BURDEKIN DRY TROPICS NATURAL RESOURCE MANAGEMENT PLAN 2016 - 2026

NQ DRY TROPICS

Australian Government

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Please reference as:

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FOREWORD

We are privileged to live in the beautiful Burdekin Dry Tropics region, which boasts extraordinary biodiversity, world-class wetlands, prime agricultural land, and the Great Barrier Reef World Heritage Area (GBRWHA).

Our region's future economic, social and environmental prosperity relies on protecting our natural resources, which include water, soil and air. It is crucial that we sustainably manage these natural resources so that future generations can swim, dive, fish, keep cattle, grow crops, and continue to enjoy the wonderful lifestyle our region has to offer. This means protecting the environment and maintaining the agricultural and industrial productivity that supports our economy.

That's why the Burdekin Dry Tropics Natural Resource Management (NRM) Plan is so important. It sets out a blueprint to guide future planning and investment priorities for NRM in our region. It:

- highlights the threats that we face, and puts forward strategies to manage them;
- identifies a diverse range of opportunities to enhance our management of natural resources;
- promotes partnerships between government, community groups, industry, scientists and NRM organisations – because working together and sharing knowledge leads to better results; and
- recognises that land managers need support and training to implement innovative, sustainable practices.

This strategic plan was developed under our guidance, and in consultation with land holders, technical experts, government, landcare groups, industry groups and the wider Burdekin Dry Tropics community. We actively sought input from the community and we have listened to those who provided input, and sought to accurately reflect their views and priorities in this document.

The plan belongs to the people of the Burdekin Dry Tropics region, and its success depends on community support and involvement. We believe it is a valuable tool that will play a key role in shaping our response to the NRM issues that affect us all.

The Burdekin NRM Plan Community Governance Group

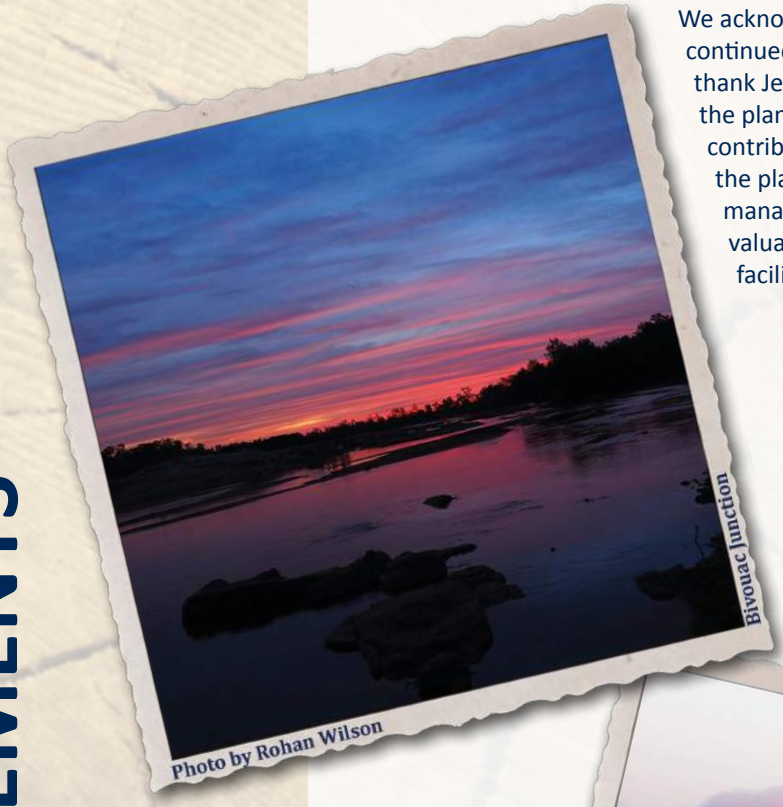
The people who live and work in our region and whose health, wealth and wellbeing depend on its natural resources, own this plan.

ACKNOWLEDGEMENTS

NQ Dry Tropics prepared the update of the Burdekin Dry Tropics Natural Resource Management Plan under the generous guidance of members of a community Governance Group – Burdekin Traditional Owner Management Group & Girringun Aboriginal Corporation (Phil Rist), CANEGROWERS Burdekin (Debra Burden), CSIRO (Nadine Marshall), Queensland Department of Agriculture & Fisheries (Adam West), Great Barrier Reef Marine Park Authority (Donna Audas), Lower Burdekin Water (David Sartori), North Queensland Conservation Council (Wendy Tubman), NQ Dry Tropics Board (Julia Broad), NQ Dry Tropics (Scott Crawford), Townsville City Council (Bronwyn Bignoux). We also recognise Bob Spiers' guidance in the initial stage of plan drafting and the support of the Australian Government in funding this project.

We would especially like to thank all those people and organisations who contributed to developing this plan through providing advice, filling in surveys, attending forums, and making submissions. This plan would not have been possible without your involvement.

We acknowledge the NQ Dry Tropics Board for its continued support for the plan. We would like to thank Jesseca Carver for her tireless effort in drafting the plan, and we acknowledge the combined contribution of NQ Dry Tropics staff, in particular the planning, communication and information management teams. We also recognise the valuable contribution by the late Candia Bruce in facilitating the Governance Group meetings.



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GLOSSARY

ANZECC Water Quality Guidelines	Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC Water Quality Guidelines) provide guideline values (numbers) or descriptive statements for different indicators to protect aquatic ecosystems and human uses of waters (e.g. primary recreation, human drinking water, agriculture, stock watering).
Basin	The portion of land drained by a river and its tributaries where surface water channels to a hydrological network (i.e. river, stream, creek) and discharges at a single point. A basin can also be referred to as a catchment (or a watershed) but tends to be used when discussing a whole of river system.
BDT	Burdekin Dry Tropics
Biodiversity	The term given to the variety of life on Earth. It is the variety within and between all species of plants, animals and micro-organisms and the ecosystems within which they live and interact.
Biogeochemical cycling	The flow of chemical elements between living organisms and the environment.
Biogeographic	The distribution of species and ecosystems in geographic space and through (geological) time.
Bioregion	Relatively large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems. They capture the large-scale geophysical patterns across Australia. These patterns in the landscape are linked to fauna and flora assemblages and processes at the ecosystem scale, thus providing a useful means for simplifying and reporting on more complex patterns of biodiversity.
Carbon dioxide equivalent	A quantity that describes, for a given mixture of greenhouse gases, the amount of carbon dioxide that would have the same global warming potential.
Carbon exchange	The movement of carbon between organic compounds and the atmosphere.
Catchment	See 'Basin'
Coal fugitive	Emissions released from equipment leaks, emissions from the bulk handling, extraction or processing of raw materials, and other industrial processes.
Community infrastructure	Appropriate services and facilities to support identified community needs.
Diffuse pollution	Pollution from widespread activities with no one discrete source.
Ecological processes	The physical, chemical and biological actions or events that link organisms and their environment.
El Niño Southern Oscillation	An irregularly periodical climate change caused by variations in sea surface temperatures over the tropical eastern Pacific Ocean, affecting much of the tropics and subtropics. The warming phase is known as El Niño and the cooling phase as La Niña.
Endemism	Ecological state of a species being unique to a defined geographic location, such as an island, nation, country or other defined zone, or habitat type; organisms that are indigenous to a place are not endemic to it if they are also found elsewhere.
Environmental values (EV)	Ecological relevant qualities of waterways that need to be protected from the effects of pollution, waste discharges and other threats to ensure aquatic ecosystems are healthy and waterways are safe for community use.
Ephemeral	Lasting for a short time.
Essential habitat	The vegetation in which a species that is Endangered or Vulnerable under the *Nature Conservation Act 1992* has been known to occur.
Eutrophication	Excessive richness of nutrients in a lake or other body of water, frequently due to run-off from the land, which causes a dense growth of plant life.
Fertigation	Fertigation is the practice of applying fertiliser in a liquid form to a crop via the irrigation system.
Friable	Easily crumbled.
GBR	Great Barrier Reef
High biodiversity areas	The biodiversity value of an area is assessed on an extensive set of attributes such as relative size or condition, whether it is habitat for threatened species, or if it provides connectivity across the landscape. https://www.qld.gov.au/environment/plants-animals/biodiversity/assessing/
JAMBA and CAMBA agreements	Agreements that list terrestrial, water and shorebird species which migrate between Australia and the respective countries. Both agreements require the parties to protect migratory birds by: limiting the circumstances under which migratory birds are taken or traded; protecting and conserving important habitats; exchanging information; and building cooperative relationships.
Landcare	Landcare is a social movement where people address environmental issues at the local level.

Mono-species	Composed of organisms of a single species.
NRM	Natural Resource Management
NRM Community groups	Active volunteer groups that play an important role in conserving natural resources in our region. They are affiliated with Landcare groups, other community 'care' groups (environment and NRM collectives), Indigenous groups and not-for profit organisations.
Net present value	The difference between the present valueof cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of a projected investment or project.
Point source pollution	A point source is a stationary location or fixed facility from which pollutants are discharged or emitted.
Ramsar-listed wetlands	Refers to wetlands recognised under the Convention on Wetlands of International Importance – an inter-governmental treaty between nations aiming to conserve natural resources. Australia was the first nation to become a Contracting Party to the Convention which was signed in 1971 in the small Iranian town of Ramsar. The Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain. https://data.qld.gov.au/dataset/ramsar-sites-queensland
Regional ecosystem	A distinct vegetation community that occurs in association with a particular combination of geology, soil and landform in a specific bioregion.
Ruminants	An even-toed ungulate mammal that chews the cud regurgitated from its rumen. The ruminants comprise of cattle, sheep, antelopes, deer, giraffes, and their relatives.
Rural population	Rural and remote regional Queensland for the purposes of population statistics comprises the 39 Local Government Areas outside of South East Queensland that are either without a regional urban centre or have defined urban centres of less than 30,000 people as at 30 June 2011.
Sclerophyll	A woody plant with evergreen leaves that are tough and thick in order to reduce water loss.
Sheet erosion	Erosion that removes surface material more or less evenly from an extensive area as contrasted with erosion along well-defined drainage lines that produces or enlarges gullies or ravines.
Socio-ecological system	Consists of 'a bio-geo-physical' unit and its associated social factors and institutions. Socio-ecological systems are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context.
Statutory planning framework	The legal framework through which development is controlled. This includes Local Government Planning Schemes, State legislation and sometimes Federal legislation.
Sub-catchments	A division of a catchment, allowing runoff management as near to the source as is reasonable.
Supplemented water	Water that is supplied via licensed or authorised water supply infrastructure.
Sustainable NRM	Sustainable natural resource management is maintaining the ability or capacity of the natural resource, such as land, water, marine and biological systems, to sustain itself with a particular focus on how the management affects the quality of life for both present and future generations.
Threatening process	Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.
Unsupplemented water	Water that is not supplied by the operation of water storage infrastructure.
Water quality objective (WQO)	WQOs are long-term goals for water quality management that enhance or protect EVs. WQOs are established for different physical, chemical and biological indicators of water quality (such as salinity, turbidity, nutrients, pesticides, macroinvertebrates).
Wet-season spelling	Spelling paddocks from livestock during a wet season.

EXECUTIVE SUMMARY

VISION

The healthy natural resources of the Burdekin Dry Tropics Region support a healthy community, a healthy environment and a healthy economy.

1. PURPOSE OF THIS PLAN

Natural resources include everything that is not made, grown or bred by people – including soils, water, air, minerals, nutrients, animals, plants, biodiversity, plains, mountains, rivers, wetlands, reefs, coastlines and oceans. If we don't protect and maintain our resource base, we risk losing the foundations on which our regional societies, communities and economies are built. The Burdekin Dry Tropics region is experiencing changes in climate, industry, technology, community and land use, all of which provide challenges for our natural resource base.

This community plan outlines high-level strategies to manage these challenges, by protecting the region's rich biodiversity, including wetlands, beaches and the iconic Great Barrier Reef, while improving long-term productivity for graziers, sugarcane farmers and horticulturalists.

It aims to help us understand how governments, land managers and the wider community can work together to make the most of our shared natural resources.

Effectively addressing these challenges requires a holistic approach, which is why we have chosen to identify problems and solutions across five closely interconnected themes: People Connections; Climate Change; Land; Water and Biodiversity. For each theme, we highlight key objectives, identify strategies to achieve these objectives, and outline the success indicators that will track our progress.

This plan updates the original Burdekin Dry Tropics Natural Resource Management Plan (2005-2010) to incorporate new information, best practices and technologies. It differs from the original plan in that it is a strategic level document which is supported by action plans that have been developed since 2005. It belongs to the Burdekin Dry Tropics community, and is complemented by a wealth of additional information located on our online information hub.

2. PLANNING METHODOLOGY

We drew on the best available knowledge to develop the plan. Between March 2013 and May 2016, we consulted closely with the regional community, and 14 natural resource management (NRM)

Planning context and linkages
This community plan outlines the high-level strategies that will help natural resource managers and users to make robust decisions, coordinate our combined regional NRM efforts and direct regional investment. This is an umbrella plan which links with a myriad of statutory and non-statutory plans and policies with differing scope, scale and intents to achieve and deliver common goals and objectives for our region.

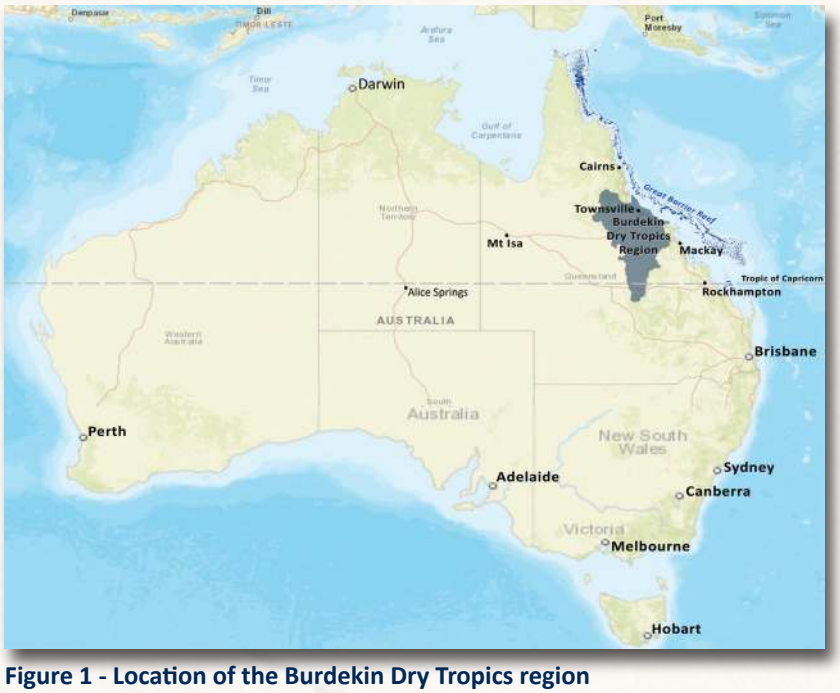


Figure 1 - Location of the Burdekin Dry Tropics region

Why we adopted a systems approach

"From an Aboriginal perspective it is extremely important that we manage our natural resources because we are connected to that tree, ... to that water hole. The blackfella 'legislation' ... links that all together. It is a very finely tuned connection between us and our environment, completely based on sustainability. We have a very sincere connection with those animals and those plants and it is engrained in our stories ... It is extremely important that we manage that system so it is there for all of us".

Phil Rist – Nywaigi Elder 2013

groups operating across Queensland. We considered international and national agreements, and Australian and Queensland Government legislation, programmes, strategies and plans.

A NRM Community Governance Group guided the planning process. We made every effort to represent the views of those who value and actively care for the region's natural resources. The plan captures hundreds of community suggestions and requests. Contributions came from individuals and representatives from a range of groups, organisations, industries, social sectors and geographic areas. Suggestions were also provided by technical experts, NRM industry leaders, and researchers from within the region and across Australia. The plan also draws on:

- the Indigenous Caring for Country Plan (2005);
- the original Burdekin Dry Tropics NRM Plan (2005);
- the Regional Pest Management Strategy (2014-2019); and
- the Burdekin Water Quality Improvement Plan (2016).

3. OUR REGION

Located in North-Eastern Queensland, our region covers eight per cent of the State. It spans a great variety of landscapes, with a land area of approximately 134,000km^2 and 12,000km^2 of sea country (see Figure 1). The Burdekin River catchment is the second biggest in Queensland, covering an area approximately the size of Tasmania. It defines much of our region, along with the adjoining smaller coastal catchments of the Don River, Haughton River, Ross River and Crystal Creek at the most northern extent.

3.1 Our natural resources

Our region has outstanding natural resources. Our coastal and marine area is dominated by the iconic Great Barrier Reef World Heritage Area and the region contains the southern extent of the Wet Tropics World Heritage Area, and Bowling Green Bay National Park – an internationally-recognised Ramsar-listed site containing one of Australia's largest wetlands (Shilton, 2005). Our region's ecosystems span three bioregions, and are highly-productive, richly diverse, and contain many organisms found nowhere else. Two of Australia's National Biodiversity Hotspots are found here. Pasture lands are distributed throughout the Burdekin rangelands and inland coastal areas. Soils suitable for dryland and irrigated cropping are also located in areas throughout the region. These areas provide our community with substantial environmental, economic and social benefits.

3.2 Our people

The region's population of about 240,000 has grown by approximately 30 per cent since 2005, with most new growth occurring in Townsville. The Queensland

Treasury expects approximately 140,000 additional residents by 2036 (Queensland Government Statistician's Office, 2015b). The population is concentrated in the major urban centres of Townsville (the largest tropical city in Northern Australia), Ayr, Bowen and Charters Towers. Many inland centres are very small, and service large, sparsely scattered pastoral properties or mines (see Figure 10, p 43). These often isolated communities are facing the twin challenges of declining numbers and increasing average ages. The Traditional Owners of country have the longest and deepest connection with the region's natural resources, and play an important role in protecting our natural resources for future generations.

3.3 Our enterprises

Beef production, cane growing, horticulture, and commercial fishing have been established in our region for well over a century. The region is also heavily-reliant on mining, energy industries and tourism. Agriculture dominates the landscape, with beef cattle grazing covering over 96 per cent of the region's land area. While less than nine per cent of the population is involved in grazing, it is by far the most important employer in rural and remote areas. The Burdekin Shire contains Northern Australia's largest irrigation area, with approximately 1,100 km^2 under irrigation, using both groundwater and surface water (Department of Agricultural and Fisheries, 2013). Dryland cropping is widespread in the Belyando-Suttor sub-catchment. The local tourism industry is also highly-focused on showcasing our region's natural assets.

The region is a hub for natural resource value-adding industries, associated essential services, and expertise, and is home to key research institutions focused on the environment and NRM. The two major ports of Abbot Point and Townsville connect our resources with world markets, and Townsville is strategically connected to major road and rail networks to the north, south and west of the region.

Governments have identified the Northern Australia zone as having strong potential for future agriculture and infrastructure development and expansion (Australian Government, 2015b). Our region is uniquely-positioned to accommodate agricultural expansion, diversification and value-adding opportunities. While agriculture and mining could be expanded in the region, any decision must consider implications for natural resources, including water availability, land capacity, biodiversity and protecting coastal wetland, marine and reef environments.

Mt Pleasant Station's Jamie Gordon wins Premier's Rural Sustainability Award

Mt Pleasant Station has undertaken the Grazing Best Management Practice and has demonstrated how changes in management practices can improve landscape condition, stop the decline in pasture, increase drought resilience, while running a profitable, commercial enterprise.

It's a great result for their property and also for graziers. It demonstrates that graziers are doing the right thing, and committed to being good stewards of their land.

The health of the natural resource base must be managed for maximum performance. The health of the landscape determines the health of the animals. The goal of Mt Pleasant Station is quality food from healthy animals, grown in a healthy environment to feed our community.

6 November 2015
(Agforce Projects, 2015)

Photo: Charles Burke (Agforce CEO), Jamie Gordon (Mt Pleasant Station), Steven Miles (Qld Minister for Environment & Heritage, Minister for National Parks and the Great Barrier Reef).

4. OUR PRIORITIES

4.1 People connections

Strongly connected, well-informed and highly-skilled communities are the region's greatest NRM assets. Sustainably managing our natural resources depends on these communities – including rural land managers, Traditional Owners, NRM community groups, industry, researchers and all levels of government – working together and being empowered to make informed NRM decisions. The strong spirit of regional collaboration is illustrated by a wide range of decision-making forums, and formal and informal partnerships between groups. Traditional Owners have a crucial role to play, given their connection with the land and their traditional ecological knowledge.

The strategies in our plan aim to:

- connect and inform the regional community so it is empowered to participate in NRM;
- build on existing networks and create opportunities for new connections to share knowledge;
- coordinate NRM research, education, investment and extension to reduce duplication, increase effectiveness, and improve accessibility to NRM knowledge;
- reflect our regional community's priorities and desired actions by providing opportunities to be involved in NRM planning and decisions;
- ensure the region's natural resource data and mapping is updated and accessible, so it can provide the basis for informed NRM decisions;
- support improved collaboration between NRM community groups;
- build capacity of Traditional Owners to appropriately capture, store and use traditional ecological knowledge;
- increase the opportunities for Traditional Owners to connect to country by supporting training, employment and enterprise opportunities, access to country arrangements, and partnerships with other organisations;
- provide rural land managers with the information and skills to make sustainable land management decisions; and
- promote collaboration between the agricultural, financial, environmental, government, research, education and training sectors to develop long-term, region-specific support processes for rural communities.

4.2 Climate change

Climate change is threatening the Great Barrier Reef (GBR) and its catchments, our natural resource-reliant enterprises and communities. The GBR is currently experiencing its worst coral bleaching event on record primarily caused by elevated sea temperatures. Our grazing industry is experiencing drought conditions, with nearly 80 per cent of our region currently drought declared. Predicted regional effects from a changing climate include longer drier periods, more hot days and less frequent but more intense storm systems. This could mean less water resources and more pressure on biodiversity and land productivity. Land managers and communities are understandably concerned by predictions of more prolonged periods without rain.

The strategies in our plan aim to:

- support programmes that assist individuals, local councils and industries to reduce carbon emissions and capture carbon;
- investigate and promote commercially competitive, alternative and renewable electrical energy, fuel resources and consumable products;
- incorporate climate change projections into planning and NRM;
- build capacity of our communities and individuals to adapt to climate change impacts; and
- improve the resilience of our natural resources by protecting areas of 'native refugia' and investigating:
  - innovative land and water management practices;
  - crop diversification and switching;
  - new enterprises; and
  - the pest and biosecurity implications of higher temperatures.

4.3 Land


Photo by Joan Ruffle

Land resources are finite, and need to be appropriately planned for and managed to ensure their ongoing economic and environmental productivity. Land managers and community groups need a range of support, including training, extension, and easy access to available information on the condition of our natural resources and how to best manage them. With over 97.4 per cent of our region being rural, ultimately a large part of NRM governance is carried out by graziers and farmers through their own initiative and funds, as well as through partnerships with industry and government that provide flow-on benefits throughout the community.

The strategies in our plan aim to:

- provide land managers with information, training and extension that support best management practices;
- ensure significant projects and infrastructure development incorporate measures to protect and manage natural resources, including groundwater and downstream impacts;
- consider land capacity prior to expanding new irrigated and dryland cropping areas;
- ensure land use planning prevents increased development in natural hazard areas;
- support land managers to better identify the capability of their land, adopt innovative management techniques, and employ best management practices that improve land condition;
- provide regional strategic direction for land management and long-term improvement in soil health;
- reduce adverse impacts of pests and weeds on agricultural land productivity;
- prioritise soil health by supporting the development and promotion of innovative methods to maintain and increase soil carbon and soil chemistry within cropping, horticulture and grazing systems;
- avoid or, where it is occurring, remediate gully and stream bank erosion;
- reduce the extent of dryland salinity and protect the environment from the impacts of disturbing acid sulfate soils; and
- reduce risks to community safety, the environment and rural activities from abandoned mines, processing plants and exploration activities.

4.4 Water


Photo by Doug Willis
Burdekin Falls Dam

The region's community identified water as the most important resource requiring management and protection. Major issues include increasing demand for water, quality of water entering GBR-connected waterways and Bowling Green Bay wetlands, and altered surface and groundwater interactions in the Lower Burdekin sub-catchment.

The community and governments have a strong commitment to protect the GBR as an exceptional natural resource. The major threats to the health of the GBR are declining water quality, coastal development and climate change. Increased sediment, nutrient and pesticide runoff from agricultural land uses are the greatest cause of declining water quality on the GBR. The Burdekin River catchment generates the single largest source of suspended sediment to the whole GBR (Bainbridge, et al., 2013).

Increased investment in the past 10 years has helped us to better understand water resource condition and to provide support to tackle declining water quality, but more is needed. Land managers in our region need the information and support to continue to adopt innovative and improved land and water management practices.

