattle property while maintaining the integrity of the wetlands and creeks and the special habitats bordering Rinyirru National Park.

The station has areas of particularly erosive, sodic soils, and soil management is a significant part of property planning. A major issue was the number of feral cattle which would move to larger, significant wetlands as smaller wetlands dried up. Feral cattle were the most significant threat - damaging the wetlands and contributing to erosion. The owners have worked with Cape York Natural Resource Management to undertake land management activities to protect the wetlands and reduce erosion prone country. This work includes:

- installing a 39.7km fence around an area of significant-value wetlands to exclude cattle
- fencing approximately 13,000-hectares of erosion-prone country to exclude feral cattle, informed by a Griffith University project identifying high erosion areas from sediment hotspots, grazing land type and soil resilience class mapping
- undertaking musters to remove feral cattle from within the fenced wetland and gully areas.

The projects on Violet Vale Station were funded through the Australian Government's Reef Trust Program and the National Landcare Program with significant co-investment by the landowners, who provided machinery, time and labour. The landholders are dedicated to maintaining the new infrastructure to ensure the longevity of project results.



#### Sandringham Wetlands Complex

The Sandringham Wetland Complex is located on the coastal plain of the Plane Catchment Basin in the Mackay Whitsunday region. The complex is a mix of fresh and marine waters, and includes extensive shallow water, areas of deeper water and subtidal and intertidal mudflats. The area provides important habitat for many birds including the beach stone curlew, royal spoonbill, oystercatchers, egrets, plovers, sandpipers, and is recognised as internationally important for migratory birds. Other species including flatback turtles and green turtles occasionally use the area. The lowland coastal areas have been highly modified for agricultural and other activities. The wetlands play a unique role in nutrient cycling and water supply to the surrounding lands, as well as providing food, shelter and the chance to reproduce for many plants and animals. They also have a major role in filtering water before it enters the Reef lagoon.

The Sandringham Wetlands improvement project was funded by the Australian Government's Reef Trust and delivered through the National Landcare Program Regional Land Partnerships agreement. The project seeks to improve the ecological function and condition of the Sandringham Wetland Complex and threatened ecological communities within the region by enhancing habitats and bio-passage to improve threatened and socio-economically significant fish populations. The vision is to support profitable and sustainable grazing properties while maintaining the wetlands as a healthy, functioning natural ecosystem. Reef Catchments works with landholders, land managers and technical experts to identify and adopt land management practices that benefit farming operations and improve the function, condition and ecology of the wetlands. On-ground activities are planned on a site-by-site basis with a focus on addressing impacts and implementing restoration activities. Activities include:

- revegetation, weed and pest control
- facilitating management practice change
- developing site-specific management plans
- installing fish-friendly structures to improve fish passage, freshwater retention and availability
- installing improved fencing to exclude cattle from sensitive wetland areas and reduce impacts to native animals
- installing troughs to water cattle away from natural wetlands.

The work of the landholder (Jason Bradford) was recognised in 2022 when he received the Reef Conservation Champion Award.



Photographs: © Reef Catchments

# Theme 4 | Engagement, education, communication and capacity building

### Improved awareness of the value of wetlands, management tools and involvement in wetland planning and management.

Engagement, education, communication and capacity building are key to creating a shared understanding, driving innovation and action, and encouraging protection and best practice management of wetlands. Activities under theme 4 provide information that supports people to increase their appreciation of wetlands and become involved in their management.

There are many different avenues and opportunities to inform, consult, involve, collaborate and empower people. Active involvement, engagement and communication with land-owners, managers and others involved in wetland management will build collaboration, understanding and efficiencies in wetland management. Wetland*Info* is a first-stop-shop for wetland information in Queensland. It provides an extensive range of tools, information and resources to assist with the sustainable management of wetlands.

Information is provided by many stakeholders including Australian, state and local governments, regional natural resource management bodies, research institutions and other reliable sources.

Wetland*Info* is regularly reviewed and updated to include information on new or emerging topics.

Objectives		Activities
4.1	Wetland visitors, residents and industry appreciate wetlands and are aware of actions they can take to conserve them.	<ul> <li>Prepare and promote educational material and activity programs for managers, schools, tertiary institutions, industry, community groups and other relevant sectors.</li> <li>Promote the Wetlands of Queensland book and look for opportunities to develop other communications products.</li> </ul>
4.2	Innovative approaches are used to deliver key messages on wetlands.	Provide accessible, comprehensive, up-to-date wetland information through the Wetland <i>Info</i> web portal and promote its use. Develop story maps, including catchment stories, and other mechanisms that deliver integrated science delivery and messaging.
		Wetlands management information is available on relevant websites including those managed by Australian, state and local governments, natural resource management groups, other non-government organisations and industry.
		Explore new message delivery mechanisms to promote wetland conservation, including social media, to broaden audience coverage.
		Explore different engagement approaches tailored to specific and new audiences.

#### Table 4. Engagement, education, communication and capacity building

Objec	tives	Activities
4.3	Wetland education is available at strategically	Provide up-to-date information on wetlands, including their values and the importance of wetlands, to education centres and at wetland areas.
	located sites and events.	Use key celebrations and events (such as World Environment Day, National Water Week, World Wetlands Day, State Landcare Awards) to raise awareness of the environmental, social, economic and cultural importance of wetlands and the Reef 2050 Wetlands Strategy, and recognise outstanding contributions to implementing the Strategy.
4.4	Collaborative partnerships promote best practice wetland	Continue the Great Barrier Reef Wetlands Network to build connections between wetland decision makers and managers.
	management, restoration and regeneration.	Establish and maintain networks of technical groups for specific topics including, but not limited to, wetlands treatment systems, bio- passage, fish management, shorebirds and wetland rehabilitation.
		Continue regional and local wetlands networks to share knowledge, collaborate and coordinate wetlands management activities.
		Continue stakeholder advisory groups for Ramsar listed sites to collaborate on management activities.
		Support collaboration between citizen scientists and volunteers with researchers and other experts to undertake research and management activities.
		Support collaboration between government agencies involved in health and safety and land management (e.g. Queensland Parks and Wildlife Service) to develop and deliver information and training about safe access to wetlands.
4.5	Collaboration between government agencies at all levels is enhanced.	Promote communication and the development of networks, forums and relationships between government agencies that are involved in policy, legislation and/or on-ground activities involving wetlands.
		Identify and promote government membership on existing collaborative groups involved in wetland policy and management.
4.6 Traditional Custodians knowledge into wetlan	Traditional Owner and Custodians of Country	Ensure appropriate and effective engagement occurs with Traditional Owners and Custodians of Country on wetland related initiatives.
	knowledge is incorporated into wetlands initiatives.	Investigate and support opportunities to incorporate, encourage, enhance and improve cultural immersion and cultural revitalisation for Traditional Owners and Custodians of Country to manage and advise on wetland management.
		Establish clear points of contact for Traditional Owners and Custodians of Country and other wetland stakeholders to support collaboration on wetland activities.

Objectives		Activities
4.7	4.7 Wise use of wetlands for tourism and recreational	Develop a Wetlands to Visit tool in consultation with Reef stakeholders and promote its use.
purposes is encouraged.	Explore opportunities for promoting sustainable access to wetlands and wetland education and appreciation activities.	
		Develop infrastructure to support visitor access to and experience of wetlands but ensure this does not impact wetland values.
4.8	4.8 Create a sense of community empowerment, responsibility and ownership in wetland management.	Promote initiatives for citizen scientists, volunteers, industry and businesses that contribute to protecting, maintaining and enhancing wetland values.
		Communities are encouraged to engage in citizen science activities to improve the management, knowledge, monitoring and appreciation of wetlands.
		People undertaking citizen science activities are trained in data collection and management to the appropriate standard for the data they are collecting and its intended use.
4.9	Build capacity among land managers and owners who are involved in wetland	Establish networks, training and education initiatives to improve the capacity of policy makers, environmental managers and others delivering information, wetland tools and extension activities.
	management.	Undertake on-ground management training to build capacity in applying best practice standards and methods to meet specific on-ground needs.
		Communities are encouraged to be involved in best practice wetland management.
		Volunteering is encouraged to support organisations involved in wetland management.
		Explore opportunities to increase the capacity of Traditional Owners and Custodians of Country to undertake wetland management on Country.
		Educate private landholders on their responsibilities and opportunities to manage their wetlands.
		Maintain web information about training resources and opportunities and promote its use.