The strategies in our plan aim to:

- ensure that water resources are sustainably managed, and that planning decisions incorporate environmental values, and pressures from climate change, increased demand and development;
- promote the adoption of water-efficient technology and water-efficient urban and industrial use and farming practices;
- manage environmental flows for the health of natural ecosystems, for example to allow for drying and wet seasonal flushes of coastal wetland ecosystems;
- promote activities that ensure groundwater table levels and salinity concentrations in the Lower Burdekin are maintained at optimum levels;
- support efforts to reduce nutrient and sediment loads to the GBR, to achieve targets identified in the

Burdekin Water Quality Improvement Plan (2016) and Reef 2050 Plan;
- remediate and control gully erosion in high priority areas as identified in the Water Quality Improvement Plan;
- support land managers to implement best management practices to conserve water resources and incorporate environmental outcomes into their management systems; and
- establish a *systems repair* and prevention approach for the wider NRM community to address holistic sub-catchment and ecosystem health issues – identifying what is needed to restore and maintain the function of coastal wetland ecosystems.

4.5 Biodiversity

Our region's rich biodiversity is being threatened by:
- declining water quality and land condition associated with land management practices;
- weeds and pests; and
- climate change.

The strategies in our plan aim to:
- maintain landscapes in good biodiversity condition and rehabilitate poor condition landscapes;
- improve the distribution, composition and diversity of regional ecosystems, and native plants and animals;
- effectively manage the adverse impacts of pest plants and animals on our region's biodiversity, environment, economy, society and culture;
- maintain terrestrial habitats of sufficient size and condition to support functioning ecosystems and healthy and viable populations of native plants and animal species;
- maintain riparian vegetation to protect catchment connectivity, bank stability, stream processes and water quality;
- protect natural wetland conservation values and ecological processes from the effects of excessive irrigation, to help reintroduce natural season wetting and drying cycles; and
- establish and implement a regional Conservation Action Plan.

5. OUR PLAN

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*
>
> World Commission on Environment and Development, 1987

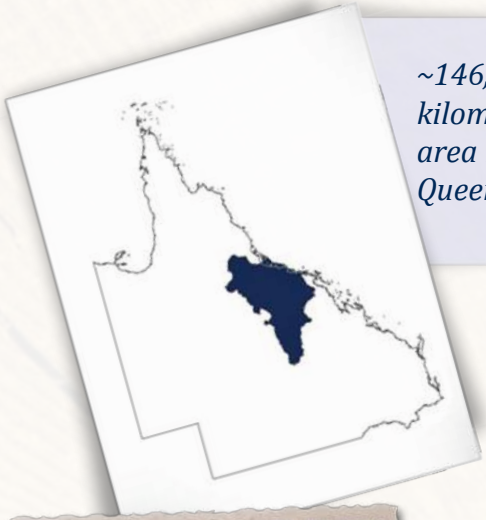
This plan is an active document, which we will update as new information about the condition and management of natural resources becomes available. The plan identifies the priorities, challenges and opportunities faced by the community. It is delivered in three parts:

Part A: Regional Scene Setting – Provides an overview of our region and community priorities for each sub-region. These priorities have been reflected in our regional goals, objectives and strategies described in *Part B: NRM Strategic Direction*.

Part B: NRM Strategic Direction – Identifies the broad natural resource management priorities for our region, which have been grouped into five interconnected themes. Each theme includes a 'snapshot' (discussion of condition, management and issues) and 'delivery section' (objectives, strategies and success indicators).

Part C: NRM Planning Framework – Outlines the process to facilitate the delivery of the NRM plan, for updating the plan and celebrating achievements.

PART A: REGIONAL SCENE SETTING



~146,000 square kilometre area (8% of Queensland)

Diverse land use

16 Traditional Owner Groups

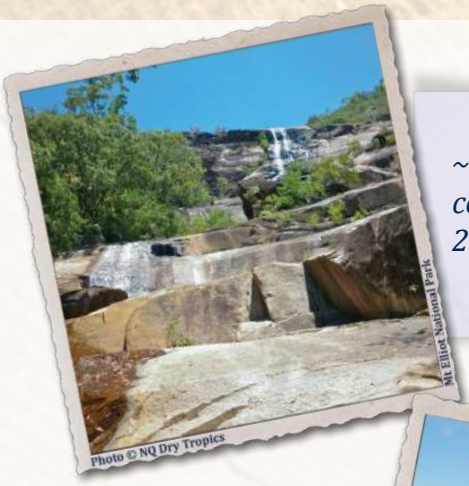
> *"Land is our Mother, we come from her and go back to her"*
>
> Traditional Owner Group 2015

~240,000 people live in the region

>90% of region grazing land

~0.8% of region sugarcane land (1/4 of Australia's total annual cane supply)

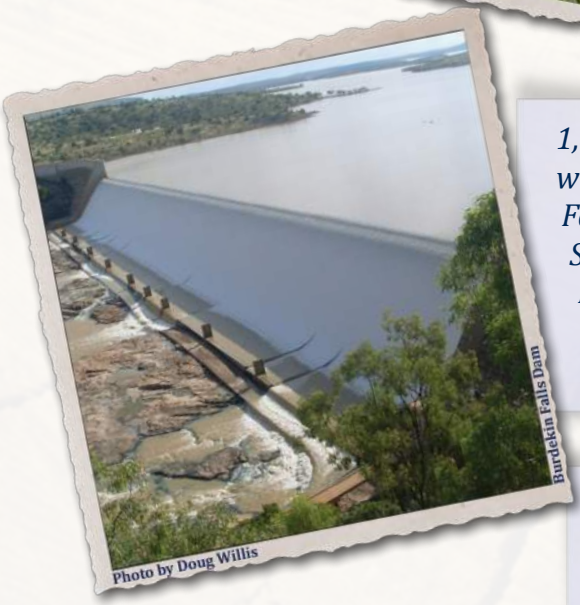
<1% of region forestry land



~6% of region conserved land
25 National Parks

34 nationally important wetlands
1 Ramsar wetland

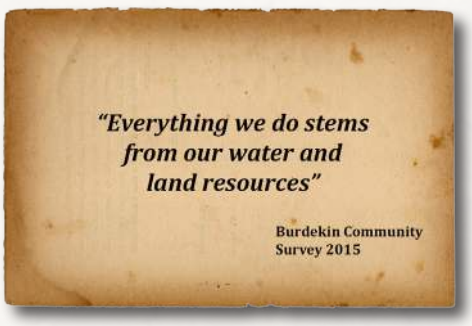
500 km coastline of the Great Barrier Reef World Heritage Area; part of the Wet Tropics World Heritage area



1,860,000 megalitres of water stored in Burdekin Falls Dam (4 times Sydney Harbour); Burdekin River is 4th largest in Australia by volume

21 endangered species;
2 critically endangered

What words come to mind when thinking about the Burdekin Dry Tropics Region
Burdekin Community Survey 2015



RESOURCE-RELIANT ENTERPRISES

Our region's economy relies heavily on natural resource-based industries – the gross value of commodities produced in our region for 2014-15 was an estimated $1,228.9m (Australian Bureau of Statistics, 2016) (described below). The region is well placed to support sustainable and diverse enterprises due to its significant water volumes captured by the Burdekin Falls Dam (Queensland's largest dam), fertile soils, pasture-rich rangelands, mineral-rich geologies, wild fish stocks and unique natural wonders. Building on these enterprises, our region is a leader and hub in value-adding industries, associated essential services, and expertise in natural resource research, management and marketing. Strategic infrastructure is also a significant feature that strengthens the region's competitiveness, including two major ports – Townsville and Abbot Point, which connect our resources to world markets. All of these enterprises create ancillary businesses and services that provide local employment.

Grazing

- 9% of population involved in grazing on over 90% of region's land area.
- About 1,400,000 head of cattle run for local markets and box/chill and live export to various global markets (Australian Bureau of Statistics, 2015).
- Gross value of production estimated $511.7m for cattle livestock slaughtered and other disposals (Australian Bureau of Statistics, 2016).

Challenges

- Climate variability.
- Market drivers (eg. strength of Aus $ and export demand).
- Business costs.
- Regulation.
- Protecting the GBR.
- Ownership of abattoirs.

Opportunities

- Integrated multi-purpose pastoral land use and management, including tourism and carbon sequestration.

Commercial Fishing

- Includes commercial trawling, net and crab (pot) fisheries that take prawns (tiger, red-spot king, endeavour and banana), scallops, bugs, grey mackerel, barramundi, threadfin and mud crabs (Beumer, et al., 2012).
- Marine wild fishing returned an average of around $67m/yr (Centre for International Economics, 2013).
- Established aquaculture businesses in region are worth around $35m/yr (Centre for International Economics, 2013).
- 22 – 28% of people in region enjoy recreational fishing (Farr, 2013).

Challenges

- Predicted climate change impacts.
- Decline in water quality.
- Lack of fish passage connectivity.
- Adverse impacts on intertidal nursery habitats and marine ecosystems.

Opportunities

- Expansion of sustainable aquaculture operations using new technology.
- Innovation to reduce barriers to fish passage and trawling by-catch.

Cropping and Horticulture

- The Burdekin Falls Dam, groundwater and fertile soils enable cropping and horticulture mainly along the coast and Lower Burdekin sub-catchment.
- Irrigated agriculture based on groundwater e.g. Don sub-catchment, and water harvesting from rivers in the Upper Burdekin, Cape, Belyando and Suttor sub-catchments.
- The quality and security of regional produce makes it desirable to international markets.
- Key crops include sugar, tomatoes, capsicums, melons, mangoes (among many others) and large areas of cereal crops in southern inland areas.
- Major value-adding industries include sugar milling, and crop packaging and handling.
- Gross value of production estimated $697.9m pa (Australian Bureau of Statistics, 2016).
- Broad acre crops $402.5m pa, main products are:
  - crushed cane/$355.2m
  - sorghum/$38.1m.
- Horticulture $286.2m pa, main products are:
  - tomatoes/$59.3m, capsicums/$41.7m, melons/$37.2m, beans/$15.6m, mangoes/$14.4m, potatoes/$6.2m.

NOTE: The ABS figures are estimates based on information obtained from respondents to the Rural Environment & Agricultural Commodity Survey (REACS) for year ended 30 June 2015 and are subject to sampling variability. Data received from Queensland Department of Agriculture and Fisheries for horticulture enterprises in our region (Mullins, 2016) show a higher value of production for the 2014-2015 year as:

- Horticulture for the Bowen Gumlu Agricultural Precinct $449m pa, main products are:
  - tomatoes/$161m, capsicums/$104m, beans/$69 m.
- Horticulture for the Giru area $117.48m pa, main products are:
  - rockmelon and honeydew/$29m, mangoes/$20m, watermelons/$17m.

Challenges

- Ownership of sugar processing and marketing.
- Bio-security.
- Global market shifts.
- Business costs and regulation.
- Declining soil health.
- Protecting the GBR.

Opportunities

- Regional expansion and diversification.
- Ethanol production from sugarcane.
- New technologies.

Energy
- Energy and fuel is sourced from outside of region. Private solar energy is increasing in popularity throughout region.

Challenges
- Land-use conflicts with good quality agricultural land.

Opportunities
- Development of regional electricity generation (particularly renewable energy), operating gas and liquid biofuel production.
- Proposals for solar farms potentially powering tens of thousands Queensland homes (Clare Solar Farm, 2015).
- Proposals for biofuel production and co-generation power sourced from sugarcane and sorghum in Lower Burdekin (Austcane Energy Ltd, 2015) and Pentland (Renewable Development Australia, 2015).
- State Government mandate to promote use of biofuels towards a clean energy economy (Department of Energy and Water Supply, 2015).

Tourism
- Heavily dependent on experiencing our natural environment.
- Employs around 4,000 people, 1,047,000 visitors with an annual expenditure of about $764m (Destination Q, 2015) (Townsville Enterprise, 2014).
- Key tourism assets include the GBR and remote islands, Magnetic Island; mainland beaches; wetlands and rivers (including Bowling Green Bay); Townsville and other urban centres; Paluma rainforests; and national parks.

Challenges
- Foreign currency exchange rates.
- High local labour costs.
- Global economic volatility.
- Remote to international markets.
- Significant threats to the vitality of the GBR and coastal ecosystems from development, pollution and climate change.

Opportunities
- Expansion of adventure tourism, ecotourism and cultural tourism, including on Palm Island.
- Further develop industry experiential tourism (farm stays, working on Orpheus Island or on NRM projects).

Defence
- Centred around Townsville including the largest military base in Australia – Lavarack and Ross Island Barracks, RAAF Base, Townsville Field Training Area and Port.

Opportunity
- Large landholder with significant well resourced conservation and land management programmes.

Mining, extraction and mineral processing
- Employs around 4,295 people, 12,789 additional flow on employees, and has a gross regional product of about $2.2b (data for Townsville, Charters Towers, Burdekin and Whitsunday LGA's only) (Queensland Resources Council, 2015).
- Active exploration and mining of gold has occurred for 150 years.
- Major coal reserves in Bowen and Galilee geologic basins.
- Galilee is one of the largest untapped coal reserves on the planet (Galilee Basin, 2015).
- Coal shipped to overseas markets via Abbot Point bulk coal port.
- Sand and gravel extraction and rock quarrying along the coast is regionally essential for building and construction.
- Townsville has three major mineral processing operations: Queensland Nickel refinery (currently under care and maintenance), Sun Metals Zinc refinery and Glencore Copper refinery.
- Townsville Port is strategically placed on the Pacific Rim to access the global mineral processing market.

Challenges
- Declining coal price and markets.
- High carbon emissions.
- Potential environmental impacts to surrounding environment and GBR.
- Risk to surface and groundwater.
- High financial leakage from the region due to 'fly in fly out' workforce (Office of Economic and Statistical Research, 2012).

Opportunities
- Nine coal mega mines planned for region would generate large workforces in construction and operations.
- Projects may include rail and port construction.

Education and Research (E&R)
- Strong expertise hub exists in region.
- E&R underpins much of knowledge and technological innovation, which supports more sustainable use of natural resources.
- Major NRM E&R organisations include James Cook University, Australian Institute of Marine Science, and CSIRO as well as industry bodies Agforce, Meat and Livestock Australia, Sugar Research Australia and Government Agencies.

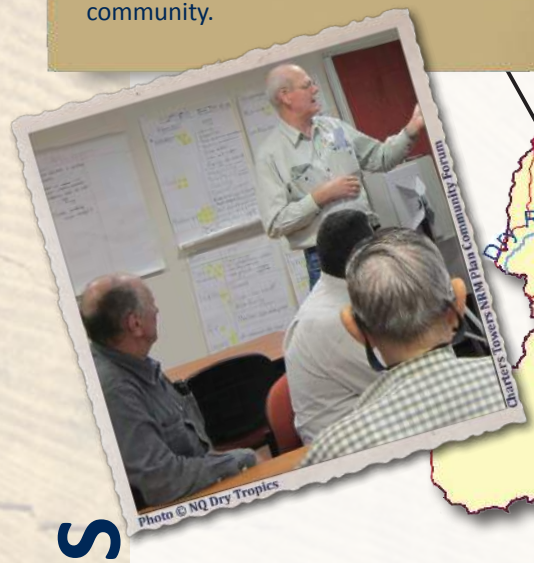
Challenges
- Inconsistent funding arrangements.
- Getting the information to land managers in a coordinated manner.

Opportunities
- Developing new technologies and practices that:
  - o improve productivity,
  - o minimise impacts on receiving environments,
  - o protect biosecurity and
  - o improve land and water management.
- Increased networking and collaborative use of funding resources.
- Improved business and regulatory education/ understanding.

SUB-REGIONAL SYSTEMS

The 2005-2010 Burdekin Dry Tropics Natural Resource Management (NRM) Plan was developed in consultation with a range of sub-regional communities, to ensure that it incorporated local values and knowledge. We built-on this process to develop the 2016 plan, conducting community forums around our region to capture local input. The following summarises the landscapes, people and priorities in each of the five sub-regions. These sub-regional priorities are reflected in the regional goals, objectives and strategies described in *Part B: NRM Strategic Direction*.

BURDEKIN RANGELANDS: NRM involves us all. With our variable climate, every drop of water counts in making our soils productive for all plants and animals. We will work together to face pest and weed issues and share our knowledge about how healthy country can support a resilient and productive community.



TOWNSVILLE COASTAL PLAINS & OFFSHORE: Townsville has a great variety of natural and built environments, and community will be supported to use and appreciate them. We recognise how our food and lifestyle choices can impact local produce markets and create pollution. We are rising to the challenges of helping everybody learn from past mistakes in soil and water management so that future generations can experience healthy urban and reef ecosystems.

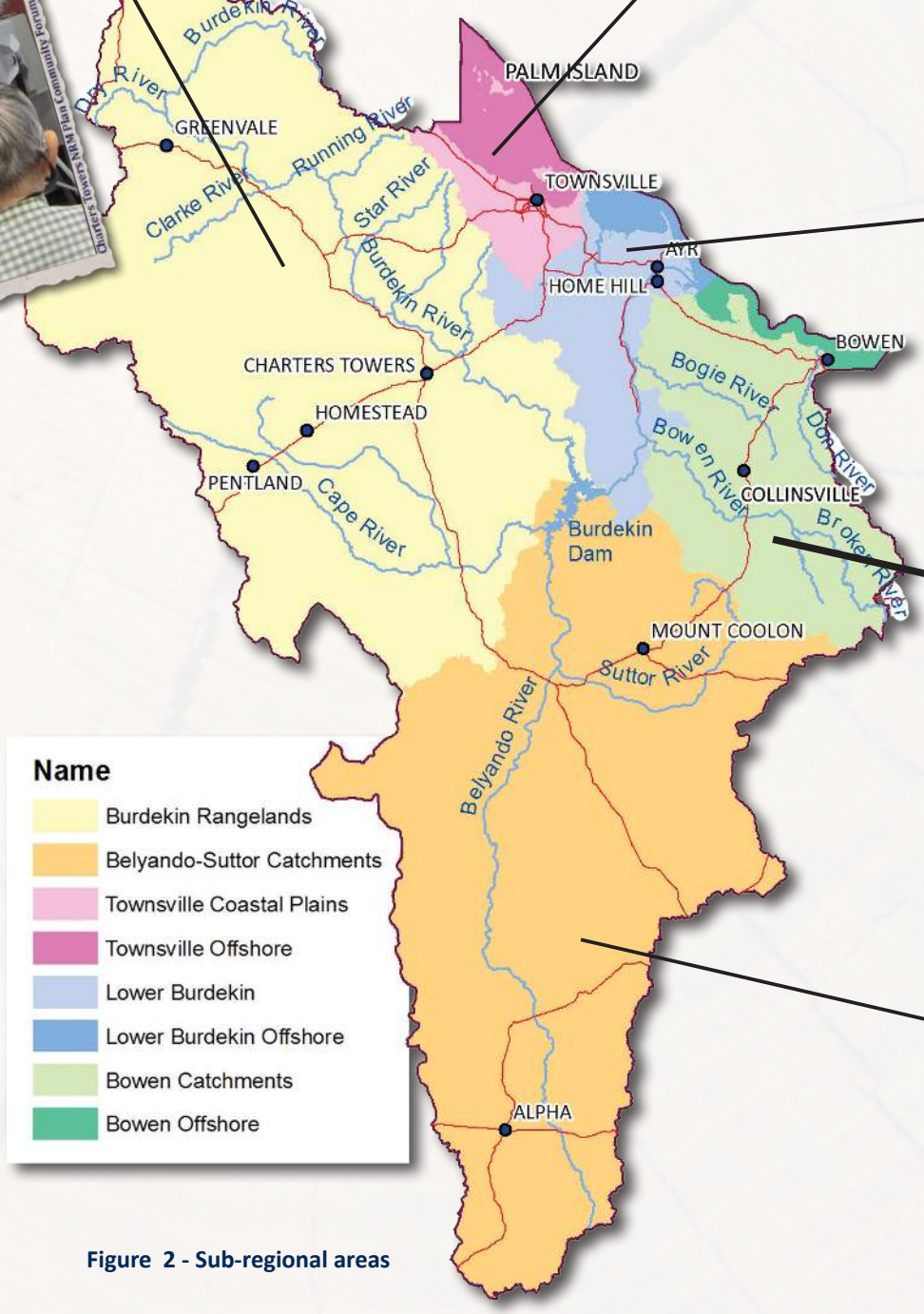


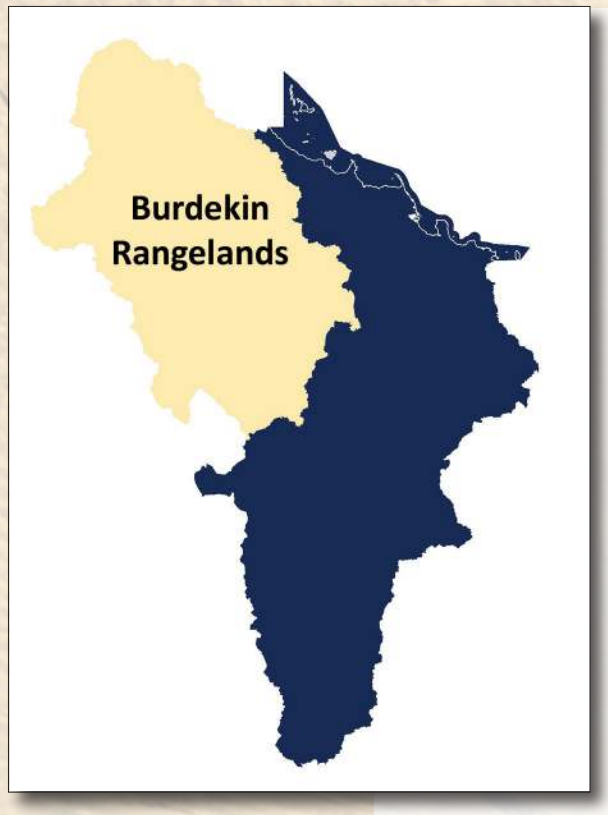
Figure 2 - Sub-regional areas

LOWER BURDEKIN & OFFSHORE: We will be guardians of our land and oceans, so that we have healthy food production and an outdoor life for our families and visitors for generations to come.

BOWEN CATCHMENTS & OFFSHORE: We value local knowledge of land and soils, waterways, the coast, sea and reef. This needs to be integrated into management decisions to guide natural asset protection for long-term development and high industry productivity.

BELYANDO-SUTTOR: We will work to create a healthy natural environment, cared for and shared by the community, which is sustainably productive and valuable for generations to come.

BURDEKIN RANGELANDS



Country

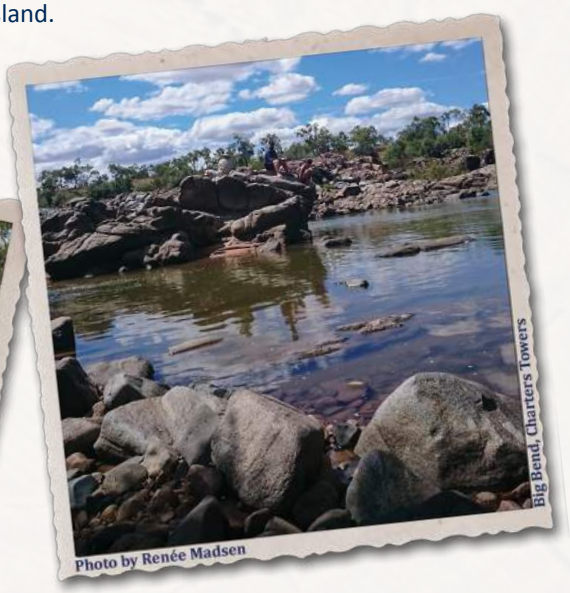
The Burdekin Rangelands sub-region is bound by mountains, and a large proportion of the area consists of strongly undulating terrain. To the west, the basalt plateaus of the Great Dividing Range rise to over 900m. The crest of the eastern ranges near Paluma supports rainforest and includes the southern extent of the Wet Tropics World Heritage Area.

This sub-region features a small area of the Einasleigh Upland bioregion in the north, the Northern Brigalow bioregion in the centre, and the Desert Uplands bioregion in the south-west. Vegetation includes acacia open forest and eucalypt woodland. The Dalrymple, White Mountains and Great Basalt Wall national parks are found in the rangelands, along with nationally important wetlands including Lake Dalrymple. The lake is formed by the Burdekin Falls Dam on the Burdekin River, the largest dam in Queensland. The river and dam are popular destinations for fishing and bird watching.

Community and enterprise

Charters Towers is the main urban centre in the Burdekin Rangelands. Established in 1867 and boosted by the discovery of gold, the current population of around 12,500 is supported by the mining and beef industries. Mining is a significant employer, however the majority of land is used for beef production on natural grasslands. Charters Towers sources its water from the Charters Towers Weir, and the town is an education centre, with boarding schools catering for remote rural families. It has many heritage buildings which, together with national parks, provide outback tourism opportunities.

There have been calls from landholders and the Charters Towers Regional Council to expand irrigated agriculture in this sub-region, however this would require a secure and sustainable supply of water, careful consideration of land suitability and impacts on downstream systems.



BURDEKIN RANGELANDS COMMUNITY PRIORITIES

Community and industry resilience

We most value our people, because landholders are key to good land and NRM. Succession planning is important to attract energetic and enthusiastic young people, along with schemes that address social isolation and promote a better understanding between city and country dwellers. A stable community is a good environment in which to do business, and enterprises need diverse talents to 'ride out' market and climate variability. We will work with extension and education providers to take up new technology and explore business skills and diversification options.

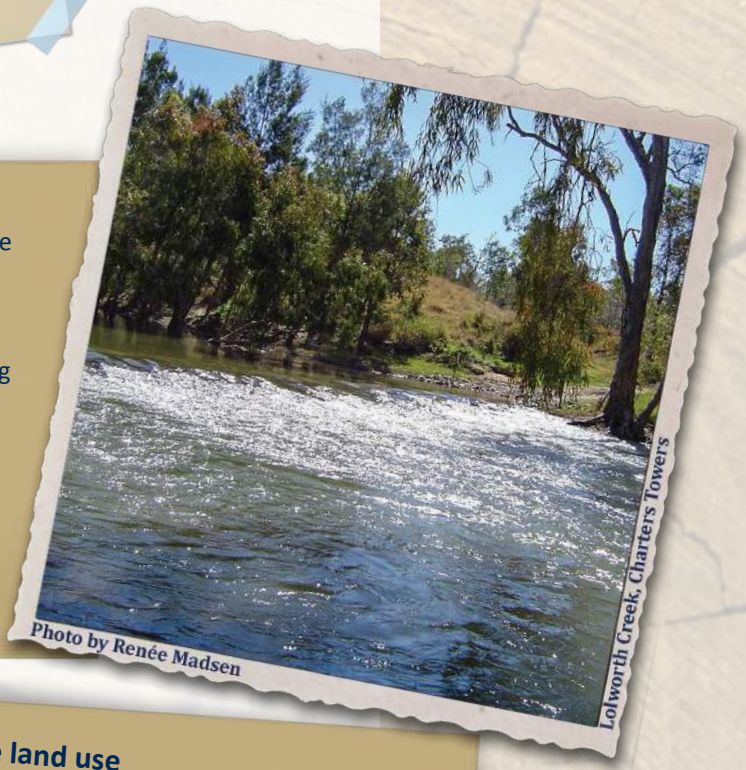


Photo by Renée Madsen

Lolworth Creek, Charters Towers

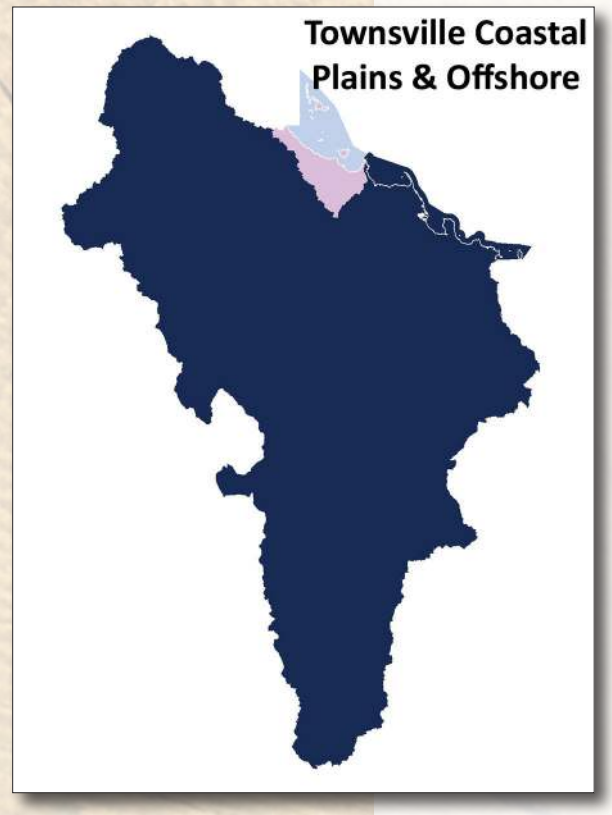
Sustainable land use

Our community would like to protect our land, which is a source of cultural identity and an inspiration for current and potential new enterprises, including tourism. We will continue to support property management, which integrates actions to look after soils, water, vegetation, weeds and feral animals, with agricultural best practice and business sustainability. We will strive to achieve good soil biodiversity, which benefits pasture, captures moisture and carbon, and prevents erosion.

Efficient research investment and collaborative decision-making

Good quality research is shared with landholders as it is essential to help properties become more resilient by diversifying and developing new commercial markets. Our community wants to encourage investment in our area for emerging industries, such as using woody weeds as a resource, feedlots, camels and new crops. To achieve this, we will work with State and local governments to influence decisions about land development and regulation that impact on business profitability. We would like to encourage banks to be more flexible, and reduce red-tape for enterprises that can demonstrate planning for long-term sustainability.

TOWNSVILLE COASTAL PLAINS & OFFSHORE



Country

Townsville City lies on the shores of Cleveland Bay and Halifax Bay, protected to some degree from weather that predominantly comes from the south-east. Cleveland Bay is mostly shallow inshore, with several large beaches and continually shifting sand bars. The seagrass meadows and fringing reefs are home to rare dolphins, dugongs, migratory whales and turtles. The mouth of the Bohle River and Cleveland Bay are declared Fish Habitat Areas and Cleveland Bay is covered by a Dugong Protection Area.

The sub-region includes the coastal flats of the Ross, Black and Bohle rivers, which flow from the eastern slopes of Hervey Range, through Townsville's urban and urban fringe areas. The Crystal Creek catchment extends from the Paluma Range's tropical rainforests.

This sub-region also includes two populated islands within the Great Barrier Reef (GBR) World Heritage Area. Magnetic Island (Yunbenun) lies 8km offshore from Townsville. Nearly three quarters of the Island's 52 km² is national park, with Mt. Cook in the centre rising to 497 metres and the island is a haven for wildlife. Palm Island (Bwgcolman) is 65km north-west of Townsville and about 30km off-shore. It is the main island of the Greater Palm group, and comprises small bays, sandy beaches and steep forested mountains in a wet tropical climate.

Community and enterprise

With a growing population of over 190,000, Townsville is considered the unofficial capital of North Queensland. It hosts many government, community and major business administrative offices for the northern half of the state.

The Townsville region has a diverse economy with no single dominant sector. Townsville is an important service hub, linked to supply chains and value-adding services. The Port of Townsville is the primary sea link to the region's mineral and agricultural areas, and population centres. The port handles an eighth of Queensland's international trade (by value). Townsville City and its port are serviced by major national and state road and rail networks to the north, south and west (Port of Townsville, 2015). Townsville is unique as it is the only city globally to refine three different base metals; zinc, copper and nickel. Ross River Dam is located close to the city and provides the main water storage for the urban area.

The Palm Island Aboriginal Shire Council manages most of the islands in the Greater Palm group. It has a resident community of about 2,600 people and a strong interest in cultural and eco tourism. Magnetic Island is a suburb of Townsville City with a population just over 2,400.

The Townsville sub-region's growing population relies on secure water resources for domestic, commercial and industrial use. Expansion of the urban footprint also needs to consider impacts on land and biodiversity at a local landscape scale.

TOWNSVILLE COASTAL PLAINS & OFFSHORE COMMUNITY PRIORITIES

Connected corridors and urban green space

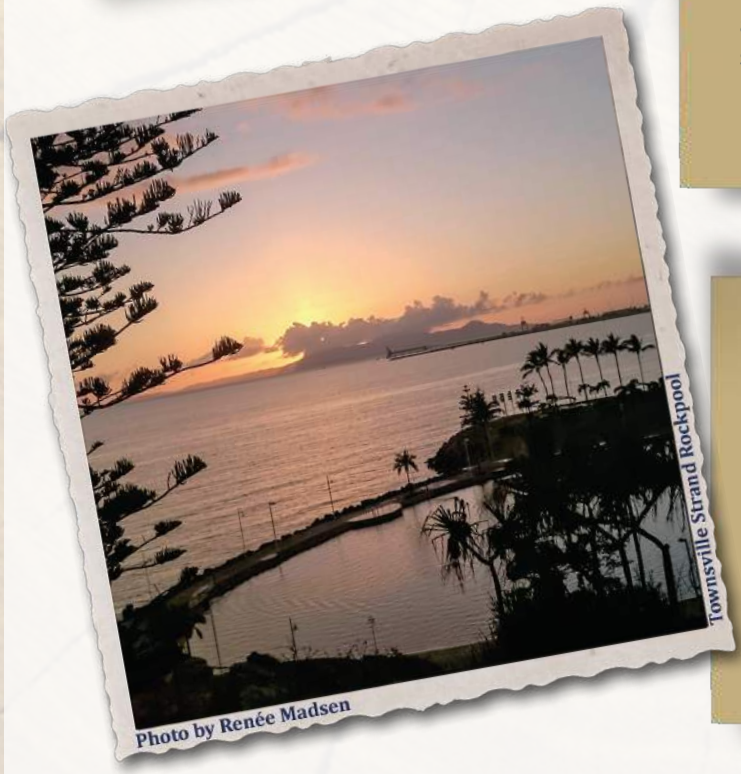
Our region is managed for residential lifestyles which are integrated with, and sensitive to, the natural environment. Our community wants to improve this by creating more natural links between urban green spaces and within agricultural land, identifying biodiversity hot spots, enhancing habitat and riparian corridors, and protecting intact coastal foreshores. The integrity of our coastline is important to protect against storm surges, waves, wind and overland flows, which may require sand and vegetation restoration works.

Community education and partnerships for transformation

We want to see more opportunities for the community, including the Indigenous community, to care for and access country, and make a difference for biodiversity conservation. Some people think our environmental problems are being taken care of, but we need large-scale transformational changes, rather than more of the same on-ground activities. We need access to accurate scientific information, and better, more targeted communication and education. We will try to achieve this by building on partnerships between individuals and community groups with local councils, the relevant State departments that are consolidated in our region, industry, and research organisations.

Catchment to reef water management

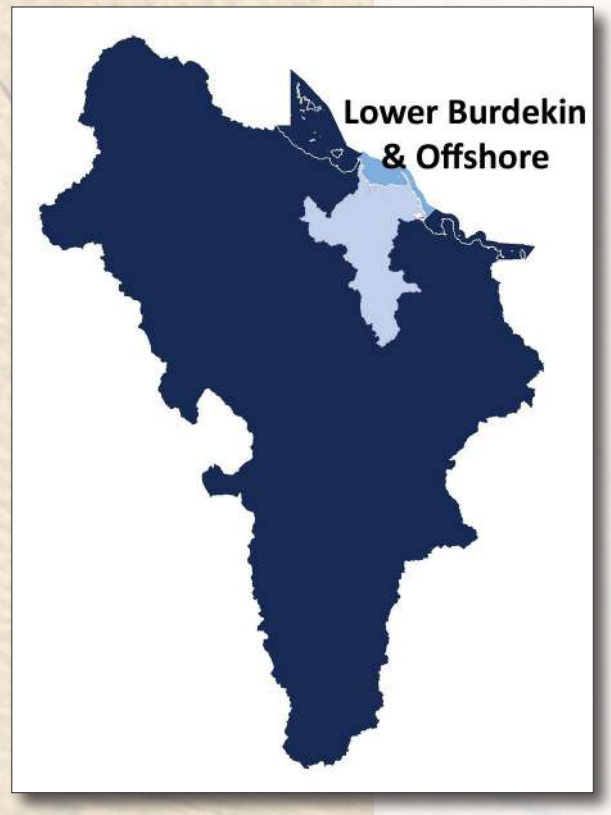
Our community sees water as the most valuable natural asset and we need to take a holistic view on how it is managed to protect the quality of water entering the GBR. Working with stakeholders across our region and with our neighbours, we will strive to collaboratively manage our waterways for low impact use, and diligently control sediments, nutrients and pest aquatic species.



Strong governance

Strong governance arrangements are needed for successful regional NRM, including a more 'bottom-up' and transparent approach. Our community will celebrate our successes, while implementing strategies to maintain volunteers, skills and funding. We need to find community champions who are strong voices for the environment, and ensure that we acknowledge competing stakeholder interests, while achieving successful social, economic and environmental outcomes.

LOWER BURDEKIN & OFFSHORE



Country

This coastal sub-region covers the Burdekin-Haughton lowlands and includes the irrigated Burdekin agricultural areas around Ayr and Home Hill. It is bounded to the north-west by Mt Elliot National Park and to the west by the Leichhardt Range, where coastal plains give way to hilly country characterised by pastoral land use. The sub-region includes coastline from the internationally-listed Ramsar wetlands at Bowling Green Bay in the north to Gumlu in the south-east.

The coastal waters include seagrass-dominated, shallow marine environments of the GBR Lagoon which provide significant habitat for many iconic marine species and are covered by Bowling Green Bay and Upstart Bay Fish Habitat Areas and Dugong Protection Areas.

The Burdekin River is the fourth largest river by flow in Australia and flows through this sub-region to its mouth near Ayr. This river generates the single largest suspended sediment and nutrient load point in the whole GBR Lagoon (NQ Dry Tropics, 2016). Key local assets are river water supplies, particularly from the Burdekin River, groundwater, flat irrigable land on alluvial soils, a picturesque natural coastline and extremely diverse and productive natural ecosystems. The coastal systems in this sub-region play an important role in providing ecosystem services to the surrounding community as well as flow on services to the adjacent GBR.

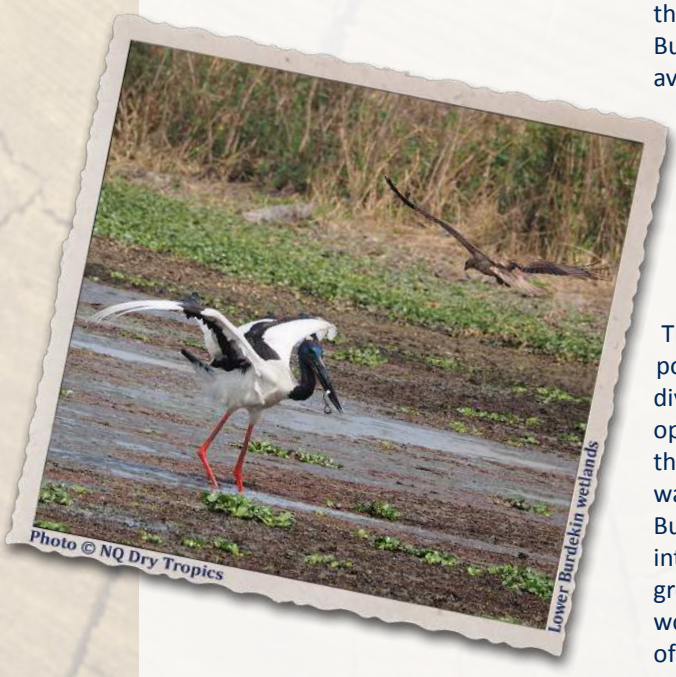
The water from the Haughton and Burdekin Rivers is also used as an urban water supply and drought reserve for Townsville through an inter-valley transfer pipeline to the Ross River Dam.

Community and enterprise

Approximately 18,000 residents live in this sub-region, mostly within Ayr and Home Hill and surrounding intensive irrigation areas. Away from the coast, larger grazing properties support a sparse population.

The Lower Burdekin contains the largest irrigation area on the east coast of Australia. It is increasingly known as one of the most productive agricultural districts in Australia due to its abundant year-round supply of water supplied by the Burdekin Falls Dam higher in the Burdekin catchment. Combined with an average of 300 days of sunshine each year, it is consistently the most productive sugarcane growing area in Australia. The sub-region also produces fruit, vegetables, beef and seafood for domestic and international markets.

This area is somewhat uniquely positioned to accommodate expansion, diversification and value-adding opportunities, however this relies on the ability to secure and transport water (including potentially raising the Burdekin Falls Dam), soil capacity and interaction of irrigation water with groundwater systems. In addition it would need to be within the constraints of downstream impacts on high priority wetlands and the GBR.



LOWER BURDEKIN & OFFSHORE COMMUNITY PRIORITIES


Photo © NQ Dry Tropics
Lower Burdekin

Effective management of water and energy for productivity and the environment

Our community recognises the link between adopting innovation and profitability, and that efficient use of energy and water increases agricultural productivity and environmental protection. We will achieve this by sharing information, adopting beneficial technologies and clearly measuring results to build community resilience, successful enterprises, and the health of our local groundwater systems, rivers, wetlands and the GBR.

A skilled and collaborative community

We want ongoing support from well-trained extension staff who continue to build the skills of our community to work individually, or collaboratively, to manage the natural resources on which our livelihoods depend. We will establish strong partnerships and relationships between landholders, community groups, researchers and government, to help disseminate knowledge for future generations.

Recognised land stewardship and control of introduced pests

Our farmers are stewards of the land, who seek to achieve social, economic and environmental outcomes for their enterprises to create security for their families and the community. Our community will encourage them to increase their uptake of best management practices and explore opportunities for financial incentives to reward sustainable practices. We will encourage urban development without the loss of prime farm land, and promote the importance of urban, rural and peri-urban residents proactively working together to tackle pest and weed issues. We would like to foster strategic and compatible land use to realise its full potential, while maintaining soil health and reducing unnecessary financial inputs.


Photo © NQ Dry Tropics
Sugarcane, Lower Burdekin

BOWEN CATCHMENTS & OFFSHORE

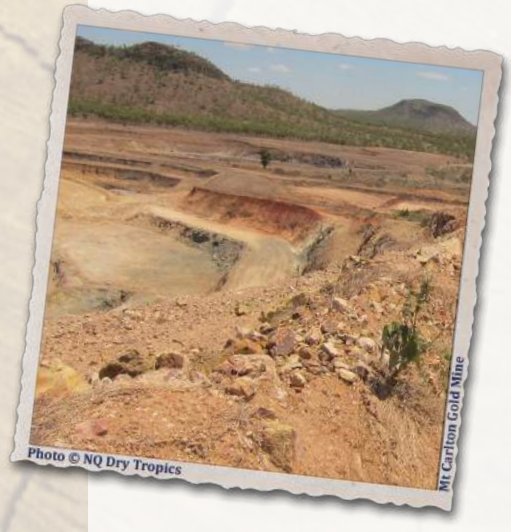
Country

Bowen sits on a peninsula, with ocean to the north, east, and south. On the western side, where the peninsula connects with the mainland, the Don River's alluvial plain provides fertile soil that supports a prosperous farming industry. The Don River drains a flatter inland area immediately south of Bowen township and west of the Bowen River.

The Bowen and Broken rivers are tributaries of the Burdekin River. They start about 50km from the coast and combine to flow north-west for 100km to join the Burdekin River below the Burdekin Falls Dam. The Broken River is the shorter tributary flowing from Mt Bruce through a valley to Eungella Dam before joining the Bowen River.

Picturesque creek scenery, lush rainforest remnants and grassy open eucalypt forest are features of inland national parks and state forest areas at Eungella, Mt Aberdeen, Sonoma and Crediton. Around Eungella, there are mist-shrouded mountains, and the forested national park hosts 860 plant species and a wide variety of wildlife.

Cape Upstart National Park is an imposing granite headland covered in a range of vegetation types from vine thicket to heath, and flanked by sandy beaches. Significant areas of beach scrub and coastal dunes are protected in the park, and adjacent marine areas are included within the GBR Marine Park. There are important turtle breeding sites on the sub-region's beaches, and the coral reefs around Bowen feature several shipwrecks. The coastal waters include seagrass-dominated, shallow marine environments of the GBR Lagoon, and Edgecumbe Bay is a declared Fish Habitat Area and Dugong Protection Area.



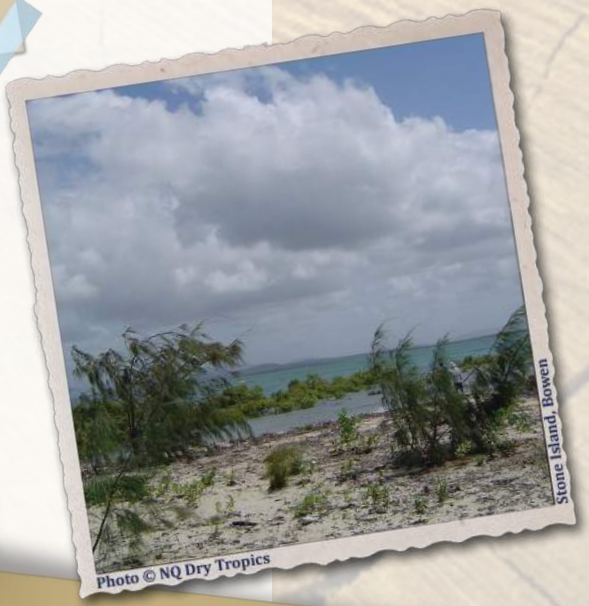
Community and enterprise

Bowen township has a population of around 9,500. The area has a diversified and prosperous economy based on agriculture, fishing, tourism, and mining. Its climate and fertile alluvial soils support a thriving horticulture industry, comprising small crops such as tomatoes, rockmelons and capsicums. Inland, away from the alluvial plain, cattle grazing is the dominant land use. The offshore seagrass meadows support the local commercial fishing industry.

Collinsville is an older mining town of around 1,500 people in the coal-rich Bowen Basin. It is connected by rail to the Abbott Point coal terminal which lies 25km north of Bowen. Mineral resources and mining are the largest economic contributors to the sub-region. Coal is mined inland of Bowen from Newlands, Collinsville and Sonoma mines in the Bowen geological basin, and exported mainly to China and India. Expansions of the established rail network have been proposed to service potential Galilee geological basin coal mines in the Belyando-Suttor sub-region.

The sub-region has potential to expand mining and agricultural development, however any decision would need to carefully consider implications for natural resources, including water availability, land capacity, and the need to protect adjacent coastal wetland, marine and reef environments. There is potential in the Collinsville area to develop renewable energy projects, including a hybrid solar thermal power station at the site of the Collinsville Power Station.

BOWEN CATCHMENTS & OFFSHORE COMMUNITY PRIORITIES



Industry growth and diversification

Our community desires increased co-investment between locals, government and (limited) foreign interests in our tourism, fishing, horticulture, grazing, aquaculture, mining transport infrastructure, renewable energy and solar industries. Mining is a strong economic resource for our region but we also have the opportunity to build the resilience of our agricultural industry by diversifying products and markets, and developing value-adding businesses. We will work with government to reduce red tape and improve export prospects.

Water quality for reef health

Our community would like to showcase our stewardship of the GBR by effectively managing water supply and quality to adapt to climate variability. Reliable water provision can be an issue in our region and some of our community supports the development of the Urannah Dam and Elliot Channel, which would assist broad acre and urban expansion. Greater collaboration for local decision making and targeting of expenditure will help to deliver social, economic and environmental benefits.

Soils for productivity

Our land and soils are interdependent and their health is critical for viable horticultural and livestock operations. We will undertake integrated land management practices to increase soil productivity and minimise sediment loads in local waterways, which can impact on fishing and tourism activities.

Passionate people caring for our landscapes

Our community greatly values the wetlands, beaches, rivers, dunes and woodlands that make up our region. One of our greatest resources is a community that is passionate about caring for these landscapes. Our diverse marine and terrestrial habitats support a variety of industries. We are a small community, and to sustain these environments and industries into the future we need appropriate long-term career pathways and methods to retain NRM professionals with local knowledge. We believe technology can increase community awareness, and may encourage greater local actions to support sustainability.

BELYANDO-SUTTOR

Country

The Belyando-Suttor catchments are bounded to the west by the Great Dividing Range, to the south-east by the Fitzroy River Basin, to the north-east by the Leichhardt Ranges and to the north by connection to the Cape and Burdekin rivers. The Belyando Catchment extends from about 50km south of Alpha, with the Belyando River flowing about 200km to the north before joining the westward-flowing Suttor River. The Suttor River flows north from the junction to the upper reaches of the Burdekin Falls Dam.

Most of the country is undulating old sedimentary basins or alluvial plains. The vegetation is open acacia and eucalypt woodlands within the Northern Brigalow bioregion, as shown on Figure 16, p 67. This is interspersed with areas that have been cleared for improved pastures and dryland cropping. The area that includes part of the Desert Uplands bioregion has a drier climate along the sandstone hills of the Dividing Range, with thickly-vegetated acacia woodlands or eucalypt woodlands with a spinifex understory. The Desert Uplands bioregion is particularly diverse ecologically, and intact areas contain near-threatened and endangered species.

It features ten national parks, state forests and private conservation lands, but most are small and isolated, and while important for conservation, they are mostly difficult to access and are not tourism destinations.

Community and enterprise

Alpha in the south is the main population centre with around 400 residents. The sub-region contains the majority of the 247,000km² Galilee thermal coal basin, which is one of the largest untapped coal reserves in the world. It also contains a section of the Bowen Basin, which extends into the Suttor River Catchment. These operations are serviced from Moranbah, which lies just outside the Burdekin Dry Tropics region to the east. The rest of the population is spread sparsely on large grazing and cropping properties. The sub-region is characterised by long-distance road and rail freight networks.

Over 90 per cent of land is under beef production, but between Alpha and Kilcummin there are areas of sorghum cropping, for export by rail and ship to markets such as Asia for alcohol production. In the past, the area featured intensive irrigated cropping, such as cotton. Some properties still maintain the necessary support infrastructure and could potentially resume these practices should market conditions improve.

Coal mining or mining exploration and development is a significant economic enterprise in the area. Currently, nine coal mega-mines are proposed for the Galilee Basin, which at full production would double Australia's coal exports to over 600 million tonnes a year (Sunrise Project, 2015).