Objectives		Activities
4.10	A collaborative approach and information synthesis is encouraged to inform value-	Identify and provide support and training in understanding funding processes and mechanisms that support implementing wetland activities.
	for money investment and avoid duplication in wetlands- related projects	Ensure sharing of information and data is embedded in contracts and agreements and encouraged in cross-collaborations.
		Establish a community of practice of water quality practitioners to share information on best practice wetlands and water treatment projects and investment.
		Support opportunities for collaboration between funding bodies to invest in wetland rehabilitation and management.
4.11	Enhance collaborations for improved wetlands	Expand the membership of Queensland Wetlands Governance Group and Great Barrier Reef Wetlands Network to include other key partners.
	management.	Establish and maintain a high level multi-disciplinary technical reference group to provide direction and technical support for wetland rehabilitation initiatives.
		Explore opportunities to increase the profile of wetlands and the Reef 2050 Wetlands Strategy with Reef advisory, policy development, program and management agencies, specifically through collaborative approaches with the Great Barrier Reef Marine Park Authority.
4.12	Shorebirds and other waterbirds are managed	Continue to collaborate on the conservation of shorebirds and other waterbirds, including by sharing data and information.
	collaboratively.	Continue to engage in relevant international agreements and conventions for the protection of migratory species.
4.13	Land managers understand the connection between their actions and the health of wetlands, catchments and the Reef.	Develop material and undertake education on the purpose and benefits of management activities including improving the health of wetlands and achieving other ecosystem services such as increased productivity and resource efficiency.
	The ricks and encerturities for	Information is developed and promoted on the visks and apportunities
4.14	wetlands from climate change	for wetland management from climate change.
	are known by managers and decision makers.	Update and develop climate change tools to respond to new information and assist adaptive management.

#### Wetlands of Queensland

Queensland has more types of wetlands than any other state in Australia. The importance of protecting these valuable ecosystems and ensuring their wise use is explained through the *Wetlands of Queensland* book. It shows the variety, beauty and complexity of wetlands in Queensland, and how the plants and animals within them have evolved to thrive in the vastly different climate zones and landscapes within the state.

The book contains a chapter dedicated to wetlands of the Great Barrier Reef and its catchments. These wetlands are some of the most diverse and biologically rich in Queensland, covering multiple climate zones, terrains and landscape types across a wide range of land uses. Reef catchments extend over 2,300 kilometres from the tip of Cape York in the north to Hervey Bay in the south and extend, in places, up to 400 kilometres inland.

The variability in climate, topography, geology, form and size of the Reef catchments results in many different types of wetlands. Two wetland complexes are listed as internationally important Ramsar sites (Bowling Green Bay, and the Shoalwater and Corio Bays Area). A total of 115 wetlands in Reef catchments are recognised as being of national significance, more than double the number in the rest of Queensland. Wetlands are prominent features of the landscape, covering an area of nearly 16,000 square kilometres and making up over 3.7% of the land surface. Reef catchment wetlands include seasonally inundated and ephemeral grass, herb and sedge wetlands; expansive riverine floodplains; springs and wetlands associated with volcanic landscapes; and intertidal and subtidal wetlands including the Reef itself.



The Wetlands of Queensland book is the product of a multi-year collaboration between the Department of Environment, Science and Innovation and the Queensland Museum. It is a richly illustrated publication which includes more than 500 images of wetlands and their species. Text that describes aspects of wetland ecology will help readers understand why wetlands are a critical component of the environment and the many ecosystem services they provide.

Gaining a greater understanding and knowledge of wetlands will assist with building a greater appreciation of the importance of wetlands and a desire to ensure they are protected for their intrinsic value and for future generations to enjoy.

#### Theme 5 | Monitoring, evaluation, reporting and improvement

An adaptive management approach incorporating effective monitoring, evaluation, reporting and improvement is implemented to improve wetland management.