BELYANDO-SUTTOR COMMUNITY PRIORITIES

Landholder and industry capacity for strong bio-security

Working with government, we would like to be empowered to undertake effective bio-security practices that mitigate risks to and from local industries. We would like to see collaborative decision making lead to proactive funding and support that allows landholders to achieve outcomes, and industries to conserve important natural ecosystems.

Belyando catchment

Photo © NQ Dry Tropics

Comprehensive resource management to build resilience

Our community believes in exchanging knowledge about resource management issues and collaboration between different stakeholders in a manner that makes the best use of time. We need to support opportunities to improve communication as well as effectively demonstrate the benefits of integrating environmental action with improved production and better economic viability. This includes working with the mining industry to have a real voice in decisions. Resilience will require new skills and innovation in farming practices, and strengthening of community adaptability in the face of a variable climate.

Good water and pasture

Our community's biggest concern is water quantity and quality, for livestock, for our environment to be sustainable, and community survival. We will support best practices in water management in our region to assist grazing productivity, minimise the loss of soils, improve reef health and secure community infrastructure in an integrated manner.

Sorghum crop

Photo © NQ Dry Tropics

Part B: NRM STRATEGIC DIRECTION

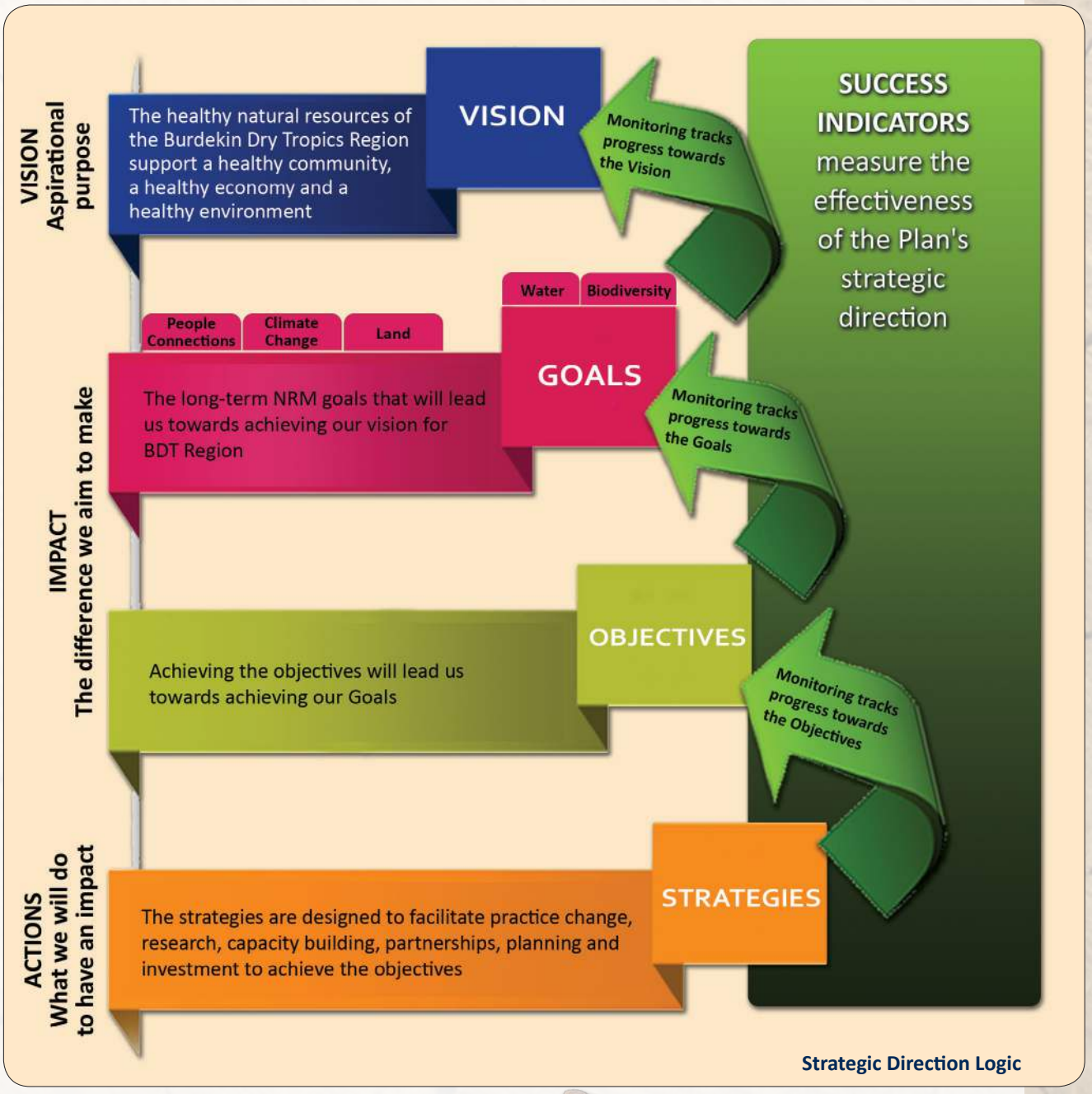
Part B identifies the broad natural resource priorities for our region, which have been grouped into five themes: People Connections, Climate Change, Land, Water and Biodiversity. Whilst each theme has its own section, it is important that they are read together as they are deeply interconnected, which highlights the need for a balanced and holistic approach to addressing regional NRM challenges.

Each section begins with a regional context, including the current situation and relevant historical information, and outlines the main issues and challenges. This is followed by a delivery package that:

- lays out key objectives;
- identifies strategies to achieve these objectives; and
- recognises the success indicators that will track our progress.

Logic for how the goals, objectives, strategies and indicators are linked is described in the diagram on page 24. The strategies nominated in the plan are the community's and are designed to facilitate practice change, research, capacity building, partnerships, planning, and investment in line with the objectives.

Success indicators are nominated to measure the effectiveness of the plan's objectives and goals. These are ideal indicators, and it may not be possible to report against some of them in the initial stage of the plan. However, organisations, groups and the community will need to work together to ensure that over time we will be able to monitor and report against all success indicators.



Strategic Direction Logic

PEOPLE CONNECTIONS

REGIONAL GOALS

The Burdekin Dry Tropics community is connected, empowered and actively participates in sustainable NRM

Rural and remote communities have strong stewardship of our natural resources

Traditional Owners participate significantly in NRM and have a close connection with country

NRM information, including education and extension activities, is coordinated and easily accessible

SNAPSHOT

Strongly connected and well-aligned communities are our region's greatest NRM assets. The key is bringing together the NRM community to:

- participate in NRM decision making and on-ground activities;
- build capacity and skills to pursue innovative business opportunities and sustainable management practices; and
- share experiences and research findings, and identify knowledge gaps for further research.

Sustainable NRM depends on an informed, skilled and connected community. In the region, a large proportion of our community are involved in protecting, researching and managing our natural resources, including rural land managers, Traditional Owners, NRM community groups, industry, researchers and all levels of government (described below). So many people are working hard in the NRM environment, and strategic coordination is critical to boost the efficiency and effectiveness of their efforts.

Traditional Owners

Our region has a rich Indigenous history, with 16 identified Traditional Owner groups (see Figure 3, p 26) and many clan and family groups. The Townsville area also has a large Torres Strait Islander community, and the lower Burdekin is home to significant numbers of people of South Sea Island origin. Indigenous people currently represent around six per cent of our regional population (Queensland Government Statistician's Office, 2015a).

Traditional Owners have by far the longest and deepest connection with country and continue to have a shared living culture with their environment. It is vital that cultural knowledge, which embraces the concepts of intergenerational sustainability and resilience, is not lost and is captured and protected by Traditional Owners for future generations. Incorporating Indigenous people's traditional ecological knowledge into strategic NRM decision making, and on-ground works, maintains their strong connection to country and also better protects and manages our region's natural resources.

In our region, a Traditional Owner Management Group (TOMG) provides regional indigenous leadership and advice in NRM. Traditional Owners have observed that our region's Indigenous 'A Caring for Country Plan' (2005) remains relevant, although only partly delivered, and the implementation strategies require ongoing support and recognition. The Caring for Country Plan recognises that natural resources are also

culturally defined, and articulates strategies that support Traditional Owners to develop their capacity to undertake NRM actions on country.

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

Aboriginal Peoples' connection to land

Aboriginal People are the ancestors of the original population of their geographical country (Australia). Their understanding of land and water is the living cultural knowledge that is passed down from generation to generation. This forms a rich and significant matrix of people, totemic, social, economic and spiritual connectedness with country. The connectedness extends from the past, and shapes both present and future land and natural resource management.

Queensland Museum website (www.qm.qld.gov.au)

Rural land managers and communities

Over 97.4 per cent of our region is rural and used for agriculture, and a large proportion of this occurs in remote areas, however only 24.8 per cent of the region's population is identified as *rural population* (Queensland Government Statistician's Office, 2015b) (Office of Economic and Statistical Research Qld Treasury and Trade, 2012). Rural landholders are key on-ground sustainable land managers and have an understanding and strong emotional connection with the land. They have a crucial role to play in improving the condition of natural resources on their land, while improving long-term productivity and profitability.

Rural landholders and communities continue to face many challenges, including:

- remoteness and isolation;
- decreasing and ageing rural populations;
- attracting, retaining and managing the cost of labour;
- cost of education and fixed costs;
- relatively low quality and reliability of infrastructure (including digital) and services;
- low local enterprise diversity;
- poor access to equity for building a sustainable practice;
- world market shifts;
- changing government priorities; and
- high climate variability.

Research based on measures of resource-dependency and adaptive capacity, found that across the Monsoonal North area, social resilience is low, particularly for graziers (Marshall, et al., 2015). Social resilience is defined as "the ability of

Figure 3 - Traditional Owner Groups

social and ecological systems (such as cattle producers and rangelands that are mutually dependent on each other) to cope and adapt to change". The research identified that most cattle producers are highly vulnerable to climate change, with only 16 per cent of producers considered to have higher levels of resilience to change. They tend to be younger, well networked, technology users, who manage larger businesses and feel a high level of responsibility for the future productivity of their land (Marshall, et al., 2015).

> Ongoing support and recognition is critical to farmers and graziers who have invested funds and effort into sustainable farming practices, as they recognise that it makes economic sense as well as protects our natural resources. They are doing good quality work, including undertaking land and water management practices to reduce erosion and improve water quality in the catchments, value adding to waste products, carrying out weed and pest control, and protecting natural areas.

Social media could help to promote communication between landholders and their communities. While communications technology has advanced, landholders and communities in our region's remote areas continue to have difficulty participating in the national and global economy due to a lack of digital capacity. Indeed, significant areas of our region continue to have only rudimentary dial up services.

Rural to urban migration continues to occur, with already isolated rural communities experiencing declining populations and increasing average ages. This trend is attributed to the lack of rural youth employment opportunities and timely succession planning (Bandaranaike, 2005). From a young age people within the rural community learn and develop experience and understanding of natural resource values and management. Maintaining this human resource and ensuring the intergenerational passing of knowledge is a significant challenge for future management of the majority of our region.

To face these challenges, individuals, family enterprises and communities in remote and rural parts of our region need support to build their resilience and capacity to adapt. Professor Helen Ross, from the University of Queensland's School of Agriculture and Food Sciences, identified six key factors that help communities to be resilient (The University of Queensland, 2015):

- people-place connections;
- knowledge, skills and learning;
- community networks;
- engaged governance;
- a diverse and innovative economy; and
- community infrastructure.

The research identified that NRM groups were "well positioned to help communities thrive alongside improving their environments, and to also improve their capacities to deal with and adapt to major changes such as industry deregulations, economic downturns and natural disasters".

Industry associations play an important role in providing industry information, training and education programmes and lobbying to influence government policy. Some of these industry associations representing the interest of farmers in the Burdekin region include:

- AgForce Queensland;
- Bowen Gumlu Growers Association;
- Burdekin Productivity Services;
- Burdekin water supply & irrigation groups;
- Canegrower groups, including CANEGROWERS Burdekin Ltd;
- Growcom;
- Meat and Livestock Australia; and
- Queensland Farmers Federation.

NRM policies that affect rural land managers must be flexible and realistic to account for varying conditions and take a long-term strategic approach. The delivery of NRM policy, information and training, needs to:

- be enduring;
- engage a large proportion of the community;
- consider socio-economic circumstances;
- account for extreme weather events (eg. water security); and
- identify that improved resource condition leads to better financial performance and farm profitability.

It is possible to sustain the land by increasing people's confidence and capacity to adapt (Stokes, et al., 2010). If land managers have the capacity to adopt sustainable practices, pursue innovation

and contribute towards environmental stewardship, they can better support the resilience of our natural resources, and in turn enhance their own wellbeing.

Adopting sustainable agricultural practices in the region is strongly influenced by family, the local community and networks (Pahl, 2015). Trust and confidence in new practices often only occurs when other producers or trusted people in wider networks can give reassurance. Taking up innovative practices is also linked to increased levels of formal and informal training, and financial capacity, with the driver being financial sustainability and gaining knowledge (Greiner, et al., 2003).

Industry, government and researchers have demonstrated that adopting long-term sustainable NRM practices correlates to long-term productivity and profitability (O'Reagain & Bushell, 2011), (McIvor, 2012) (Poggio, Page & Grieken, 2010) (Department of Employment, Economic Development and Innovation, 2010). A key goal is to establish landholder confidence in this information and provide them with the support to adopt new practices.

Urban NRM

Urban communities make up over 75 per cent of our region's population. It is important that they have opportunities to connect with their surrounding natural environment and understand how lifestyle and purchasing decisions impact on natural resources and surrounding rural areas. This can be achieved in many ways, including:

- providing public natural environmental areas;
- maintaining or reestablishing connectivity between important core habitat areas;
- carefully using resources, including adopting domestic water efficiency practices in the home and garden (such as water-saving devices);
- planting native and habitat-promoting garden plant species; and
- reducing pollution and litter from urban areas entering surrounding natural environments and impacting native species.

Active urban landcare initiatives focusing on biodiversity include protecting and revegetating habitat and riparian corridors, and improving water quality flowing into wetlands and the GBR. Other initiatives that focus on sustainable urban lifestyles include James Cook University's 'TropEco' programme for students and staff, Townsville's Permaculture group, and 'Food for Thought', which shares information on our food choices from a sustainability perspective. People who reside in the region's urban areas may also be involved in the rural industry and NRM research, policy development, administration and financing.

A number of local councils have agreed to work together to improve the health and resilience of the GBR by joining the Great Barrier Reef Marine Park Authority's 'Reef Guardian Councils' programme, which includes initiatives for urban water, waste and land management, climate change, community education and capacity building. Additionally, a number of urban businesses, schools and fishing operations also participate in the 'Reef Guardians' awareness programme.

NRM Community Groups

NRM community groups play a significant role in our region by bringing people together to improve land management practices, restore our landscapes and conserve natural resources in their local area. NRM community groups include volunteers affiliated with Landcare groups, other community 'care' groups (environment and NRM collectives), Indigenous groups and not-for profit organisations.

Our region has a network of over 25 active NRM community groups, which covers the majority of our area including:
- BirdLife Townsville
- Bowen and Collinsville Landcare Group
- Burdekin Bowen Integrated Floodplain Management Authority Committee (BBIFMAC)
- Central Highlands Regional Resources Use Planning Cooperative (CHRRUP)
- Coastal Dry Tropics Landcare Inc. (CDTLI)
- Conservation Volunteers Australia (CVA)
- Dalrymple Landcare Committee (DLC)
- Desert Uplands Build-up and

Figure 4 - Local Government areas within the BDT Region

1 - Tablelands Regional Council
2 - Etheridge Shire
3 - Flinders Shire
4 - Charters Towers Regional Council
5 - Isaac Regional Council
6 - Barcaldine Regional Council
7 - Hinchinbrook Shire
8 - Palm Island Aboriginal Shire
9 - Townsville City
10 - Burdekin Shire
11 - Whitsunday Regional Council
12 - Mackay Regional Council

Development Strategy Committee (DUC)
- Girringun Aboriginal Corporation
- Greening Australia
- Gudjuda Reference Group Aboriginal Corporation
- Lower Burdekin Landcare Association (LBLCA)
- Magnetic Island Nature Care Association (MINCA)
- Mundy Creek Catchment Care
- North Queensland Conservation Council (NQCC)
- North Queensland Wildlife Care Inc
- Queens Beach Action Group (QBAG)
- Ravenswood Restoration and Preservation Association
Reef Check Australia
Sea Turtle Foundation
- Tangaroa Blue Foundation
- Toomulla Coastcare
- WetlandCare Australia
- Woodstock Landcare
- Wunjunga Progress Association

Many of these are volunteer groups that have varying levels of membership, knowledge and expertise to undertake ongoing activities to improve environmental sustainability. Several not-for-profit organisations, including NQ Dry Tropics, play an important role in building NRM community connections and capacity through extension, education and on-ground work.

It is vital that local NRM community groups are empowered and supported to strengthen their community links, expand the size of their networks, and maintain the momentum created by their good work. This can be achieved by providing opportunities to build capacity and to share information and experiences.

Government

All levels of government are important partners in NRM in the region.

The region covers 12 local government areas, including Townsville, Burdekin, Charters Towers and Palm Island, significant parts of Whitsunday, Isaac and Barcaldine and small sections of the Tablelands, Etheridge, Flinders, Hinchinbrook and Mackay (see Figure 4).

Local government is actively involved in NRM, including through statutory town planning, strategic environmental management planning, public education, regulating development, and managing open spaces, which includes controlling weeds and other pests. Specific examples in the region include managing wetlands, beaches and foreshores in Townsville, Burdekin and Bowen, and Townsville City Council's community energy programmes (wind, solar and reflective roofing).

The **Queensland Government** is actively involved in natural resource planning, management and regulation, including funding NRM programmes, managing state lands (including protected areas), allocating natural resources (water, minerals, quarrying), providing extension and education programmes, and regulating the use of, and impacts on, natural resources (such as vegetation clearing and mining). One of its important roles is to provide up-to-date information and maps on natural resources, for example, regional ecosystems and soils, which form the basis for informed NRM planning and management decisions. Current Queensland Government functions are detailed in Appendix B, p87.

The **Australian Government** provides national strategic direction through national plans such as the Reef 2050 Plan, oversees a threatened species programme, and World Heritage and other international agreements. It is a large investor in research and NRM activities, including funding universities, the Green Army, the National Landcare Programme, the 20 Million Trees Programme and projects to tackle invasive species. The current Australian Government functions are shown in Appendix B, p 87.

The health of the GBR World Heritage Area is a major driver for funding NRM management in our region. The GBR Intergovernmental Agreement 2015 between the Australian and Queensland Governments reflects their shared responsibility for meeting the targets of the Reef 2050 Plan, which includes

improving the quality of water leaving catchments that feed into the GBR. The Great Barrier Reef Water Science Taskforce identified that climate change is the most significant long-term threat to the GBR and improving water quality now will help build the GBR's resilience and its ability to bounce back. The Taskforce identified that the greatest water quality risks to the reef are excess nutrients, fine sediments and pesticides (Great Barrier Reef Water Science Taskforce, and the Office of the Great Barrier Reef and Department of Environment and Heritage Protection, 2016).

Australian and Queensland governments' investment makes it possible and achievable to understand natural resource values and threats, and to undertake innovative practices that lead to better management. However, it is critical that governments have strong connections with the region's community so that they are aware of regional priorities when making NRM policies and decisions. Our community has identified that the shifts in policy direction caused by changes in government, remain a barrier to long-term sustainable NRM. Changes to government priorities can lead to funding cuts that impact upon worthwhile projects, and result in a loss of valuable scientific and technical research and information.

Researchers

Our region hosts major research organizations, including the Australian Institute of Marine Science (AIMS), the Commonwealth Scientific and Industrial Research Organisation (CSIRO), James Cook University (JCU) and other universities, and is strongly placed to undertake the research and monitoring needed to sustainably use and manage our natural resources.

Within the region, this work focuses heavily on how land use activities impact the GBR. There are many research organisations in our region that have strong collaborative programmes for NRM and work closely with government and non-government organisations to help the community make use of this knowledge.

These institutions provide ongoing monitoring of known and predicted impacts to natural resources from development, land and water management practices and climate change. They also develop new technologies and practices to improve productivity and minimise impacts on receiving environments. Natural resource managers and the wider community in our region need easy access and exposure to the full breadth of NRM knowledge and expertise that is relevant to their potential activities. Advanced knowledge of threats that could adversely affect the amount and quality of water resources, soil productivity and viable habitat, enables proactive planning management, rather than reactive management which is often more costly in the long-term.

Rural land managers throughout our region have participated with on-farm research and monitoring. Continuing this alliance and providing feedback on results from research projects is valuable to developing a good local NRM knowledge base.

Land managers have commented on the need to more effectively share information and links between research outcomes, practical application and local on-ground NRM delivery. This could be achieved by engaging and maintaining land manager participation in monitoring and science in the paddock initiatives. There are also opportunities for industries to learn from each other's experiences. Opportunities also need to be provided to undertake strategic research over larger areas, rather than at a property scale to identify the potential implications at a landscape scale.

Collaborative learning.
Recent innovation, developed by MBD Energy, Pacific Reef Fisheries and James Cook University, uses bioremediation to clean nutrient-laden waste water from aquaculture farming, while also creating economically valuable microalgae-based byproducts. Representatives from the cane industry are assessing the benefits of adapting this practice to address nutrient runoff from cane farms, although this will require funding for strategic investigation over a catchment area.


Data logging, Lower Burdekin wetlands survey
Photo © NQ Dry Tropics


Resilience in Grazing Open Day, Glenapline Station
Photo © NQ Dry Tropics

DELIVERY

There is a strong spirit of collaboration within our region, illustrated by the many decision-making forums, and formal and informal partnerships between groups. The plan aims to help strengthen these NRM community connections by facilitating networks that deliver relevant, up-to-date information as well as provide support to undertake sustainable management practices. Collaboration will help us understand and share the challenges and barriers to change. Empowering the community to make informed NRM decisions is key to the long-term resilience and sustainability of our natural resources.

Objectives	Strategies
A connected and informed regional community is empowered to participate in NRM.	a) Build on existing networks and create opportunities to make new collaborative connections for training and knowledge exchange among and between: • research scientists; • landholders; • Traditional Owners; • natural resource reliant industry; • local, state and federal governments; • NRM community groups; and • regional NRM bodies.
	b) Coordinate NRM research, education, investment and extension to reduce duplication and improve efficiency and effectiveness of delivery.
	c) Develop and maintain strategic NRM partnerships within our region. *For example: in addition to parties with common interests in NRM, include parties that have complementary contact with natural resources (such as recreational users – fishers, birdwatchers, bushwalkers) and parties that have greater potential for impacts (such as mining and processing companies).*
	d) Support improved communication and collaboration between NRM community groups on project development and delivery. *For example: through training and knowledge exchange opportunities to improve group capacity.*
	e) Build collaborative networks and partnerships between local councils to share knowledge and establish a consistent approach to leading NRM in urban areas. *For example: hold an annual regional NRM conference to network, share information, identify challenges and partner with regional programmes.*
	f) Improve NRM knowledge, skills and experience through education and extension programmes so the community can build capacity to: • understand the local environment; • understand regional NRM priorities; • participate independently in ongoing sustainable management; • apply for available funding grants to assist in undertaking sustainable NRM; and • make informed NRM decisions.
	g) Acknowledge landholders who undertake successful sustainable NRM activities on their properties that contribute to regional outcomes. *For example: rewards and financial incentives for proven stewardship.*
	h) Create opportunities for urban and rural communities to network and share information. This will foster a mutual understanding of their respective NRM priorities and challenges, and promote a united approach to tackling them.
	i) Create opportunities for the community to be engaged with scientific research regarding ecological condition and improvement, by participating in monitoring and mapping activities.

Objectives	Strategies
A connected and informed regional community is empowered to participate in NRM (cont.).	j) Improve and maintain accessibility to NRM knowledge on topics including: • innovation and best management practice; • new and innovative renewable business opportunities; • past, present and predicted information on natural resources; • technology and research reports, including local early adopted experiments and research; • NRM community groups, projects, activities, proposals and sponsorship opportunities; and • current projects and initiatives relating to natural resources in our region.
	k) Engage regional youth through school and extracurricular programmes to promote regional NRM knowledge, planning and practices. *For example: Reef Guardian schools and school-based agriculture sustainability programmes.*
	l) Deliver education and extension programmes for improving NRM knowledge, skills and experience based on behavioural change approaches that consider the attitudes, barriers and benefits of change to the audience.
Community priorities and desired actions are reflected in regional NRM decisions.	a) Build capacity and create opportunities for NRM community groups, landholders and/or representative bodies to participate in regional planning processes such as the: • NRM Plan; • Conservation Action Plan; • Water Quality Improvement Plan; • Reef 2050 Plan; • Regional Pest Management Strategy; • local government planning; and • state government planning.
	b) Develop and implement a regional NRM community groups strategy that: • facilitates a shared responsibility for a healthy environment; • enhances skills and capacity to undertake NRM; • builds linkages and relationships to deliver NRM projects; • supports participation to provide ongoing feedback; • supports succession planning; and • contributes to NRM decision making.
	c) Ensure our region's natural resource data and mapping is updated and accessible to the community, so it can provide the basis for informed NRM decisions.
	d) Create a multi-sector governance group, with sub-regional representation, to represent community NRM interests, provide NRM knowledge and expertise, and support delivery of the NRM plan, including promotion, monitoring, evaluation, reporting and improvement.
Traditional ecological knowledge is protected and incorporated appropriately in NRM.	a) Build capacity of Indigenous people to appropriately capture, store and use traditional ecological knowledge in NRM planning and activities.
	b) Identify location names and story places to increase awareness within the wider community.
	c) Share and celebrate cultural traditions through community gatherings and events.
Traditional Owners have increased opportunities for connecting to country to aid the wellbeing of Indigenous people.	a) Continue to support implementation of the *Caring for Country Plan 2005*.
	b) Build Traditional Owners' NRM capacity through training, employment and developing enterprise.
	c) Support access to country arrangements for areas of the region.

Objectives	Strategies
Traditional Owners have increased opportunities for connecting to country to aid the wellbeing of Indigenous people (cont.).	d) Establish partnerships and joint NRM initiatives between Traditional Owner groups and other organisations.
	e) Develop, update and implement Indigenous land and sea management plans.
Traditional Owners and Indigenous peoples' priorities and desired actions are reflected in regional NRM decisions.	a) Work with the Traditional Owner Management Group (TOMG) to help ensure that Indigenous aspirations and priorities are reflected in regional NRM planning processes such as the: • NRM Plan; • Conservation Action Plan; • Water Quality Improvement Plan; • Reef 2050 Plan; • Regional Pest Management Strategy; • local government planning; and • state government planning.
	b) Develop a participation strategy for our region that identifies Indigenous land management in NRM.
Rural land managers are informed and skilled to make sustainable land management decisions.	a) Promote collaboration between the agricultural, financial, environmental, government, research, education and training sectors to develop long-term, region-specific support processes for rural communities. *For example: full-time traineeships particularly for rural youth.*
	b) Provide land managers with on-site specific information, training and extension that supports best management practices and builds their capacity to ensure a healthy and productive way of life for their business, the community and the natural environment.
	c) Design NRM education and extension programmes and actions to increase the capacity of land managers that: • consider their wellbeing and economic pressures; • are based on behavioral change approaches that consider their attitudes, benefits and barriers to change; and • facilitate development of planning and risk management skills.
	d) Support the promotion of sustainable land management, which is tailored to the motivations and opportunities of rural communities and links with social services and business planning. *For example: succession planning is actively encouraged to ensure farms continue to be managed for productive agricultural land.*
	e) Support the viability of rural communities by providing physical and digital infrastructure and services.

SUCCESS INDICATORS

By or before 2026 there is:	
	• a diverse range of strategic partnerships in delivery of NRM in our region;
	• improved coordination of NRM investment, extension, education and research in our region;
	• improved accessibility to NRM research and information;
	• improved capacity of Traditional Owners to participate in NRM;
	• increased capacity of rural land managers to undertake sustainable land management practices;
	• increased participation in NRM community groups.


National Tree Planting Day
Photo © NQ Dry Tropics


National Tree Planting Day
Photo © NQ Dry Tropics


Wetland training session, Kalamia Creek fish ladder
Photo © Dept of Agriculture and Fisheries

CLIMATE CHANGE

REGIONAL GOALS

Reduced dependency on finite natural resources and transition to renewable resources for electricity production, fuel and other non-renewable products

Natural resources including soils, vegetation & reefs, are managed as carbon stores to offset emissions

Natural resources and communities are more resilient to climate change impacts and stresses

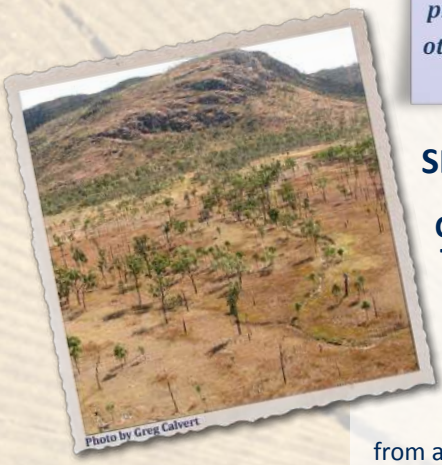


Photo by Greg Calvert

SNAPSHOT

Climate of the Burdekin Dry Tropics region

The Burdekin Dry Tropics region has a pronounced wet and dry season, with most rain falling between November and April. Average annual rainfall ranges from around 500mm to 1500mm however this varies across our region as well as year to year (Dight, 2009). This variability is linked to the El Nino Southern Oscillation and the formation of tropical low pressure systems sometimes referred to as the Monsoon Trough. Additionally, cyclones generated by low pressure systems and warm oceans can contribute significant volumes of rainfall on land (Lough, 2001).

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

Changes to climate and its impacts

Climate change has the potential to become a major threat to the region (Lough, 2001). Whilst climate varies naturally on timescales, from millions of years to year-to-year, since the advent of the industrial age there has been a rapid increase in temperatures, and the variability of weather events.

The International Panel on Climate Change considers that "warming of the climate system is unequivocal". A report by the National Oceanic and Atmospheric Administration (NOAA) shows that 2015 was the hottest year since records began in 1880, breaking 2014's record by a large margin, with 15 of the 16 warmest years occurring in this century (NOAA, 2016). There is now a very high degree of certainty that the world will experience greater extremes in temperature ranges with average temperatures rising, longer dry periods, more intense individual rainfall events, and more extreme river runoff events and water flow characteristics (Cubasch, et al., 2013).

A recent CSIRO technical report on climate change in Australia identified average temperature rises in the Monsoonal North region (in which the Burdekin Dry Tropics region is situated) of between 0.9˚C and 1.0˚C since 1910, and predicts further increases of greater than 1.3˚C by the end of the century (Moise, et al., 2015).

The CSIRO's Monsoonal North East report, and previous reports for northern Australia, outline the following general projected changes during the next century as a consequence of changes in the climate (Moise, et al., 2015) (Miles, 2005).

Burdekin Dry Tropics' emissions and carbon exchange

Global, national and state initiatives to mitigate the effects of climate change aim to improve the carbon exchange (carbon flux) in our atmosphere (i.e. reduce carbon emissions and increase carbon capture) (Kricher, 2011). On 12 December 2015, at the United Nations Climate Change Conference, 196 countries (including

CATCHMENT SCALE CHANGES DUE TO CLIMATE CHANGE

DECREASING

- Water resource quantity
- Water resource quality
- Plant and crop growth
- Frequency of tropical cyclones occurrence

INCREASING

- Evaporation
- Wildfires
- Intensity of rainfall events
- Intensity of tropical cyclones
- Number of hot days and warm spells
- Average temperatures
- Mean sea level
- Height of extreme sea level events
- Vulnerability of sensitive wetlands

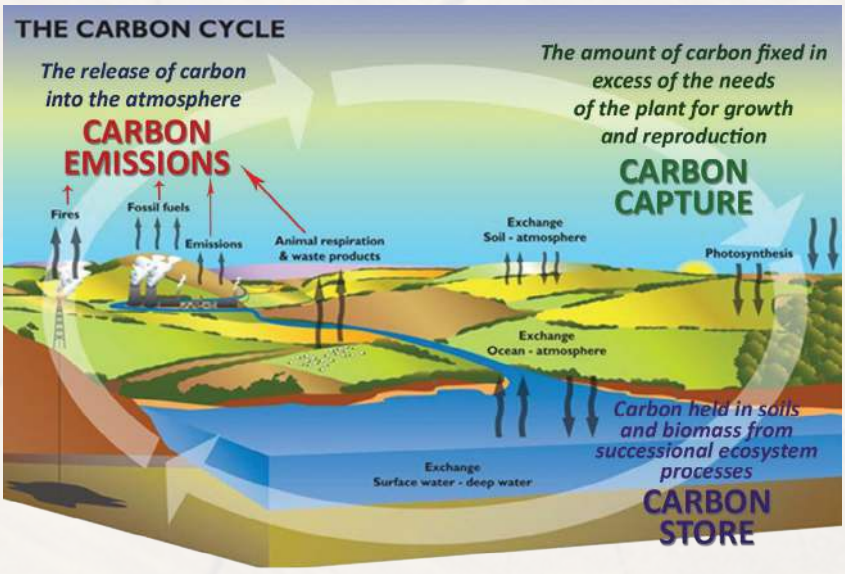
Australia) adopted the 'Paris Agreement' which includes a commitment from each nation to reduce carbon emissions enough to limit global post-1990 temperature increases to a maximum 2˚C, with an aspiration level of 1.5˚C.

Australia's greenhouse gas emissions per capita are the highest of the countries of the Organisation for Economic Co-operation and Development (OECD) and among the highest in the world (Garnaut, 2011). The Burdekin Dry Tropics region's total emissions, excluding coal exports, equates to approximately 0.9 per cent of Australia's total emissions (about 538 Million tonnes of carbon dioxide equivalent [Mt CO_2 –e]) and emits the average amount per capita for the country (Parsons, 2014). Our region may be on par with the rest of Australia for local emissions, however it is a large exporter of emissions from coal mined in the Galilee and Bowen Basins, which is used to produce energy.

Whilst not emitted into the Burdekin region air space, and due to the accounting system not counting it as Australian carbon emissions, a significant amount of carbon is removed from the region in the form of coal exports. When burnt in power production, the annual carbon emission from coal exported from the region is approximately 53Mt CO_2 –e, which is equivalent to 10 per cent of Australia's annual emissions. Should the potential coal resources of the Galilee Basin be realised, the increase in emissions is projected to be as much as 266Mt CO_2 –e when burnt, which would equate to half Australia's annual emissions (Parsons, 2014). Within the global context, experts assert that Australian coal is on average high quality, compared with other countries, and as a consequence, less coal is needed to generate the same amount of energy, leading to lower carbon emissions by weight (Australian Broadcasting Corporation, 2016).

"I think water resources will be critical. I also believe that getting more carbon into soil and restoring degraded soil would reduce the amount of CO_2 in the atmosphere."

Burdekin Community Survey 2015



Adapted from British Geological Survey website (www.bgs.ac.uk)

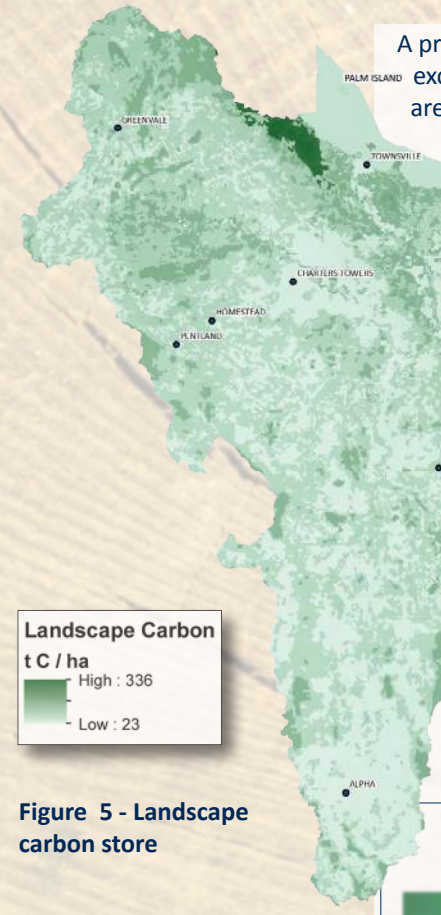
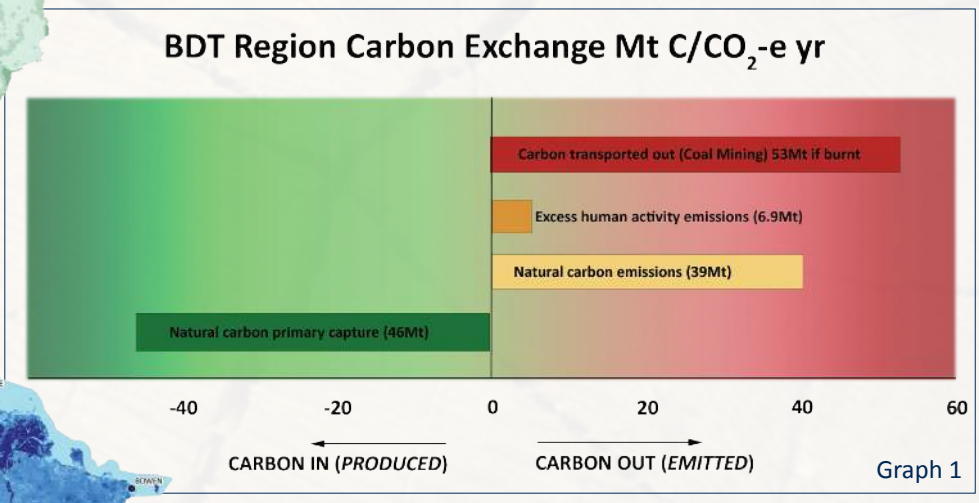


Figure 5 - Landscape carbon store

A preliminary assessment of the carbon exchange in our region identified the areas and activities that **store** (Figure 5), **capture** (Figure 6) and **emit** (Figure 7, p 38) carbon (Parsons, 2014). Remote sensing identified that fertile soils and wooded vegetated areas store the greatest carbon amounts, whilst carbon capture is highest towards the coast in tropical rainforest and in irrigated sugarcane farming areas. The annual carbon capture gains from sugarcane in the lower Burdekin however, are lost due to cane burning practices. Additionally, the urban areas of Townsville, Charters Towers and Ayr were noted as high carbon emitters.

The preliminary regional assessment also summarized the carbon exchange and identified the main activities influencing the movement of carbon in our region, see Graph 1 below. Regional carbon storage in soils and living biomass is currently about 865 Million tonnes of carbon (Mt C) with an annual carbon capture rate of 46Mt CO_2-e yr^{-1} per year. Natural processes emit a total of 39Mt CO_2-e yr^{-1} through soil respiration (11Mt CO_2-e yr^{-1}) and above ground plant respiration (28Mt CO_2-e yr^{-1}). Human activity-induced carbon emission volumes in the region emit approximately 6.9 Mt CO_2-e per year, mainly from agricultural (electricity and fuel), coal mining (electricity and fuel), defence (fuel) and industrial practices, see Chart 1 below. These are primarily attributed to fuel use, electricity production, fires in natural settings, sugarcane fires, fugitive emissions from coal mines, waste processing and cattle (ruminants).



Graph 1

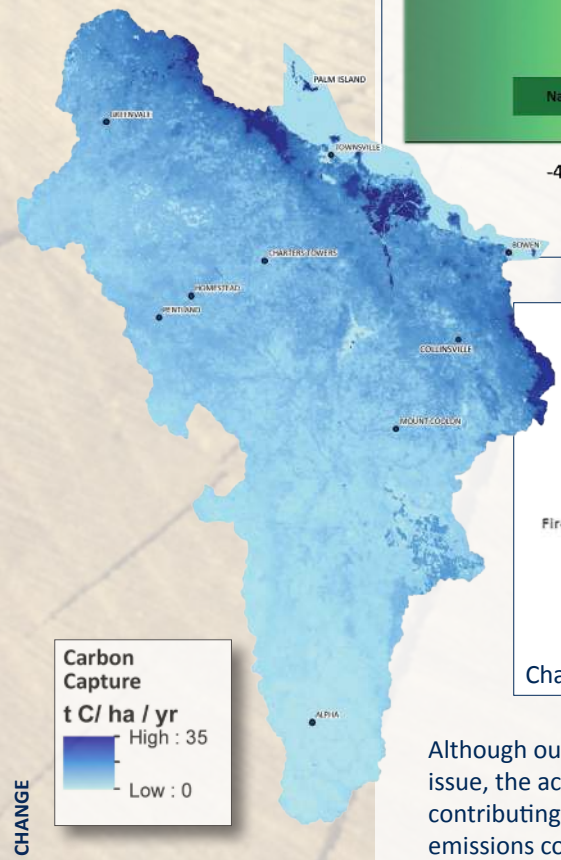


Figure 6 - Carbon capture

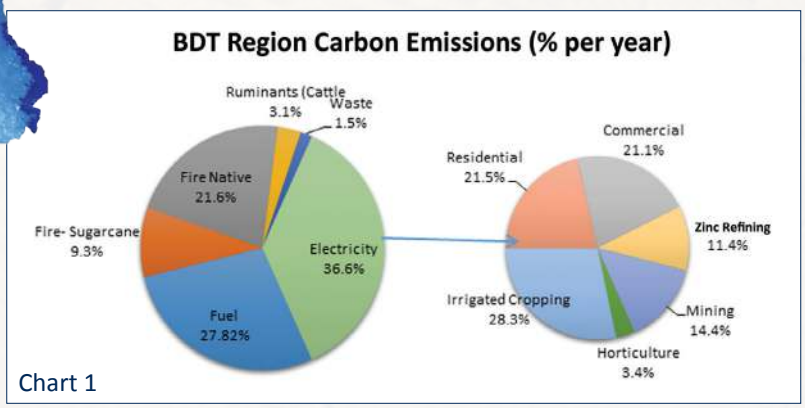


Chart 1

Although our regional emissions contribution is only a small part of a global issue, the accumulative effect globally of unnatural greenhouse gas emissions is contributing to the greenhouse effect and shifts in climate. To reduce our regional emissions contribution in order to be prepared for the change in climate, we need to influence the carbon cycle. This means concurrently implementing several different approaches to target carbon exchange processes in the region.

Managing carbon

Managing the carbon exchange includes adaptation and mitigation measures and building resilience to future changes in the climate, including influencing a shift in the carbon exchange by reducing emissions, and increasing carbon capture and storage. Options relevant to our region include:

- using renewable, low carbon electricity sources;
- alternative primary production;
- reducing mining fugitive emissions;
- managing cattle digestion to reduce methane emissions;
- savanna burning;
- carbon forestry;
- waste to energy projects; and
- building resilience in ecosystem processes.

1. Efficient and renewable electricity resources

Australia is one of the most dry, sunny, windy places in the world, and is surrounded by oceans. This gives us, our region in particular, unlimited opportunities for renewable energy initiatives.

The supply of electricity and fuel is an important resource issue for our region, not only because 37 per cent of our greenhouse gas emissions are attributed to electricity production and use, and 27.8 per cent to fuel; but also because we currently export coal resources and have the potential for much larger coal and gas exports over the next 50 years. This is an area where efficiencies in our region's carbon exchange could be made.

The majority of current domestic supplies for electricity and fuel in our region are via finite fossil resources including thermal coal, gas and petroleum. However, technological innovation is providing more efficient ways to use electricity, as well as clean renewable energy and fuel sources. Opportunities to produce renewable energy are being actively investigated in our region, including solar panels and solar thermal, hydro-electric, biofuels, wind and wastes. In particular, the advent of micro, medium and large-scale solar energy technologies and of high-performance low-cost batteries could be considered global energy game changers.

Our region is known for its many days of sunshine per year. As an example Townsville is celebrated for having around 300 days of sunshine per year and was a location for the Australian Solar Cities programme (Townsville City Council, 2015). Renewable solar power has been identified as an opportunity for our region with proposals at Clare, Collinsville, The Pinnacles and Charters Towers having the potential to power tens of thousands of homes.

There are also aspirations for biofuel production and co-generation power sourced from sugarcane and sorghum in the Lower Burdekin and Pentland (Austcane Energy Ltd, 2015) (Renewable Development Australia, 2015). The Queensland Government is actively promoting biofuels and bio-manufacturing industries in Queensland to reduce greenhouse gas emissions and contribute to regional growth. (Department of Energy and Water Supply, 2015).

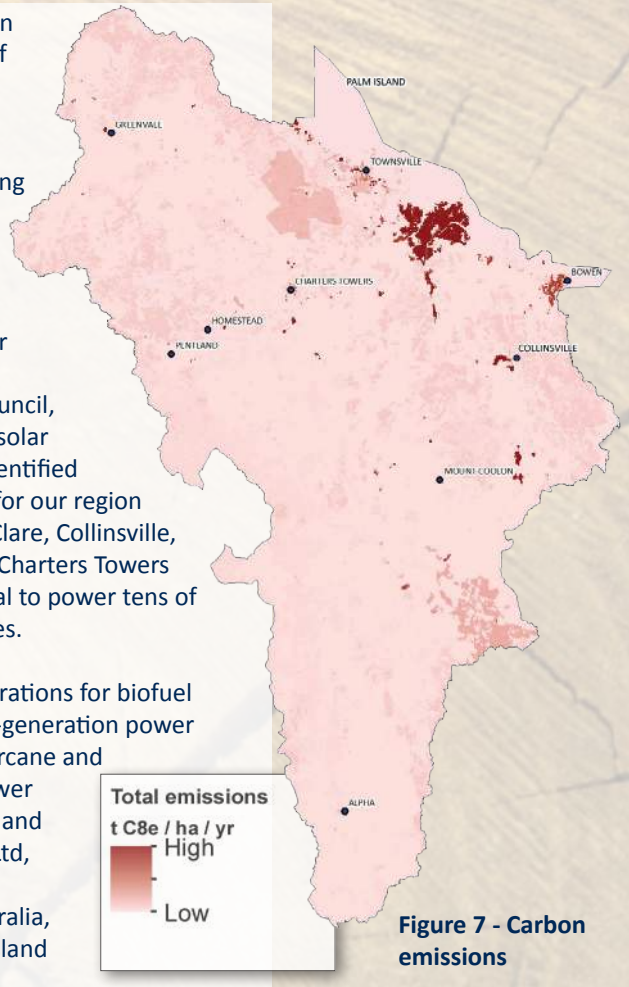


Figure 7 - Carbon emissions

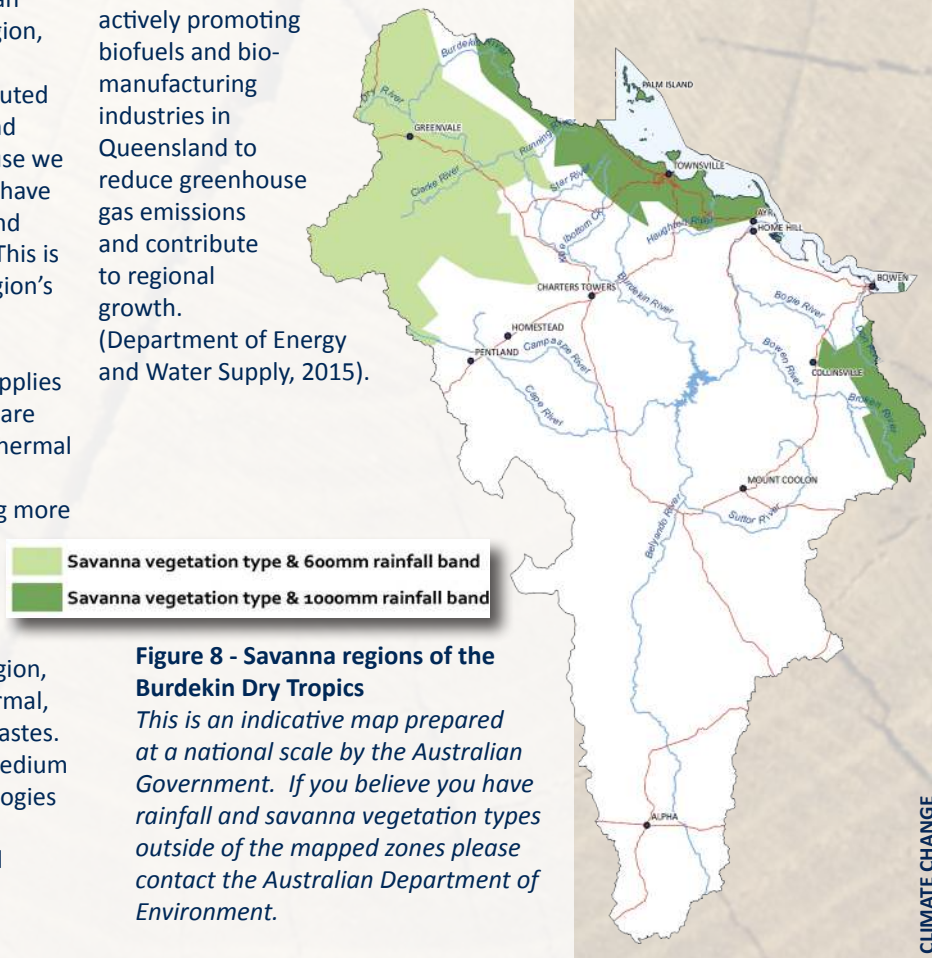


Figure 8 - Savanna regions of the Burdekin Dry Tropics

This is an indicative map prepared at a national scale by the Australian Government. If you believe you have rainfall and savanna vegetation types outside of the mapped zones please contact the Australian Department of Environment.

$ for Carbon Credits?

Do I have potential on my land ?
See strategic carbon planting map

Do I have the rights to carbon on my land?
Check land title and tenure

Where to for more information?
Touch base with Australian Government to find out more about the Emissions Reduction Fund at the Clean Energy Regulator website: http://www.cleanenergyregulator.gov.au/

Each Australian carbon credit unit (ACCU) captured and stored has a current market value of about $10/unit. One ACCU is earned for each tonne of carbon dioxide equivalent (tCO2-e) stored or avoided by a project.