Theme 5 provides a range of objectives and activities that support continued assessment, review and improvement of wetland management activities to ensure they provide beneficial outcomes within Reef catchments and for the Reef lagoon. This includes supporting monitoring and reporting and informing reviews of the *Reef 2050 Plan* and *Reef 2050 Water Quality Improvement Plan*.

A long-term monitoring and evaluation program is needed to identify emerging issues and changes that take time to detect. This is particularly relevant when identifying and responding to changes in the environment due to climate change. Benchmarks and indicators to track change are key to informing adaptive management responses and improving wetland management practices.

Photograph: Gary Cranitch © Queensland Museum



Table <sup>1</sup>	5. Monitoring.	evaluation.	reporting	and im	provement
	J	•••••••••••			

Objectives		Activities		
5.1	Wetland objectives, condition and extent are consistently monitored, evaluated and reported.	Continue to monitor and report on wetland targets through the Reef 2050 Plan wetlands reporting (no net loss of wetland extent and an improvement in wetland condition), Reef Water Quality Report Card and regional report cards.		
		Promote initiatives to standardise monitoring methods, including cost- effective methods.		
		Investigate opportunities for more efficient, frequent and cost-effective monitoring methods to report on the extent, pressures on, and condition of wetlands, including through involving Traditional Owners and Custodians of Country, citizen scientists and volunteers.		
		Report on changes to wetlands through a range of monitoring, evaluation, reporting and improvement (MERI) programs including the State of the Environment Report, Great Barrier Reef Outlook Report, Queensland Coastal Adaptation Plan (QCAP) and the Queensland Biodiversity Strategy.		
		Initiate greater monitoring of bio-passage conditions across catchments and the effectiveness of fish passage designs.		
		Continue monitoring activities under the Environmental Flows Assessment Program and monitor stream flows and groundwater levels through the groundwater and surface water monitoring networks.		
		Continue regular performance reporting for water plans.		
		Undertake regular risk assessments of pressures on water resources and threats to water plan outcomes.		
5.2	Monitor the extent and effectiveness of management	Use tools developed under theme 1 to measure changes from management interventions.		
	initiatives on wetlands including through changed	Monitor the number, type and location of on-ground wetland projects (including water treatment systems).		
	involvement in wetland management.	Monitor wetland projects for their success in achieving wetland service and values outcomes including water quality outcomes.		
		Learnings and outcomes from managing protected areas, such as marine parks and declared fish habitat areas, are incorporated into wetland management.		
		Monitor community attitudinal change to the importance of protecting and enhancing wetland and water quality health.		
		Monitor levels of volunteering in wetland protection, enhancement and citizen science activities.		

Objec	tives	Activities
5.3	Monitor and evaluate the effectiveness of wetlands delivering intrinsic/existence values and ecosystem services.	Monitor the effectiveness of wetlands to improve water quality including natural wetlands and treatment systems, and their link to water quality entering the Reef lagoon. Monitor wetlands for their role in delivering carbon sequestration. Explore opportunities to monitor the delivery of other wetland
5.4	Report on implementing the Reef 2050 Wetlands Strategy.	Establish a database and reporting mechanism to enable regular reporting on implementing the Reef 2050 Wetlands Strategy. Seek opportunities for organisations responsible for delivering activities under the Reef 2050 Wetlands Strategy to report on implementation. Consider how reporting could support communication, education and on-ground outcomes
5.5	Report on the effectiveness of the Reef 2050 Wetlands Strategy.	Undertake reviews to identify emerging issues and potential responses. Undertake five-yearly reviews of the Reef 2050 Wetlands Strategy, following the review of the Reef 2050 Plan, considering the effectiveness and efficiency of the activities in achieving the Strategy's goals and objectives.
5.6	Obligations for reporting through international agreements, conventions and partnerships are fulfilled.	Continue to deliver state jurisdictional reporting as required under the Ramsar Convention and bilateral migratory bird agreements.
5.7	Information on changes to the characteristics and extent of wetlands, including groundwater requirements, is reported.	Report on changes in the extent of wetlands. Report on changes to Groundwater Dependent Ecosystems.
5.8	Relevant learnings and outcomes are evaluated and shared to improve wetland management and investment.	Relevant learnings and outcomes from the management and monitoring of the Reef, protected areas and public land, such as marine parks and declared Fish Habitat Areas, are incorporated into wetland management and funding opportunities.
		Management learnings are shared in forums.
		Key messages are incorporated into best management practice and disseminated to wetland landowners and managers, and other stakeholders.
		Water quality improvement treatment systems are continually evaluated and key learnings on the effectiveness of systems is regularly updated on Wetland <i>Info</i> .
		Review Reef 2050 Water Quality Improvement Plan targets for wetland protection.