Queensland Adaptation Partnerships
The Queensland Government is currently developing a Queensland Climate Adaptation Strategy with a wide range of stakeholders to address the risks to our economy, environment, infrastructure and communities from current and future climate impacts (Queensland Department of Environment and Heritage Protection, 2015b).

The Climate Change (Coastal Hazards) Adaptation Program, a joint initiative between Local Government Association Queensland, Queensland Government, Townsville City Council and Griffith University, is being implemented between 2015-2018 to help coastal communities plan and prepare for storm tide inundation, coastal erosion and rising sea levels from climate change. The aim is to ensure the long-term functionality and protection of homes, businesses, infrastructure and services along the coast (Queensland Department of Environment and Heritage Protection, 2016b).

2. Using natural resources for carbon capture

The Australian Government provides incentives to undertake carbon sequestration projects through the Emissions Reduction Fund. Carbon sequestration projects reduce carbon by removing carbon dioxide from the atmosphere and storing it as carbon in growing plants and soils. Carbon sequestration projects relevant to natural resources in our region include:

- planting native vegetation or protecting native regrowth for permanent carbon storage;
- savanna burning – reducing emissions from late dry-season fires;
- sequestering soil carbon in grazing systems;
- fertilizer use efficiency; and
- alternative waste management.

Methodologies for developing carbon sequestration projects must be approved via the Emissions Reduction Fund and involve stringent requirements. One of the obligations to qualify is to hold the carbon produced by sequestration projects for 25 or 100 years. For example the life expectancy of native or forestry trees must meet this time frame. Orchard trees are not covered by the current methodologies for carbon sequestration due to factors such as short life cycle and controlled pruning.

To support landholders and to promote carbon reduction in the region, NQ Dry Tropics has developed an indicative strategic carbon planting map to assist with identifying areas for possible tree plantings for carbon capture. These include potential areas where planting native species would improve biodiversity and habitat connectivity, as well as other locations where mono-species could be planted (see Figure 9, p 40). Planting native species in identified biodiversity areas would generate multiple benefits such as: reducing carbon emissions; earning income from carbon storage; creating native habitat; and increasing wetland buffers and riparian corridors, which also increase filtration of water runoff and overall landscape resilience.

The Queensland Government has developed the interactive Regrowth Benefits Tool, which provides site-specific regrowth information on carbon abatement potential, threatened species, biodiversity benefits and key Queensland Government regulations (Queensland Department of Environment and Heritage Protection, 2016).

There is currently an approved government method allowing people to bid for financial support to change savanna burning practices on areas with more than 1000mm average annual rainfall, and a new method is being approved for burning practices in areas of savanna vegetation with average annual rainfall between 600 and 1,000mm (see Figure 8, p 38) (Australian Government, 2016). The figure depicts areas in the catchment where each of these methods apply and where landholders can use the government's Direct Action Plan to enter into a financial contract to increase soil carbon storage.

When considering implementing a carbon sequestration project, such as planting trees or soil carbon sequestration, it is prudent for landholders to weigh up all the attributes and values of the land being used including its current and future use and productivity.

3. Natural resource and community resilience

To ensure our future food sources and livelihoods, it is vital that our natural resources and communities are resilient to the predicted pressures of climate change. It has been recognised that a concerted shift towards best-practice natural resource management and planning will increase the economic sustainability of agricultural and ancillary industries and make our natural resources

more sustainable and resilient (United Nations, 2013).

Land ecosystems have been able to absorb a third of the human-induced carbon emissions since the 1960s (Lund University, 2015). Semi-arid ecosystems such as the savannas that dominate our region are extremely important in controlling carbon storage. Compared to rainforests, savannas are able to grow more biomass to store carbon taken from the atmosphere. This highlights the importance of protecting our savannas and other dry ecosystems for mitigating climate change.

Coastal and marine ecosystems also have important carbon capture capacity. A new study has identified that the carbon capture and storage capacity of wetland vegetation (known as blue carbon) make our coastal habitats some of the most carbon-rich ecosystems on the planet (Kelleway, 2015). The study found that seagrass, mangroves and salt marsh habitats are more efficient at capturing carbon than rainforests. A recent study between the Australian Government, James Cook University and CSIRO developed methods to identify natural areas that are resilient to changes in climate. Climate-resistant areas were shown to be in locations that included valleys or elevated areas where animals could survive projected warming. Using methods such as this provides strategic direction and gives guidance about where conservation efforts can be focused, for example where nature refuges should be established (Reside, et al., 2013).

Making appropriate land-use planning decisions, such as incorporating coastal management planning and coastal adaptation strategies at a landscape level, is vital to ensure the community can deal with impacts from climate change. Community resilience also includes people becoming more adaptive to changes in their surroundings. This can be achieved by having prior knowledge about climate change and adequate time to be able to make planning and management changes (Marshall, 2013).

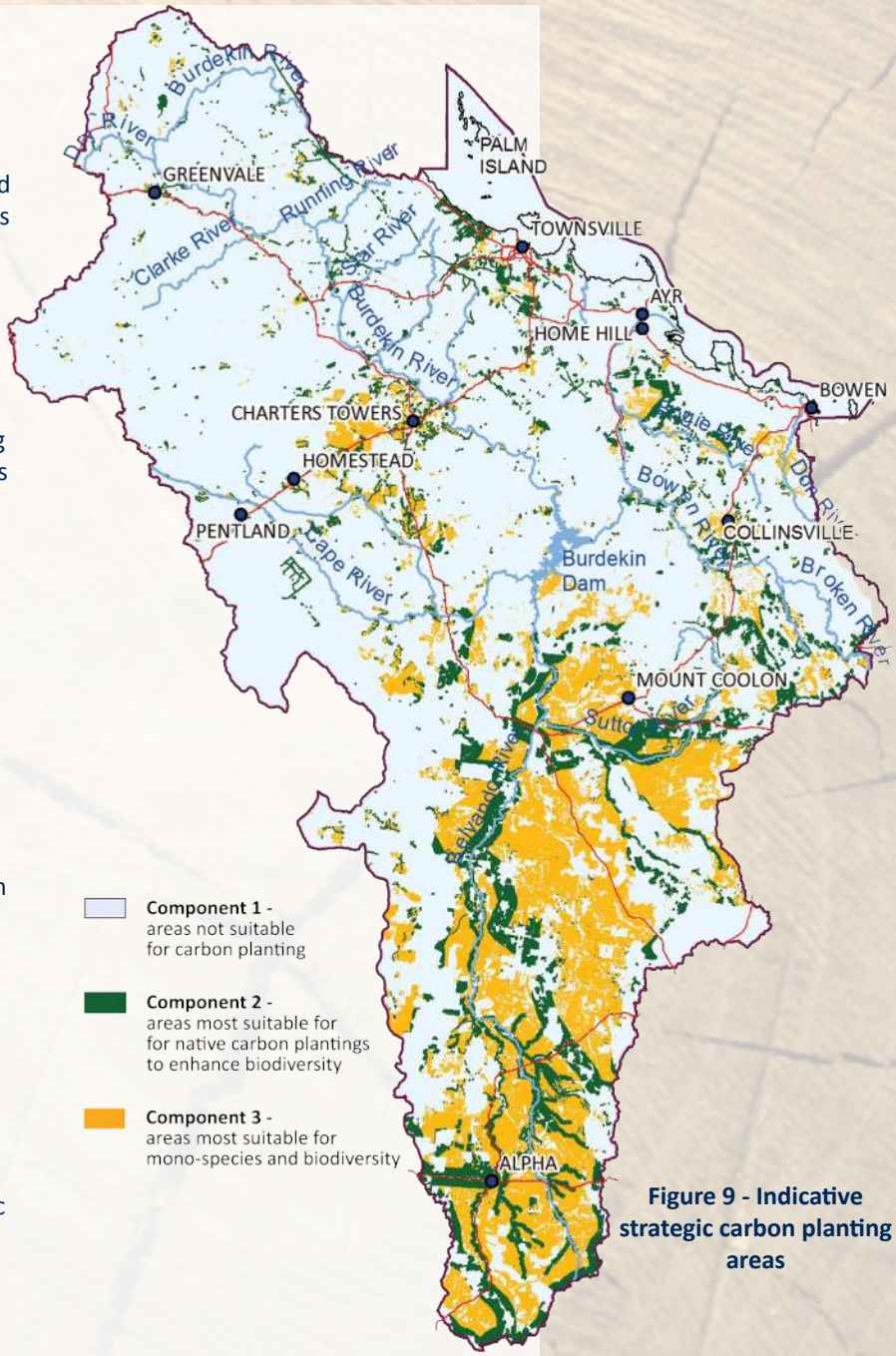


Figure 9 - Indicative strategic carbon planting areas

Land and water management techniques to improve the sustainability and resilience of natural resources are detailed in other parts of the plan. Using natural resources sustainably includes limiting how much we use and how much we reserve to respond to climate change. Goals and objectives highlighted in the plan include using water efficiently, maintaining soil health, providing nature refuges, and maintaining habitat corridor widths. The way we plan, manage, make decisions and allocate our natural resources will need to be based on a better understanding of how natural resource conditions and distribution will change and account for predicted climate change impacts, such as longer dry periods.

DELIVERY

Objectives	Strategies
Carbon emission reduction and carbon capture programmes are actively encouraged and supported.	a) Support investigation, dissemination and use of regionally-specific information to guide emission reduction opportunities, methods and tools to support decision making.
	b) Promote and implement carbon storage programmes such as carbon tree plantings, soil carbon sequestration and coastal blue carbon (mangroves etc) sequestration.
	c) Support programmes to: • assist individuals and communities reduce emissions; • encourage commercial, industry and aggregated energy and fuel efficiency; • avoid or capture coal mine fugitive emissions; • capture, or avoid generating, landfill gas, agricultural waste and biogas from wastewater; and • promote energy efficiency in town planning, house design and domestic appliances.
	d) Collaborate regional partnerships to design and bid for large-scale carbon credit projects. *For example: landscape-scale activities including grazing, planting and savanna burn fire management.*
	e) Investigate the carbon exchange and capture potential at a farm scale and for differing land use types. *For example: soil carbon sequestration options between grazing and cropping land use types.*
	f) Investigate whole-of-sugar-industry scale opportunities for obtaining credit for practice change.
Renewable electrical energy, fuel resources and consumable products are investigated and promoted to reduce the dependence on finite fossil fuel resources.	a) Support independent research into, and promote the use of, alternative and renewable electrical energy, fuel sources and consumable products that are commercially competitive and offer a wide variety of energy use and supply options. *For example: hydro, solar, co-generation and using waste as a resource for making electrical energy, fuel and other consumable products to reduce pressure on finite fossil fuel resources.*
	b) Support research and development of alternative economies not reliant on coal and oil as the only source of electrical energy and fuels.
	c) Support partnerships and networks between major industry sectors, regional planners, enterprise organisations and researchers.
Enhance knowledge and ability to respond to effects of climate change in the region.	a) Establish, expand and protect areas of 'native refugia' that are identified as being resilient to predicted climate change impacts.
	b) Investigate the impacts of climate change on natural resources, and identify management options for responding to opportunities to increase climate change resilience, such as: • innovative and sustainable land and water management practices; • including climate change projections in modeling and assessment of natural resource conditions, quantities and allocations; • crop diversification and switching; and • supporting new enterprises.
	c) Investigate pest and biosecurity implications of higher temperatures on the natural environment.
	d) Support investigation, dissemination and use of regionally specific information on: • major emission sources, rates and trends; • regional implications of projections in global emissions profiles; and • regional contributions to global climate change as defined for the volume of air above our region (air shed).
	e) Promote awareness of climate variability and practical resilience strategies.
	f) Promote awareness and apply adaptation strategies in local government planning and development decisions to avoid and reduce unnecessary impacts on the community from increased coastal hazards. *For example: The Climate Change (Coastal Hazards) Adaptation Program (CHAP)*

SUCCESS INDICATORS

By or before 2026:	
	• climate variability and change predictions are incorporated into planning and natural resource management;
	• the region's carbon store has increased and carbon emissions reduced;
	• there is increased investment in, and access to, renewable energy electricity, fuel resources and consumable products;
	• communities and individuals involved in NRM have the knowledge and capacity to adapt to climate change impacts;
	• there is increased landscape resilience to impacts of a changing climate.

Photo by Doug Willis

"The overall tension [climate change] will put on communities. The process of adaption to a changing environment may cause economic hardship if not managed early"

Burdekin Community Survey 2015

"Australian agriculture can be a net producer of energy rather than a consumer and buyer of energy, and farmers must think about how energy production can fit into rural landcapes. Solar, wind and biomass as energy producers are a natural thing Landcare can be getting into. Overall we are going to see a move away from big centralised energy grids based on big power stations to a more decentralised approach where more people are generating energy. There's a whole range of business models for the farming community, which Landcare needs to be thinking about."

Professor Andrew Campbell, Director of Research Institute for the Environment and Livelihoods, Charles Darwin University 2015

REGIONAL GOALS

Regional NRM Planning is integrated with local planning schemes and regional planning

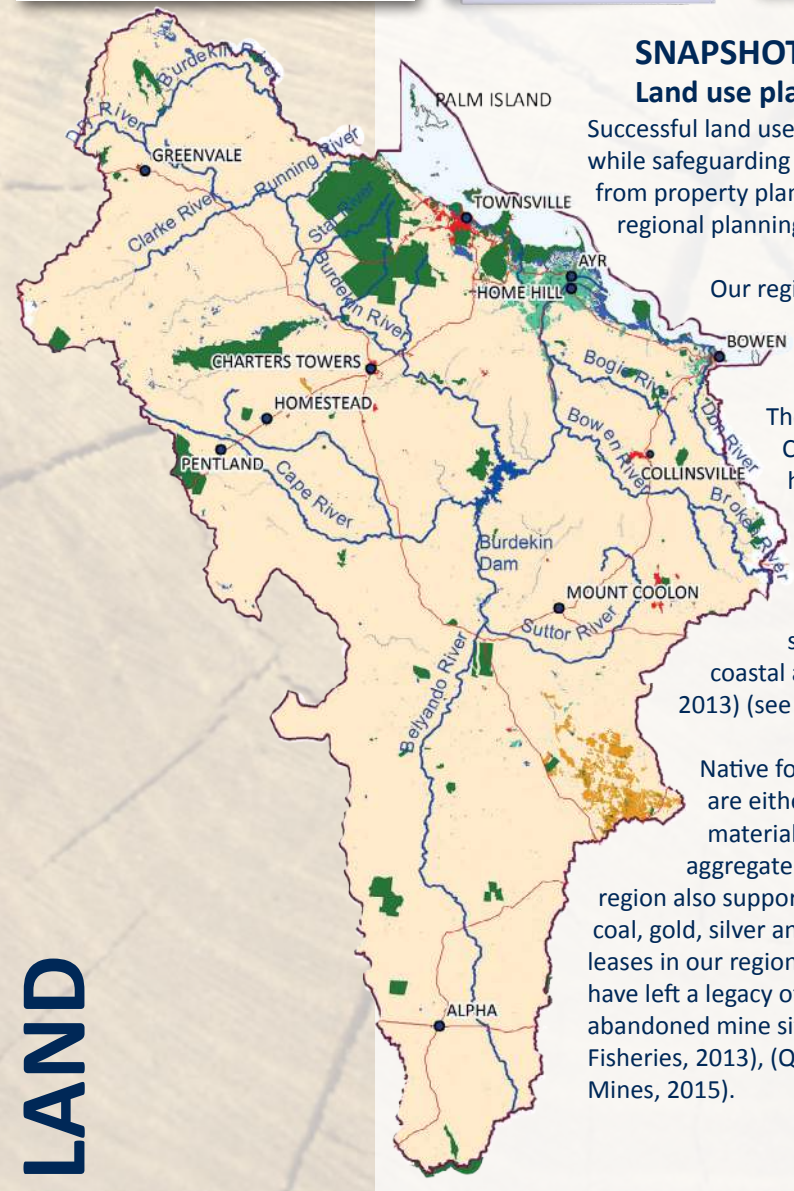
Grazing and farming land resources are productive and of good quality

Landscapes and soils are healthy

Agricultural innovations, alternative products and sustainable management practices are supported and adopted

Agricultural productivity and profitability is protected from pests and diseases

Figure 10 - Landuse



SNAPSHOT

Land use planning of the Burdekin Dry Tropics

Successful land use planning identifies the needs of the community while safeguarding natural resources. It occurs at multiple scales, from property planning through to local government area planning, regional planning and state-wide planning.

Our region covers an area of approximately 146,000km^2 and includes part or all of 12 local government areas, each with its own local planning scheme.

The major urban centres are located at Townsville, Charters Towers, Ayr, Home Hill and Bowen, however, the majority of our region is rural and supports a productive agricultural industry. Grazing occurs mostly in the rangelands, dryland cropping is widespread in the Belyando-Suttor and Bowen-Broken sub-catchments, and irrigated sugarcane production and horticulture occurs in coastal areas (Department of Agricultural and Fisheries, 2013) (see Figure 10).

Native forest on state lands also occur in our region and are either managed for forestry, recreation and/or quarry material, including sand, gravel, road base, crushed aggregate and landscaping rock. The landscapes of our region also support a substantial mining industry, which produces coal, gold, silver and copper. There are about 330 granted mining leases in our region. Mining operations over the last 150 years have left a legacy of impacts and risks associated with around 2472 abandoned mine sites in our region (Department of Agricultural and Fisheries, 2013), (Queensland Department of Natural Resources and Mines, 2015).

The Queensland Statistician's Office has predicted a regional population growth of approximately 50 per cent over the next 20 years. See table below. As urban areas and services expand, they will encroach into rural lands and natural environments.

Locality	30 June 2014 Population	2036 Predicted Population (from 2011 estimates)
Townsville City Council Local Government Area	192,038	314,362
Charters Towers Regional Local Government Area	12,517	12,459
Burdekin Shire Local Government Area	17,916	19,467
Bowen Statistical Area Level 2 (Whitsunday Regional)	9,577	13,596
Collinsville Statistical Area Level 2 (Whitsunday Regional)	4,050	5,892
Palm Island Local Government Area	2,617	3,460
Jericho 2011 Statistical Local Area (Barcaldine Shire)	965	-

Sections of the rural community have expressed a desire to expand intensive agricultural development throughout the region, particularly surrounding Ayr/Home Hill, Pentland, Belyando/Suttor (via water harvesting), Urannah and Collinsville. The Burdekin Dam provides unique opportunities to accommodate agricultural expansion and diversification, however, it also has a number of high-profile constraints around the allocation of water resources and downstream impacts, including the GBR catchment (Refer to *Water – Future Water Demands*).

Land-use planning decisions need to consider and balance multiple interests, including the land's attributes, landscape and catchment context, government policies and community views.

Development and expansion of urban areas and intensive agriculture should occur within the environmental parameters for the land and surrounding environment, and maintain soil health and water quality. In our region, we have a significant responsibility to reduce catchment impacts, in particular to improve water quality run-off from agricultural and urban development, to protect the GBR (Great Barrier Reef Marine Park Authority, 2014).

Natural Resource Response Cycle

Improved land development, innovation and best management practice techniques can provide opportunities for expansion to occur that contributes to long term sustainability for our community, industry and natural resources. For example, on-farm water management, efficient and targeted pesticide application technology, and providing habitat corridors and sufficient distance between development and natural areas to maintain biodiversity and natural processes (eg coastal erosion). Further research and development, along with investment in new technologies, is vital to maintain a sustainable agricultural industry which can still deliver the required economic, social and environment benefits, including protecting the resilience of the GBR.

Appropriate waste management and planning, including sewage treatment and future land fill needs, are also vital to reduce the health impacts on the public and the receiving environments (Department of Environment and Heritage Protection, 2014). See *Part B – Water* for more regional information regarding waste treatment and *Part B – Biodiversity* for littering and illegal dumping.

Impacts resulting from land use can also come from further afield. Urban areas and major transport corridors increase the frequency of movement of people, animals and materials and increases the risk of introducing pests and diseases. This also occurs when urban and peri-urban (rural residential) areas encroach into rural lands.

In urban environments, pests and diseases are mostly considered health issues, however, they are major threats that can migrate to adjacent rural and agricultural land where they can create ongoing pest management problems and have significant impacts on people's businesses and the natural environment

To assist with strategic land use planning, the Queensland Agricultural Land Audit (QALA) undertook a broad-scale regional investigation of land capability for cropping and pastures. The audit was based on the Land Capability Queensland Agricultural Land Class System, which maps the current and potential capability of land based on broad, coarse-scale land resource datasets. The mapping only looks at soil characteristics. It does not consider other potential constraints for new cropping development such as: availability or access to water; conservation status of ecosystems; presence of threatened plant or animal species; or proximity to strategic transport corridor infrastructure (Department of Agricultural and Fisheries, 2013).

Figure 11 (p 46) indicates the land class capabilities for our Region. The categories are:

A: Crop land – suitable for a wide range of current and potential crops with nil to moderate limitations to production.

B: Limited crop land – suitable for a narrow range of current and potential crops due to severe limitations but is highly suitable for pastures. This land may be suitable for cropping where engineering and/or agronomic improvements are used.

C: Pasture land – suitable only for improved or native pastures.

D: Non agricultural land – not suitable for agriculture uses due to extreme limitations.

Land management of the Burdekin Dry Tropics

Our region has a varied landscape, featuring a diverse range of soils, vegetation communities and native animals that shape how the land can be used and managed.

The quality and size of land and soil resources in our region support a profitable and diverse range of cropping enterprises including sugarcane, horticulture and grains, and an extensive grazing industry (Department of Agricultural and Fisheries, 2013). Resilience of these rural enterprises is important, as they contribute to the security of the local and regional economy.

(Wadsworth & Choy, 2011). Rural land managers adjoining reserves or major watercourses have expressed concern about trespassers who drop litter, potentially spread weed seeds, contribute to land and riparian degradation, and compromise livestock welfare. They have linked the issue with a lack of well-managed natural recreational areas in our region that provide urban people with the opportunity to recreate, including camping and four wheel driving. Further information on biosecurity is detailed in *Part B – Biodiversity*.

This community NRM plan can be used as a guide by decision makers and community members to help balance competing interests when undertaking land use planning assessments.

Our region's significant grazing and cropping industries rely heavily on soil condition as the basis for productivity. Soil is a precious and vulnerable natural resource. It can be considered non-renewable, given that it can take hundreds to thousands of years to form from weathering processes. Yet despite the time taken to form soil, it can be lost forever through erosion and toxification caused by inappropriate land management (Carey, et al., 2015).

Our region's soils reflect the diversity of the parent rock, landscapes and rainfall patterns. There are extensive areas of moderately productive but fairly erodible red duplex soils, widespread high productive black and red clays derived from basalt, and large areas of poor to moderately fertile sands and earths. Cracking clays are found in the Belyando-Suttor area. Large areas also have highly-erodible dispersive soils.

The Queensland Agricultural Land Audit identified that land degradation in our region has reduced the carrying capacity of grazing lands and decreased fertility of soils in cropping lands (Department of Agricultural and Fisheries, 2013).

ABCD frameworks for land condition and management

In the past decade much effort has gone towards understanding and developing methodologies to map and identify land capability, condition and management for our region. "ABCD" frameworks are used to describe land condition, its level of capability for a particular land use, and how it is being managed, with 'A' denoting the highest score and 'D' the lowest. These terms will be used throughout the NRM Plan.

Grazing land systems

Over 90 per cent of our region's land is used for grazing, and carries approximately 1,400,000 head of cattle (Australian Bureau of Statistics, 2009). Most beef cattle enterprises are located on leasehold country and are based on grazing of rangelands rather than sown pastures. There are a variety of factors that threaten condition of pastures and soils (salinity, erosion, acidity, weeds and pests), many of which are associated with land uses and management practices that do not reflect the capability of land

1. Land Condition ABCD Framework is a measure of health for grazing land that considers its capacity to produce useful forage, ability to infiltrate water, and risk level for soil erosion. The framework assists landholders to understand and manage the physical, biological and chemical elements of soil. The four cateogries used to identfy land condition are **A - Good, B - Fair, C - Poor and D - Very Poor** (Karfs, et al., 2009).