Objectives		Activities		
5.9	Dedicated governance is in place to advocate for and support implementation	Explore governance and collaboration opportunities with Australian (Great Barrier Reef Marine Park Authority), State and local governments and other organisations, to oversee and support the management and		
	of the Reef 2050 Wetlands Strategy.	implementation of the Reef 2050 Wetlands Strategy.		

Photograph: © Cape York Water Partnerships



61

#### Muunthiwarra (Jack Lakes) Wetlands Biodiversity Survey and Monitoring program

Muunthiwarra is an extensive wetland system comprising three large and several smaller freshwater lakes connected by channels and swamps that flow into the Jack River (part of the Normanby catchment) and into the Coral Sea. It is one of the most extensive wetland systems on the south-eastern Cape York Peninsula, listed nationally in the Directory of Important Wetlands due to its diverse flora, fauna and ecological communities (the Jack Lakes Aggregation). Several lakes remain wet throughout the year, providing an important refuge for waterbirds. The Muunthiwarra clan (Jack Lakes Traditional Owners) have a strong connection to the lakes as a hunting, fishing, story and ceremonial place. The most northern, top lake is owned and managed by the Kalpowar Aboriginal Land Trust. The middle and southern-most wetlands are in Jack River National Park and are jointly managed by Queensland Parks and Wildlife Service (QPWS) and the Kalpowar Aboriginal Land Trust Traditional Owners.

In 2007, 2008, 2018 and 2019 Muunthiwarra Traditional Owners, consultants and QPWS staff participated in biodiversity and wetland assessments at Muunthiwarra. The study collected baseline data on the plants and animals, wetland health and water quality; identified high value habitat areas, threats to biodiversity and future management recommendations; and developed a repeatable survey methodology. Wetland condition was assessed using the Cape York Freshwater Wetland Assessment methodology (Howley and Stephan 2009). Survey sites focused on three areas: the top, middle and lower lakes, representing a cross-section of the wetlands complex. Seasonal variation was factored in, with surveys undertaken in wet and dry seasons, where possible. Terrestrial and aquatic fauna surveys and water quality sampling was conducted across the three sites. A report (Jack Lakes Wetlands Biodiversity Assessment, November 2007 & June 2008) providing baseline species and wetland health data (comparing wet and dry seasons), identifying threats and recommending management responses was written by the Cape York Marine Advisory Group (2008)

Comparison of Top Lake in 2008 (this page) showing some pig damage, but lush reed beds still intact, and Top Lake 2018 (next page) showing pig and cattle damage with thin sparse reed growth (Photographs: K. Stephan).



Survey results over the 10-year monitoring period showed declining wetland conditions across all three wetlands. Feral pig and cattle foraging was destroying reed beds, aquatic vegetation and mud banks, impacting the natural ecology across all lakes. These impacts were greater in the top and middle lakes compared with the more biologically diverse lower lakes which were less impacted by pig damage due to the presence of bedrock.

Long-term studies are critical for providing key insights into changes to ecological condition and informing conservation management. The Muunthiwarra wetlands survey results have quantified changes to specific flora and fauna species and provided data on the threats and pressures. Recommendations to reduce the decline of the Muunthiwarra wetland include actions such as removing feral pigs and cattle and fencing off wetland areas. The surveys also highlighted the need to continue monitoring wetland condition to confirm changes from management interventions and expand research to address information gaps.

The survey and monitoring program concluded the Muunthiwarra wetlands hold significant biocultural heritage value and provide a reliable regional, tropical freshwater refuge for many species. The Muunthiwarra Aboriginal Corporation is seeking funding for ranger teams to live on and look after this Country.



### Acknowledgements

The Queensland Wetlands Program would like to thank the many people and organisations that provided advice and input to this Strategy including:

- The Great Barrier Reef Wetlands Network (Jaragun EcoServices, Cape York Natural Resource Management, Greening Australia, Far North Queensland Regional Organisation of Councils, Great Barrier Reef Marine Park Authority, Terrain Natural Resource Management, Queensland Water and Land Carers, Great Barrier Reef Foundation, Australian Marine Conservation Society, Reef Catchments, Burnet Mary Regional Group, Cape York Water Partnerships, Fitzroy Basin Association, Healthy Land and Water, James Cook University, OceanWatch, OzFish, NQ Dry Tropics)
- Queensland Government (Department of Agriculture and Fisheries; Department of Regional Development, Manufacturing and Water; Department of Transport and Main Roads; Department of Resources; Department of State Development, Infrastructure, Local Government and Planning)
- Local governments (Local Government Association of Queensland, Hinchinbrook Shire Council, Gladstone Regional Council, Townsville City Council, Sunshine Coast Council)
- Conservation organisations (Queensland Conservation Council, Cairns and Far North Environment Centre, Wide Bay Burnett Environment Council, North Queensland Conservation Council, Mackay Conservation Group)
- Queensland Ports Association
- Agricultural peak bodies (AgForce, Australian Banana Growers' Council, CANEGROWERS, Growcom, Queensland Farmers' Federation)
- Sunwater
- Australian Government (Department of Climate Change, Energy, the Environment and Water)
- Reef 2050 Advisory Committee
- Independent expert advice, University of Queensland.

Their support and continued involvement to implement the Strategy will assist to protect and restore natural ecosystems and wetlands within catchments of the Great Barrier Reef to create a healthy environment and improve water quality entering the Reef.

### Glossary

Note: A comprehensive list and description of terms related to wetlands can be found at Wetland Info Glossary.

Term	Meaning
Bio-passage	Bio-passage (aquatic fauna passage) is the process where fish and other water-based fauna move naturally around their environment. (Bio - meaning 'life', 'living things'. Passage - meaning 'a means of passing, a way, a route avenue, channel etc' Glossary of technical terms (Department of Environment, Science and Innovation) (des.qld.gov.au)).
Blue carbon	Blue carbon ecosystems – mangroves, tidal and salt marshes, and seagrasses – are highly productive coastal ecosystems that are particularly important for their capacity to store carbon within the plants and in the sediments below. They are considered a key component of nature-based solutions to climate change (UNESCO, https://www.ioc.unesco.org/en/blue-carbon).
Bio-cultural processes	Bio-cultural processes in this Strategy refer to identifying, respecting and following Traditional Owner and Custodians of Country cultural processes in engagement and partnership activities (https://researchers.mq.edu.au/en/publications/ applying-biocultural-research-protocols-in-ecology-insider-and-ou).
Cultural revitalisation	Cultural revitalisation refers to processes supporting Traditional Owners regain a sense of identity, including through connection to Country and sharing knowledge of Country. It includes processes that involve encouraging and empowering people through education and healing on Country (https://prezi.com/3qn6o_ar72yo/cultural-revitalization/#:~:text=Cultural%20Revitalization%20is%20a%20 process,been%20lost%20or%20is%20dying).
Dissolved inorganic nitrogen (DIN)	Dissolved inorganic nitrogen (DIN) consists of nitrate, nitrite and ammonium (Jorgensen, SE (2008), <i>Landscape ecology. In: Encyclopedia of Ecology.</i> , Elsevier, Oxford, Nitrogen processes – Chemical forms (Department of Environment, Science and Innovation) (des.qld.gov.au)).
Existence values	Existence values are those values that people place on something because that entity exists. Existence values are human-oriented (https://linkinghub.elsevier. com/retrieve/pii/S0921800911004927, Wetland services and values (Department of Environment, Science and Innovation) (des.qld.gov.au)).
Fish habitat areas	Fish habitat areas are areas of high value for fish habitat that are declared under Queensland's <i>Fisheries Act 1994</i> and protected from physical disturbance associated with coastal development. They are part of Australia's Nationally Representative System of Marine Protected Areas and fit within the International Union for the Conservation of Nature and Natural Resources (IUCN) Protected Area Management Category VI - 'Managed Resource Protected Area' (Frequently asked questions   Parks and forests   Department of Environment, Science and Innovation, Queensland (des.qld.gov.au)).