2. The land management practice ABCD framework for grazing and cropping lands was developed as part of the Australian Government Paddock to Reef initiative to improve water quality entering the Great Barrier Reef (Queensland Department of Agriculture, Fisheries and Forestry, 2013). It aims to improve land and water management practices for better water quality by improving soil health, nutrient management, pesticide management, water and irrigation management, and planning and recording. The ABCD category in this instance is the level of attention and sophistication of farm management practices being implemented. **A - Cutting Edge, B - Best Practice Management, C - Code of Practice and D - Old Practice.**

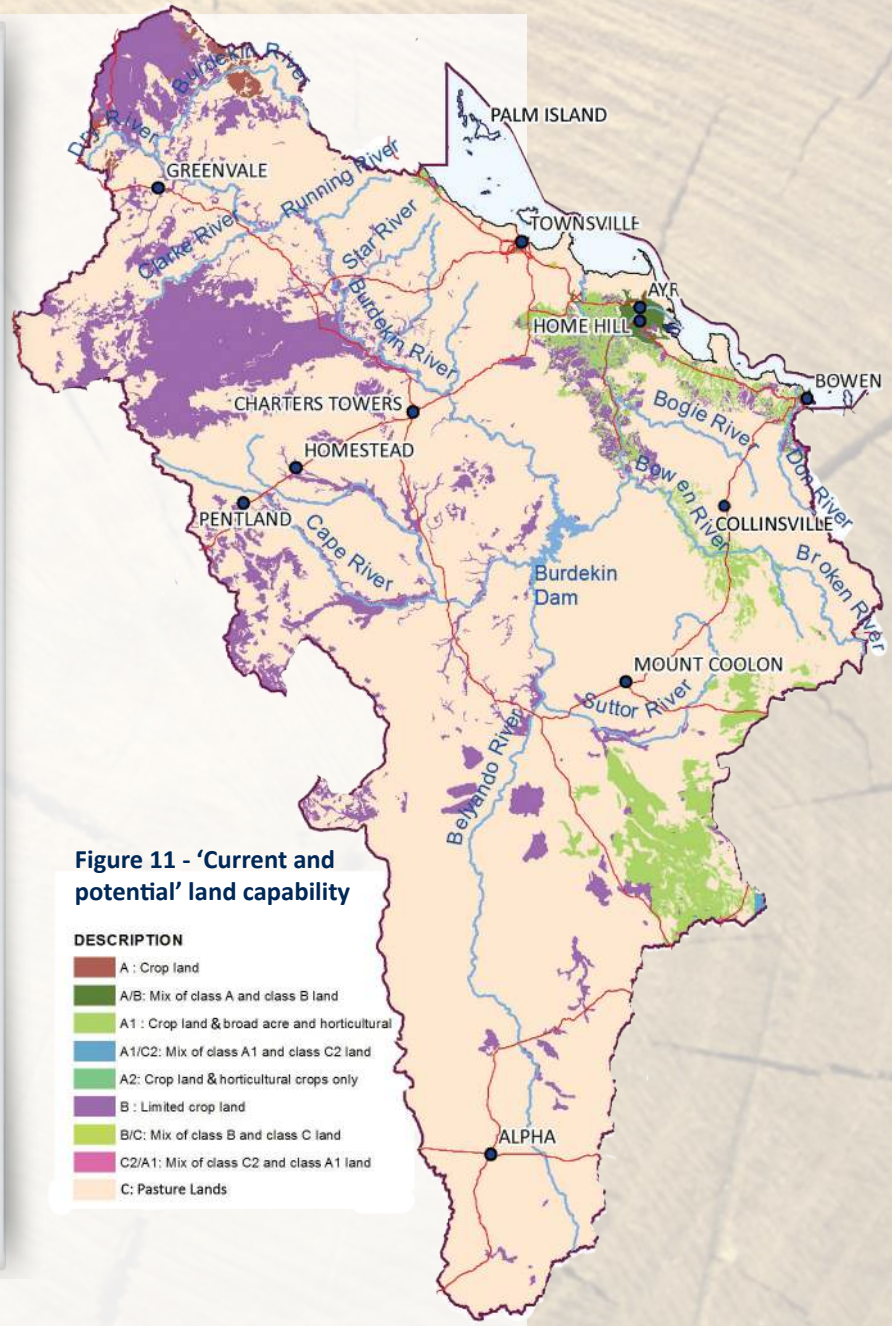


Figure 11 - 'Current and potential' land capability

or constraints imposed by the region's highly variable and challenging climate. Pasture decline is typically reflected in a loss of productive species, ingress of annual pasture grasses, reduced biodiversity and tree thickening. Research has shown that in a 20 year observation period (1993-2012) that uncleared woody vegetation is 'thickening' (increasing in stem density, stem size/basal area and/or canopy cover) on Queensland's rural landholdings. It is debated that while the increased woody plant biomass increases carbon storage, it limits the growth of associated pasture and detrimental to rural enterprises (Burrows, 2015). An appropriate fire regime can manipulate pasture composition and modify grazing patterns to the advantage of agricultural production systems. Conversely an inappropriate fire regime can contribute to tree thickening and reduce grazing opportunities (Roth, et al., 2002).

In the Burdekin rangelands, over the past 30 years, there has been a reduction in the use of fire as a land management tool to maintain the quality of native pastures and to reduce fuel loads. This has been attributed to the weather cycles, where years of big wets, which result in large amounts of groundcover, are followed by drought years, creating large fuel loads for wildfires in dry years (Pisani & Shepherd, 2012).

There are a number of information hubs that support landholders to undertake appropriate fire regimes, including:

- the Queensland Government's

When soils become strongly acid their productivity is compromised. Factors that accelerate acidification include: excess ammonium-based nitrogen fertilisers and continued removal of plant, animal and waste products. Treating surface acidity can be simple such as matching fertiliser inputs to crop demand; efficient irrigation management and early sowing after fallow.

- managing grazing lands with fire information packages; and
- Tropical Savannas Cooperative Research Centre's satellite-based fire scar mapping. This mapping can be found on the North Australia Fire Information (NAFI) website. The live maps allow graziers to monitor fires on large properties, better protect infrastructure and fodder from wildfire, improve native pastures and woodland structures, and improve fire management planning (Felderhof & Jacklyn, 2011).

Within our region's grazing area there are thirty-three land types (listed in Appendix E, p 92), which are mostly characterised by phosphorus poor and highly-erodible soils. Two documents - the Sustainable Management of the Burdekin Grazing Lands and Land Condition Photo Standards for the Burdekin Dry Tropics Rangelands, identified these land types from collating previous regional and local soil mapping data, to better understand the interconnected nature of regional land types, their soils and pasture condition requirements. They highlight each land type's preferred 3P grasses (productive, perennial and palatable), susceptibility to erosion, and safe utilisation rate (maximum rate of average annual use to maintain and encourage good land condition) (McIvor, 2012). Examples of land condition photo standards for a land type are shown on pages 47 and 48.

Example of 'A' conditon land has:
- good coverage of 3P grasses;
- >50% coverage at the end of dry season;
- few weeds and no significant infestations;
- good soil condition: no erosion, good surface condition;
- no sign, or only early signs, of woodland thickening;
- minimal run-off and high infiltration rates.

Example of 'B' condition land has:
- some decline of 3P grasses;
- increase in other species (less favoured grasses, weeds);
- 40–50% coverage at the end of the dry season;
- some decline in soil condition;
- some signs of previous erosion and/or current susceptibility to erosion is a concern;
- some thickening in density of woody plants.

In recent years there have been significant improvements in grazing practices, and reductions in the rate of fine sediment loss from the Burdekin catchment, however, the overall health of soils in rangeland areas remain weak due to erosion and a significant loss of soil carbon as a legacy from past land practices (Hook, 2011). Assessment of our region for the Water Quality Improvement Plan (WQIP) (Refer to *Part B – Water*) has identified substantial areas of the Burdekin to be in very poor 'D' and poor 'C' land condition. 'D' condition land has significantly reduced groundcover and exposed soils, which erode more readily during high-intensity rainfall events that are a common feature in the Dry Tropics.

The proportion of our region with less than 50 per cent groundcover fluctuates substantially with rainfall; after multiple wet years only five per cent of our region has reduced ground cover and after several dry years this can increase to over 40 per cent of our region (Queensland Government, 2010).

The Upper Burdekin and Bowen sub-catchments have the highest rate of erosion derived from exposed subsoils, highlighting a significant loss of topsoil into the waterways as indicated by tracing data (Lewis, et al., 2015). Studies into gully erosion in the Upper Burdekin have also identified that long-term catchment runoff may be greater than 30 per cent higher from degraded catchments than from those in good condition (Wilkinson, et al., 2013) (Meat Livestock Australia, 2015).

Runoff and eroded sediment also carry nitrogen and phosphorus away from the landscape into receiving environments such as waterways, wetlands and marine ecosystems. Rainfall simulation programmes in the Burdekin region have identified that nitrogen and phosphorous loss from 'D' condition land was seven to ten times greater than from land in better condition (Cowie, et al., 2013). The programmes identified that where rehabilitation had occurred following aggressive soil disturbance, water infiltration increased and nitrogen and phosphorous losses were lower.

In addition, dryland salinity outbreaks occur in isolated parts of our region within the Cape River and Campaspe River catchments, and parts of the upper catchment of the Suttor River. Loss of trees and native perennial grasses due to clearing and inappropriate grazing management have increased groundwater recharge in affected landscapes, giving rise to the observed salinity (Roth, et al., 2002). The Salinity Management Handbook is a comprehensive document developed by the Queensland Government to better understand, investigate and manage where salinity does or might occur.

Overall, changes to pasture management to maintain good ground coverage does have notable effects on land condition and the water quality of runoff leaving the land (Bartley, et al., 2014). Regionally, a significant effort is needed to improve and maintain land condition to build resilience and avoid continued deterioration of regional land and soil health.

Preferred management practices vary depending on factors such as land type, presence of a seed bed, erosion extent and topography. In some cases direct mechanical work is needed for specific locations, which will incur a significant initial cost, however it can lead to rapid improvements in the land condition and overall long-term productivity (Moravek & Hall, 2015). In other instances, less intensive methods can lead to significant improvements that are potentially more cost-effective, such as 'stick trap' check dams, or the use of short-term, ultra high density grazing in smaller paddocks, which uses cattle's hooves to grade eroded banks and spread manure to improve the seed bed (Wilkinson, et al., 2015) (NQ Dry Tropics, 2015c).

Grazing trials at Wambiana have proved that managing stock rates and wet season paddock spelling to maintain good groundcover can generate far more profit in the longer term than heavy stocking rates that also lead to land degradation (O'Reagain & Bushell, 2015). Generally, it is more profitable to manage stocking rates in line with the long-term carrying capacity of the grazing land type.

A range of collaborative tools and extension programmes have been developed to help graziers access information on land capability and provide farm management options to improve land condition and resilience through best management practice; including the documents mentioned previously and online tools such as FORAGE, Stocktake Plus and NRM Spatial Hub (Queensland Government, 2016) (Future Beef, 2016) (Rangelands Alliance, 2016). Improved property management practices include undertaking actions that go beyond industry standard requirements, such as:

- mapping land types;
- assessing land condition annually;
- calculating long-term carrying capacity based on area, land types, land condition, pasture utilisation rates and infrastructure;
- applying strategies to restore or improve long-term carrying capacity;
- pasture budgeting;
- strategically locating watering points;
- wet season spelling;
- fencing sensitive environmental areas; and
- managing sheet and gully erosion (Carey, 2008) (O'Reagain, et al., 2014), (McIvor, 2012) (Queensland Department of Agriculture, Fisheries and Forestry, 2013).

Example of 'C' condition land has:

- general decline of 3P grasses;
- large amounts of less favoured species;
- 20–40% coverage at the end of the dry season;
- obvious signs of past erosion and/or current susceptibility to erosion is high;
- general thickening in density of woody plants.

Example of 'D' condition land has:

- general lack of any perennial grasses or forbs;
- < 20% coverage at the end of the dry season;
- severe erosion or scalding;
- thickets of woody plants cover most of area.

Areas with high soil carbon are more physically and chemically stable and less prone to soil loss. Rainfall simulation studies in the Lower Burdekin identified that where bare soil is left, the loss of pesticide, nitrogen, phosphorus and sulfate was significantly higher than with a trash blanket soon after application. Land practices that included managing traffic control and sub-surface applications of fertilisers had significantly higher water infiltration rates and retention of nutrients.

Cowie, et al., (2013).

These practices increase pasture coverage, soil carbon content and water infiltration, improving overall soil health and land condition (Meat and Livestock Australia, Department of Primary Industries and Fisheries, CSIRO) (Queensland Department of Agriculture, Fisheries and Forestry, 2013).

Cropping and Horticulture Land Systems

Most cropping and horticulture enterprises are concentrated in the higher rainfall coastal zone, particularly the irrigated floodplains of the Lower Burdekin, Bowen and Rollingstone. Dryland cropping occurs in large areas of the Belyando-Suttor sub-catchment.

The fertile soils of the Burdekin Dry Tropics region support broadacre crops including approximately 1,050 km² of sugarcane and cotton surrounding Ayr and Home Hill; 1,250 km² of dryland crops in the Belyando Suttor areas; and highly-productive horticulture crops of sweetcorn, tomatoes, watermelons, capsicums, squash, pineapples and mangoes (among many others) at Bowen, Gumlu, Giru and Rollingstone.

The SIX EASY STEPS Method, developed by BSES limited, now known as Sugar Research Australia (SRA), manages the input of fertlisers on productive sugarcane land in a way that is economical to the farmer, and maintains soil integrity whilst also being mindful of the quality of runoff. The programme is an integrated nutrient management tool which involves testing soil characteristics to help adopt best practice nutrient management on-farm.

Sugar Research Australia (www.sugarresearch.com.au)

The warm winters and longer daylight hours enable farmers to double-crop many field crops. During the traditional 'dry' period from April to October, farmers can also programme farm management for irrigation and harvesting of many crops. For cane growers these conditions produce the highest yield and sugar content in Australia. The expanding horticultural sector also produces a variety of out-of-season winter vegetables and fruit, and the Bowen Gumlu Agricultural District is Australia's largest winter vegetable production area.

The focus and investment on agricultural chemicals and sediment loads leaving GBR-connected catchments has led to a better understanding of land management practices, particularly for sugarcane cropping land. Ultimately maintaining good soil health is the key to reducing the runoff of sediment, nitrogen and phosphorous (Dight, 2009) (Queensland Department of Agriculture, Fisheries and Forestry, 2013) (Australian Bureau of Statistics, 2015).

Continuing soil health issues for the cropping region include reductions in soil carbon, potential accelerated acidity, increased water logging and soil salinisation, as well as runoff of nitrogen and phosphorous into the waterways entering the GBR Lagoon (Hook, 2011) (Williams, et al., 2009). The loss of organic material and soil structure, and therefore soil fertility, also inhibits root growth, which leads to productivity losses and increased cultivation and fertiliser application costs (Poggio, et al., 2010). These adverse impacts can be caused by poorly-managed irrigation practices, poor quality irrigation water, and an over-application of nitrogen-based fertilizers.

For cropping lands, best management practices to improve land condition and conserve soil can include: adjusting crop rows, maintaining crop stubble and reducing tilling frequency to increase carbon content, applying fertiliser within the requirements of the soil, improving irrigation efficiency in line with crop needs, and fertigation to prevent a rising water table and salinisation. Additionally, maintaining good riparian vegetation corridors and managing gully erosion in all areas, assists with filtering sediment and nutrients from runoff entering waterways. This leads to overall improved landscape resilience, and benefits may also be present in areas with approved soil carbon sequestration projects.

Adopting new or changed farming systems to improve the rating of land management practice does incur an initial cost, however, an economic analysis of the Burdekin cropping region undertaken by the Queensland Government's Department of Agriculture and Fisheries, identified that transitioning from land management practice categories 'D' through to 'A' is worthwhile (Poggio, et al., 2010) (Department of Employment, Economic Development and Innovation, 2010). It is recognised that in any specific year, a higher farm gross margin would be achieved when operating within an improved class of management practices. This suggests that management practices at a higher class are stronger

financially, and a positive net present value is indicated when moving up the management practice categories.

The wider impacts of traditional land management practices are well established, and economic data supports the benefits of transitioning to improved methods. Despite this, not enough property owners are currently adopting best practices on their land. The recent Australian Government Reef Report Card identified that for the sugarcane lands in our region, less than a quarter to one fifth of cropping properties are incorporating best management practices for irrigation, pesticides, nutrients and soils (Australian and Queensland Governments, 2015). This highlights the need for a greater coordinated and collaborative effort by industry, government, research organisations and NRM groups to provide landholders with incentives, education and extension to support and enable their transition to more sustainable land management practices.

Regional opportunities

Soil health is important for the land itself as well as for the water entering the GBR Lagoon. Protecting the productivity of degraded rural land, and helping to improve its resilience, is becoming increasingly urgent for our regional communities. Support should be available for land managers to make considered and informed decisions to undertake best management practices that improve land condition and productivity, including using latest innovative techniques and holistic decision making, or possibly even completely changing the commodity they produce. Other best practices may also include using longer farm and business planning cycles, planning for predicted short-term changes in climate, and setting goals for outputs over 5-10 years rather than annually. Accessible technical support networks are vital for land managers who are considering methods to sustainably improve land productivity.

"There is one key fundamental concept that we have learnt. Throughout the process we went from being cattlemen, to grass farmers and then realising that we are actually soil farmers. Our future is the direct result of how we look after the soil."

Barry & Leanne O'Sullivan
Glenalpine Station
(NQ Dry Tropics, 2015a)

Decreased soil fertility continues to increase pressure on existing agricultural land productivity. More focus on soil health is required to ensure current agriculture enterprises, and any future expansion, is long lived and sustainable for future generations (Soil Science Australia Queensland Branch, 2013). There are regional strategic plans for conservation, pest management and water quality, however, there is as yet no such plan to deal with the issue of maintaining healthy soils. A regionally-specific strategy could help to increase productivity by bringing together a coordinated network of representatives to investigate the optimal levels for soil health, create an ongoing regional monitoring programme, and develop improved management practices.

Research and innovation

Scientists and landholders are currently trialing a bioherbicide technique that uses naturally occurring fungi to kill woody weeds. The bioherbicide is applied as a capsule containing millet that has been colonised by the fungi. The capsules are drilled into a targeted plant and the mega-dose kills the woody weed from the inside. This minimises physical disturbances to land and the banks of watercourses, improves pasture condition due to reduced competition from weeds, provides overall biodiversity benefits, and avoids the need to apply chemical herbicides (Allan, 2015).

Holistic Management is a decision-making framework that is proactive and considers how land productivity can be affected by factors such as soils, water, climate, pasture species, stock and crop genetics as well as weeds and pests. It also considers the social and economic outcomes and the ability to manage land in a productive and sustainable way. (NQ Dry Tropics, 2015c)

DELIVERY

Objectives	Strategies
LAND USE PLANNING	
The *statutory planning framework* in the Burdekin Dry Tropics region incorporates the principles of ecological sustainable use and management of natural resources.	a) Give due consideration to the capacity of land, prior to the expansion of new irrigated and dryland cropping areas, including assessment of: • soil health and capabilities; • water supply; • natural water cycle management; • fragmentation of the landscape and ability to retain connectivity between natural landscapes and riparian buffers along water courses; • crop type needs; and • point source and diffuse release of chemicals associated with cropping.
	b) Maintain a user-friendly and web-accessible mapping product for landholders to access property and NRM information.
	c) Support creation of a public mapping platform to display approved developments so that the community, assessing agencies and decision makers are aware of the total footprint of approved developments.
	d) Ensure that planning for significant projects and infrastructure developments incorporates measures to protect and appropriately manage natural resource assets, including: • protecting and buffering healthy waterways; • protecting water supplies from incompatible land use; • protecting biodiversity through maintaining significant habitat areas and corridors; • protecting good quality agricultural land and fertile soil resources from the encroachment of urbanization and inappropriate land use causing reverse amenity; • avoiding disturbance of acid sulfate soils, and mitigating this where it has occurred; and • appropriate waste management.
	e) Maintain air quality buffer zones between sensitive land uses and industrial and agricultural development to ensure air is consistently healthy to breathe.
	f) Investigate, and where suitable promote, alternative industries that are appropriate to the landscape and natural attributes of the area.
Natural processes and the protective function of landforms and vegetation are maintained or enhanced to mitigate natural hazard risks.	a) Ensure that land use planning in our region does not lead to increased development in natural hazard areas (for example coastal erosion prone and storm tide inundation areas, steep slopes and bushfire hazard areas).


Soil sampling, Sonoma Station
Photo © NQ Dry Tropics


Wetland training session
Photo © Dept of Agriculture and Fisheries

Natural processes and the protective function of landforms and vegetation are maintained or enhanced to mitigate natural hazard risks (cont.)	b) Incorporate and give due consideration to the geomorphologic characteristics of a site during planning and development. *For example: geomorphology may extend beyond general civil engineering requirements and may impact on issues such as natural drainage and landscape stability.*
	c) Maintain updated publicly-available mapping of natural hazard studies and mapping for the Burdekin Dry Tropics region.
	d) Develop and distribute community information packages on natural processes, risks and environmental values of areas such as riparian, wetland and coastal ecosystems.
LAND MANAGEMENT AND SOIL HEALTH	
Regional strategic direction for land management and long-term improvement in soil health.	a) Support a collaborative representative group, with sub-regional representation, to develop a regional soil management plan that can inform cropping, horticulture and grazing land management. The plan will: • collate existing information including resource condition; • update and refine soil mapping to be suitable for property scale use; • further investigate the optimal levels for soil health across grazing and cropping regions; • determine management targets to maintain or improve land condition and soil health; • develop and improve upon best management practice techniques; and • create a monitoring, evaluation and review programme.
	b) Support land managers to undertake adaptive management to maintain or improve land condition, by raising their awareness and building their capacity to identify the capability of their land, adopt innovative management techniques, and employ best management practices.
An informed and involved community effectively manages biosecurity (weeds, diseases and pests) to reduce adverse impacts on agricultural land productivity. ***Please see Biodiversity for further strategies relating to biosecurity.***	a) Support development of integrated regional biosecurity information systems and tools to support decision making that also reduces impacts on agricultural productivity.
	b) Continue to develop regional biosecurity capacity through: • the Burdekin Dry Tropics Regional Pest Strategy; • key industry bodies; and • Biosecurity Queensland. *For example: maintain a public register of potential pests/ weeds and prompt declaration processes.*

Soil biological functions are maintained, including: • **maintaining organic matter levels to support other physical, chemical and biological functions;** • **maintaining biological capacity for nutrient cycling and a resilient physical structure; and** • **avoiding populations of damaging pathogens, weeds and other pests.**	a) Support the development and promotion of innovative methods to maintain and increase soil carbon within cropping, horticulture and grazing systems. *For example: increasing ground cover; promoting plant (crop and pasture) diversity and vigour for increased rooting biomass. Maintain soil chemical and physical function.* Note: biological, chemical and physical functions are all interlinked and dependent on each other – e.g. healthy biology is very dependent on having the soil chemistry and structure in good condition.
Soil chemical functions are maintained, including: • **supplying nutrients in the right proportions for plant growth;** • **maintaining pH that supports plant growth and soil organisms; and** • **avoiding toxic levels of nutrient, trace metals and pesticides residue.**	a) Support the development, promotion and uptake of innovative and proven methods to maintain and improve soil fertility in both grazing and cropping lands.
	b) Prevent the buildup of any nutrients or chemicals to toxic levels and undertake prompt remediation where required. *For example: match nutrient applications with crop needs. Utilise fertilisers that are least likely to be lost from the paddock. Maintain soil pH at natural ranges or adjusted for crops as required. Maintain good biological activity for maximum nutrient cycling.*
Soil physical functions are maintained, including: • **getting water into the soil with minimal runoff and erosion;** • **storing plant-available water;** • **maintaining a friable structure for root growth and water extraction; and** • **maintaining gas permeability.**	a) Promote and implement cultivation practices that minimise soil disturbance, and maintain soil fertility. *For example: precision agriculture, and matching irrigation and fertiliser practices with crop needs.*
	b) Promote and implement grazing management practices that maintain an end-of-dry-season groundcover and minimise soil disturbance. *For example: high rotation grazing, or maintaining and improving the condition and cover of long-term perennial vegetation on grazing lands, to maintain good biology activity for maximum nutrient cycling and soil structure to assist water infiltration and reduce sheet/hillslope and gully erosion.*
	c) Avoid, or where it is occurring, remediate gully and stream bank erosion.
The extent of dryland salinity does not increase due to impacts from pastoral and agricultural practices.	a) Increase awareness and understanding of the impacts of dryland salinity, and identify and employ appropriate land uses and management practices in priority areas. *For example: rehabilitate sites with saline adaptive plantings.*
The environment is protected from the disturbance and oxidation of acid sulfate soils, including their direct and flow-on adverse impacts.	a) Increase awareness and understanding of where acid sulfate soils are located, their impacts, and how to avoid, mitigate and rehabilitate affected areas.
Abandoned mines, mineral processing plants and exploration activities do not compromise community safety, the health of the surrounding environment and ecological processes, and productivity of rural land.	a) Support and facilitate programmes and processes to rehabilitate abandoned mines and repair ecosystem functions within our region, including using rehabilitation bonds to undertake necessary repair or maintenance work.
	b) Investigate alternative ongoing productive uses for abandoned mining sites. *For example: power generation or processing facilities.*

SUCCESS INDICATORS

By or before 2026:	
	Land use planning
	• the most up-to-date and comprehensive data and information (statutory and non-statutory) is used when developing local planning instruments and regional statutory policies and plans.
	• urban development occurs in the most appropriate areas (i.e. not in hazard areas, high biodiversity areas or good quality agricultural land.
	Land management and soil health
	• there is improved soil health in our region;
	• there is a reduction in nutrient and sediment loads to the GBR, and targets identified in the Burdekin WQIP and Reef 2050 Plan are achieved; and
	• there are rehabilitated abandoned mines, resulting in repaired ecosystem function.