Term	Meaning
Intrinsic values	Intrinsic values are values which have worth in their own right, independent of human uses. Humans are not considered direct beneficiaries of intrinsic values (https://linkinghub.elsevier.com/retrieve/pii/S0921800911004927, Wetland services and values (Department of Environment, Science and Innovation) (des.qld.gov.au)).
Management	Management in this Strategy relates to the management interventions described in the whole-of-systems, values-based framework under themes of:
	<ul> <li>best management practice including pressure reduction</li> </ul>
	<ul> <li>engagement, extension and education</li> </ul>
	• systems repair
	<ul> <li>applied research and monitoring</li> </ul>
	engineered solutions
	<ul> <li>planning and institutional arrangements</li> </ul>
	(Identify a mix of management interventions (Department of Environment, Science and Innovation) (des.qld.gov.au)).
Monitoring, Evaluation, Reporting and Improvement (MERI) framework	The MERI framework is a process for continual review and improvements to management activities including policy, planning and on-ground actions (https://wetlandinfo.des.qld.gov.au/wetlands/management/rehabilitation/rehab-process/step-7.html).
Nature-based solutions	Nature-based solutions are actions to protect, sustainably manage and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature (https://www.iucn.org/our-work/nature-based-solutions).
Paddock to Reef Integrated Monitoring, Modelling and Reporting Program (Paddock to Reef program)	The Paddock to Reef program provides the framework for evaluating and reporting progress towards the <i>Reef 2050 Water Quality Improvement Plan</i> targets through the Reef water quality report card (Paddock to Reef   Reef 2050 Water Quality Improvement Plan (reefplan.qld.gov.au)).
Pollutants	Include nutrients, sediments, pesticides, pharmaceuticals, plastics (macro, micro and nano) and other pollutants (Treatment systems (Department of Environment, Science and Innovation) (des.qld.gov.au)).
Riparian vegetation	Riparian vegetation refers to plants along wetland margins and banks characterised by hydrophilic plants (https://wetlandinfo.des.qld.gov.au/wetlands/ ecology/components/biota/flora/flora-structural/riparian-vegetation.html).
Riparian zone	The riparian zone is an area between land and a wetland, river or stream. (https://wetlandinfo.des.qld.gov.au/wetlands/ecology/components/biota/flora-structural/riparian-vegetation.html)
Social-ecological systems	Social-ecological systems are systems categorised by interactions between human (social) and biophysical (ecological) sub-systems. The term 'social-ecological' recognises that social and ecological sub-systems are equally important to the health of a system (https://brocku.ca/esrc/2022/12/19/what-are-social-ecological-systems/).

Term	Meaning
Traditional Owners and Custodians of Country	Traditional Owner and Custodians of Country refers to the Traditional Owners and Custodians of the Great Barrier Reef land and sea Country. Traditional Owners and Custodians are the Indigenous, Aboriginal and Torres Strait Islander people who have ongoing traditional and cultural association with the land and sea, and possess rights and interests under Traditional Laws, Customary Lore and Australian and Queensland government laws (based on the definition in the Reef 2050 Plan).
Wise use	The wise use of wetlands is the maintenance of their ecological character, achieved by implementing ecosystem approaches within the context of sustainable development (https://wetlandinfo.des.qld.gov.au/wetlands/ resources/glossary.html#q=wise+use).
Whole-of-system, values- based framework	The whole-of-system, values-based framework outlines the way in which the biophysical environment, and natural and socio-cultural values are used to define objectives to identify and prioritise management interventions (Whole-of-system, values-based framework (Department of Environment, Science and Innovation) (des.qld.gov.au)).

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