Waterway Geomorphology workshop, Haughton River

Photo © Dept of Agriculture and Fisheries

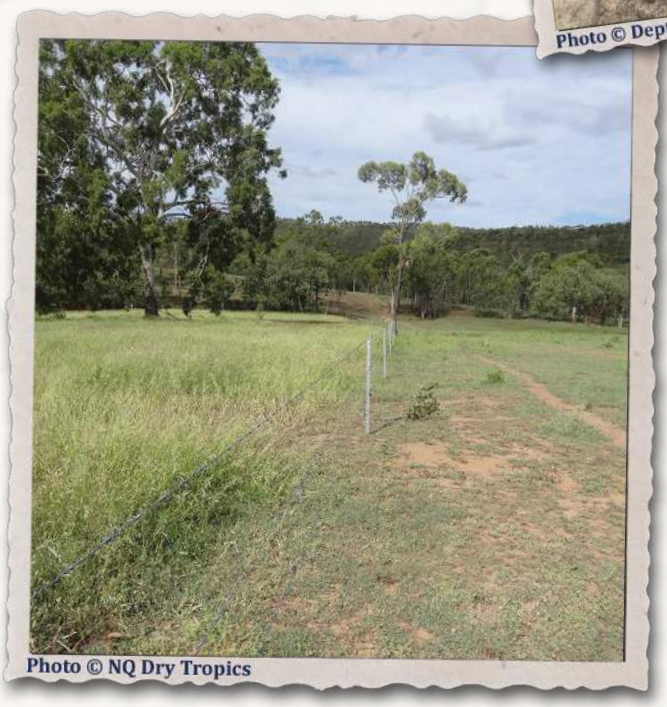


Photo © NQ Dry Tropics

"Water is life, irrespective of where you live or what you do"
Burdekin Community Survey 2015

REGIONAL GOALS

The ecological integrity and physical stability of watercourses, wetlands and marine ecosystems are restored and maintained

Water is secured for the environment, communities and industry

The Great Barrier Reef is protected as an exceptional natural resource

SNAPSHOT

Water resources of the Burdekin Dry Tropics Region

The quality and quantity of surface water and groundwater continues to be a central issue for our region. Both the marine and freshwater environments are strongly affected by changes to flow and water quality as a result of current land management practices, and water use in irrigation, urban development and mining. Since the previous NRM plan was released in 2005, substantial investment has led to a greater understanding of critical water issues such as quality, runoff, appropriate allocation allowances and management techniques.

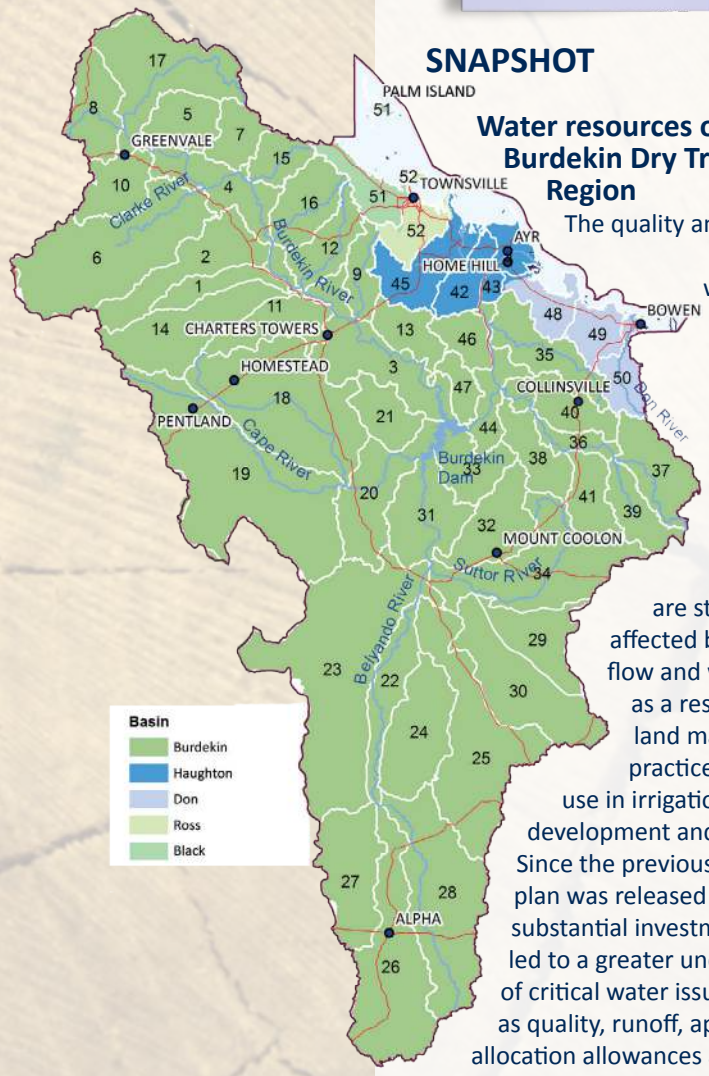


Figure 12 - Burdekin basins and sub-catchments *(list of sub-catchment names in Appendix F p 94).*

Our region includes five river basins: the Burdekin, Don, Haughton, Ross and Black rivers, which are defined into 52 sub-catchments (see Figure 12 and listed Appendix F, p 94). Our region's surface and ground waters are primarily defined by the catchment of the Burdekin River, which is the second largest river catchment on Queensland's east coast, and delivers nearly a third of the annual freshwater flow from all catchments into the GBR Lagoon (Water Planning North, 2010). The Black, Ross, Haughton and Don basins are all significantly smaller than the Burdekin and collectively make up approximately six per cent of our region. The Burdekin, Haughton and Don basins are dominated by a mostly rural environment, while the Black and Ross basins are mostly urban and peri-urban.

1. Surface flows

River flows are highly variable throughout the year and between years, reflecting the summer monsoonal season and periodic large rainfall events associated with storms and cyclones. High flows may be followed by extended dry periods. Rivers typically flow from the west to the east coast, and annual rainfall declines rapidly when moving upstream, from over 1,000mm/yr around the north east coastal ranges and eastern coastal plains, to less than 500mm/yr in the south west of our region (Roth, et al., 2002). As a consequence, even the main rivers are ephemeral over much of their length, although water infrastructure has modified some river flows, and systems may be inundated with water for most or all of the year. Surface water flows and wetland hydrology are highly-modified within the Burdekin, Haughton and Ross rivers due to dams, weirs, water extraction, tidal barrages, constructed drainage networks and ponded pasture bund walls.

2. Groundwater

Information regarding groundwaters in our region is sparse and often localised to irrigated areas, mining or domestic use. Information is more readily available for the managed groundwater systems where there are increased demands on aquifers. These are located in:

- the Burdekin Delta, which includes Australia's oldest artificial aquifer recharge system;
- the Bluewater sub-artesian area,

WATER

including the Black River;
- the Bowen aquifers – Don River Alluvium, Euri Creek Alluvium, Granite and Town Common Alluvium;
- the Highlands sub-artesian area; and
- part of the Greater Western sub-artesian area.

Western areas of our region (Galilee Geological Basins) are a recharge source for the groundwater of the Great Artesian Basin, which underlies 22 per cent of Australia. The basin lies largely beneath arid areas where groundwater is the only reliable source of good-quality water for human activity, and supports important natural ecosystems, including significant mound springs.

Regional groundwater vulnerability mapping developed by the Queensland Government identifies the sensitivity of groundwater sources to potential pollutants. Figure 14 shows that groundwater most vulnerable to potential pollutants occurs mostly in the upper reaches of the catchments and the lower Burdekin River floodplain. Land use mapping for the corresponding areas displayed in Figure 10, p 50 show that the upper catchment reaches are relatively undeveloped and any impact from potential pollutants (such as fertiliser and pesticides, septic tank effluent, landfills) would be isolated to townships and mining activities. However, the groundwater in the Lower Burdekin sub-catchment, supports significant irrigated cropping which has led to a degradation of ground water quality. This is discussed further in the Lower Burdekin catchment section and the Burdekin WQIP.

3. Aquatic ecosystems

Aquatic ecosystems in our region include rivers and wetlands, many of which are listed in the National Directory of Important Wetlands (Figure 13), including the significant inland freshwater wetlands - Valley of Lagoons and the Scartwater aggregation. Further east, the Townsville-Burdekin wetland aggregation is one of the most extensive on Australia's east coast and includes the Bowling Green Bay Ramsar-listed wetlands (Environment Australia, 2001). These wetlands play an important function in the landscape and in the health of the GBR by removing excess nutrients, chemicals, pollutants and sediment before they reach sensitive seagrass communities and near shore coral reefs. Many popular and important commercial and recreational seafood species, including Mangrove Jack, Barramundi, Mullet, eels, crabs and prawns, also depend on these wetlands and waterways for habitat, and other parts of lifecycle including mating, spawning and dispersal.

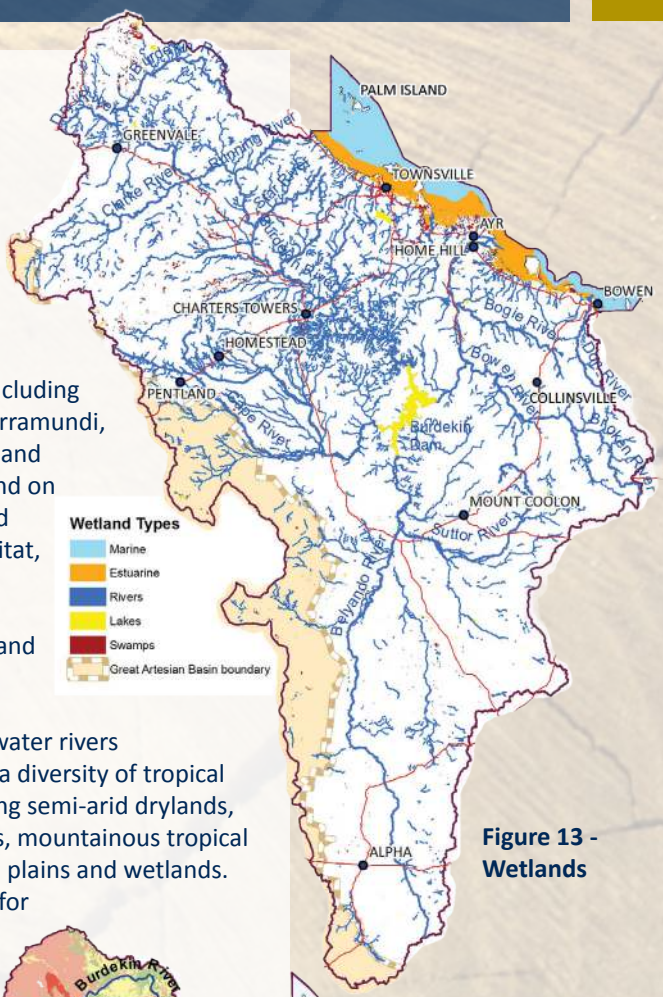


Figure 13 - Wetlands

Our region's freshwater rivers and streams drain a diversity of tropical landscapes including semi-arid drylands, wooded grasslands, mountainous tropical rainforests, coastal plains and wetlands. They are essential for environmental, agricultural and other anthropogenic uses. While work has occurred over the last 10 years on understanding water quality and downstream impacts on the GBR, in-stream health of our waterways linked with catchment scale land capability is poorly documented. In many freshwater ecosystems, the key influences on

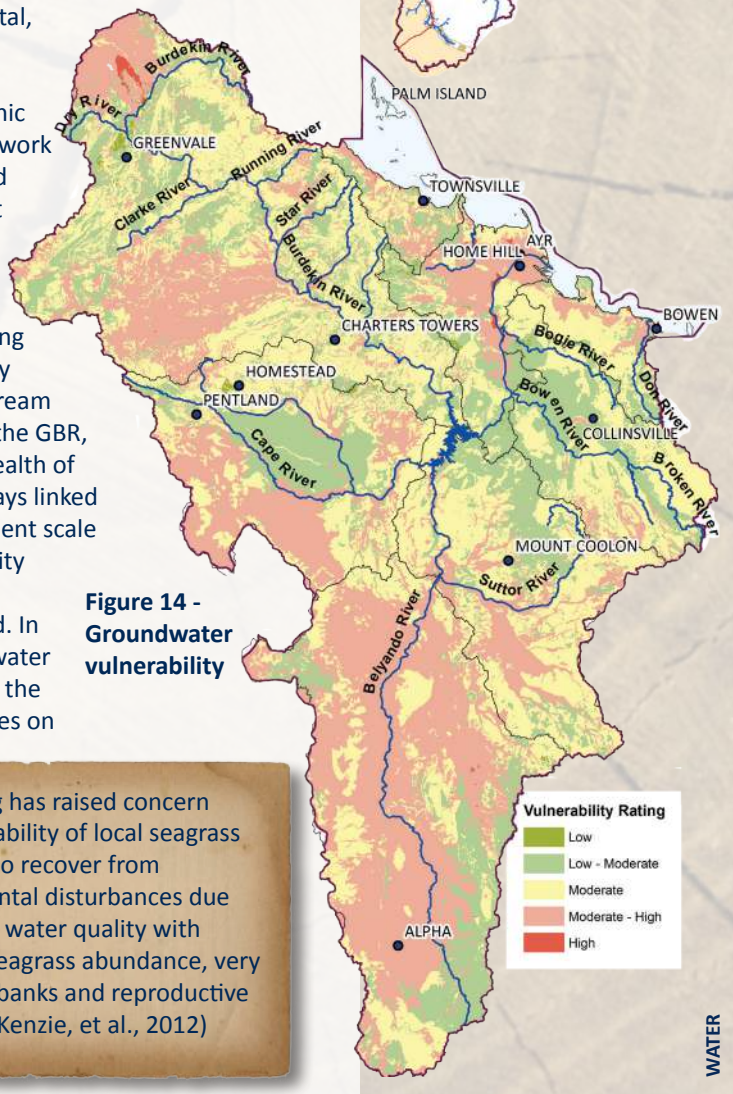


Figure 14 - Groundwater vulnerability

> Monitoring has raised concern about the ability of local seagrass meadows to recover from environmental disturbances due to reduced water quality with declining seagrass abundance, very poor seed banks and reproductive effort. (McKenzie, et al., 2012)

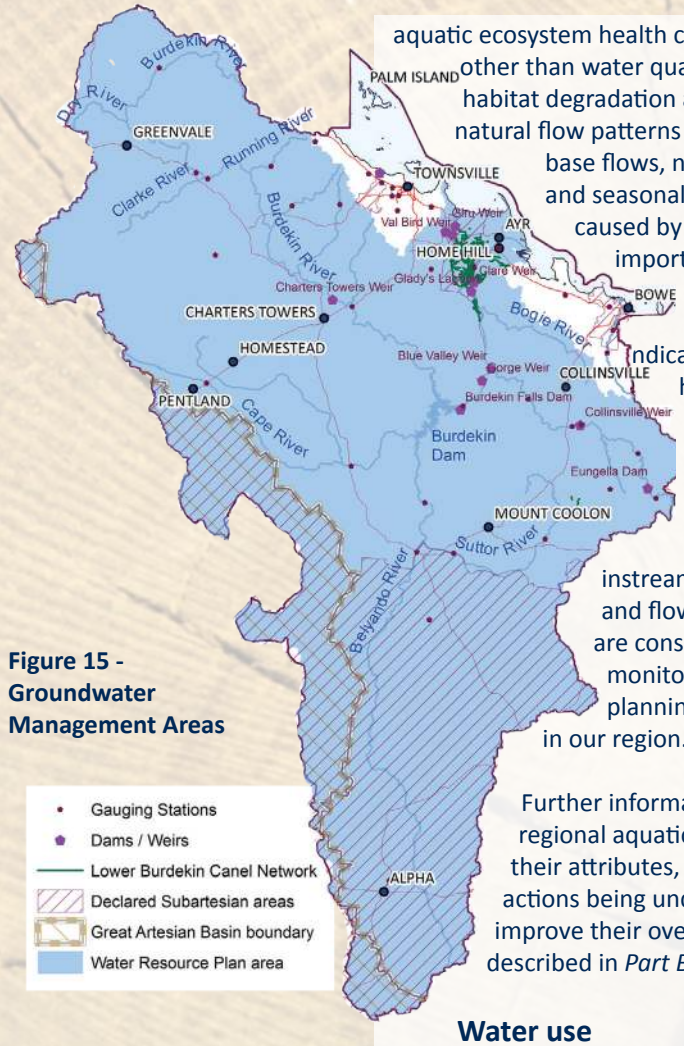


Figure 15 - Groundwater Management Areas

aquatic ecosystem health can be factors other than water quality, including habitat degradation and changes to natural flow patterns (peak flows, base flows, no flow periods and seasonality of flows) caused by humans. It is important that as well water quality, biological indicators of the health of in-stream flora and fauna, habitat indicators (riparian and instream habitats) and flow indicators are considered in monitoring and planning programmes in our region.

Further information on regional aquatic ecosystems, their attributes, threats, and actions being undertaken to improve their overall health is described in *Part B – Biodiversity*.

The impacts of nutrients and other contaminants in surface waters on instream/freshwater include:
- reduced health of aquatic biota;
- accumulation of contaminants throughout the food chain;
- decreased oxygen which may cause fish kills;
- low pH (e.g. from acid sulfate soil discharge) which may cause fish kills;
- decline in drinking water quality;
- algal blooms; and
- weed growth

Department of Sustainability, Environment, Water, Population and Communities (2013)

Water use

Water resources in our region support a variety of uses – residential, commercial, irrigated agriculture, mining and industrial (including meatworks, power stations and mineral refineries). Townsville's water is supplied from Paluma Dam, Ross River Dam and, during extended drought conditions, the Burdekin Haughton Water Supply Scheme (BHWSS). Town supply for the other population centres is provided by the Burdekin River, including the Burdekin River Weir, BHWSS, and Bowen, Broken Water Supply Scheme (BBWSS). Groundwater bores supply town water for Alpha in the most southern part of our region. The expected urban and industrial growth in towns in the northern part of our region will be underpinned by water from the Burdekin Basin (Department of Energy and Water Supply, 2014).

The Burdekin Basin also supports 901 km² of irrigated cropping, largely based on sugarcane in the Lower Burdekin catchment (Waterhouse, 2016). Water used to irrigate cane crops is sourced from the groundwaters of the Burdekin Delta aquifer and Burdekin Falls Dam. Groundwater for irrigation in the Delta area has been supplemented by discharge from the Burdekin Falls Dam since it was constructed in 1987. This water availability led to a major expansion of the sugarcane industry, into an area north of the Burdekin River extending to the Haughton River and Barratta Creek, which is known as the BHWSS (formally known as Burdekin River Irrigation Area). Irrigation water is supplied to farms across the BHWSS through a complex system of natural and artificial drainage channels. The soils of the area are substantially different from those of the Delta area, and are predominantly composed of more impermeable duplex soil types (Davis, 2006). This supplemented water for irrigation from the Burdekin Falls Dam has resulted in a highly modified flow regime within the rivers and creeks that dissect the Lower Burdekin catchment. Flood or furrow irrigation is most common in the sugarcane areas, with over 95 per cent of growers adopting this system to irrigate their crops (Queensland Government, 2015).

The water pricing arrangements in the Lower Burdekin results in an incentive for irrigators to use the full allocation entitlement regardless of variability in actual needs particularly where individual irrigators have access to BHWSS channel water and gravity delivery (Waterhouse, et al., 2016). The impact on coastal ecosystems of the superfluous delivery of water to farms and Water Board aquifer recharge systems is further discussed in the Lower Burdekin section, p68. The Burdekin WQIP provides further information regarding the water pricing arrangements for irrigators, including the Burdekin Water Boards.

Water allocation

The Queensland Government is responsible for overseeing the sustainable allocation and management of both surface water and groundwater for our region under the provisions of the *Water Act 2000*. Since the 2005 NRM Plan, the Burdekin River Basin now has a Water Resource (Burdekin Basin) Plan 2007 (WRP) which includes a Resource Operations Plan (ROP) that deals with

surface water and overland flow. A review of the WRP is due in 2017. The other river basins in our region are still under the broader responsibilities of the *Water Act 2000* and are managed at the catchment scale.

Groundwater in our region is also managed where the Water Regulations 2002 have identified declared sub-artesian areas, some of which also have a groundwater management area (GMA) where water sharing rules apply (See Figure 15).

Water resource planning for the Burdekin Basin has identified reserves of unallocated water (see table below). Water is not available for allocation from the General reserve except when released for an open tender process. Water is only available from the Strategic reserve via an approved application from the Queensland Government. At the commencement of the WRP, these reserves totaled 543,000 megalitres per year (ML/yr) which are distributed across the WRP sub-catchment areas. The bulk of the General reserve occurs in the Belyando-Suttor sub-catchment (130,000ML/yr) and Lower Burdekin sub-catchment (50,000 ML/yr). While the majority of the Strategic reserve is spread across the Lower Burdekin and Haughton sub-catchments (150,000 ML/yr), Bowen and Broken sub-catchments (150,000 ML/yr) and the Belyando-Suttor sub-catchments (20,000ML/yr) (Water Planning North, 2010).

Reserve Purpose	Total Mean Annual Volume (ML)
General reserve	200 000
Strategic reserve for state purposes	35 000
SunWater reserve	8 744
Strategic reserve for a future raising of Burdekin Falls Dam	150 000
Strategic reserve for water infrastructure for the Bowen and Broken sub-catchments	150 000

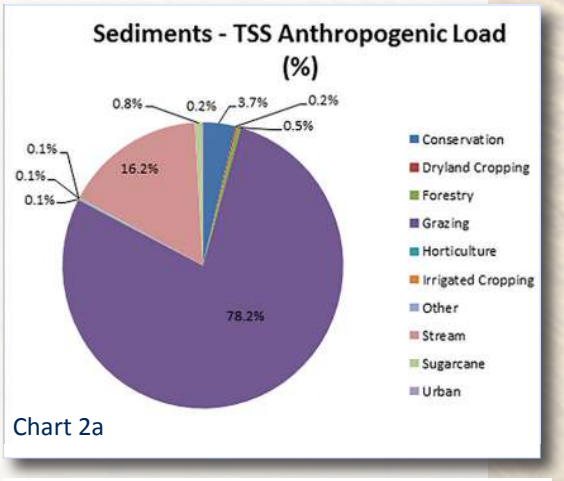


Chart 2a

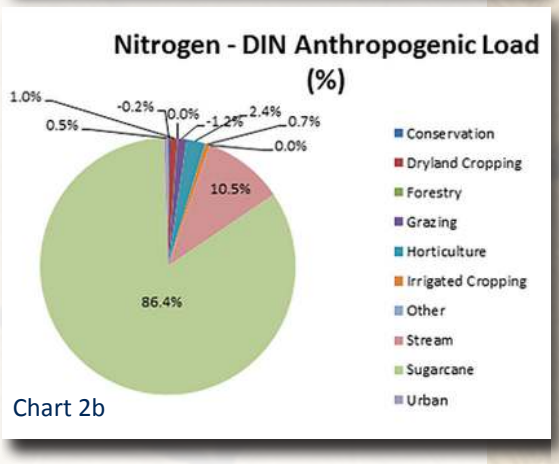


Chart 2b

Water quality

Water quality is central to the integrity of the environment and determines the suitability of water for a particular purpose e.g. community drinking water supply, recreational or agricultural purposes. Nutrient, sediment and other contaminants run-off from land, impacts on the receiving freshwater, estuarine and marine ecosystems (Department of Sustainability, Environment, Water, Population and Communities, 2013).

The GBR fringes the coast of our region and its extraordinary biodiversity is recognised internationally through its status as a World Heritage Area (listed in 1981). The major threats to the health of the GBR are climate change, poor water quality and coastal development (Great Barrier Reef Marine Park Authority, 2014). Increased sediment, nutrients and pesticides runoff from agricultural land uses are the greatest cause of declining water quality on the GBR (Great Barrier Reef Marine Park Authority, 2014).

The Burdekin region is a priority area for nitrogen (focused on the Lower Burdekin and Haughton), pesticides and sediments entering the GBR World Heritage Area.

Reef 2050 Long Term Sustainability Plan - land and catchment management targets by 2018:

- 90% of sugarcane, horticulture, cropping and grazing lands using best management practice systems in priority areas,
- minimum 70% late dry season groundcover on grazing lands.
- riparian vegetation is increased, and
- no net loss of the extent, and an improvement in the ecological processes and environmental values, of natural wetlands.

Reef 2050 Long Term Sustainability Plan – water quality targets by 2018:

- at least a 50% reduction in anthropogenic end-of-catchment dissolved inorganic nitrogen loads in priority areas, on the way to achieving up to an 80% reduction in nitrogen by 2025,
- at least a 20% reduction in anthropogenic end-of-catchment loads of sediment in priority areas, on the way to achieving up to a 50% reduction by 2025,
- at least a 20% reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas, and
- at least a 60% reduction in end-of-catchment pesticide loads in priority areas.

The Reef 2050 Plan targets equate to the following end-of-catchment Ecologically Relevant Targets for the Burdekin Region by 2035:

- a 60% reduction in the total nutrient load, including:
  - 80% (~880 t) reduction in dissolved inorganic nitrogen from sugarcane in the Lower Burdekin, and
  - 52% (~1,455 t) reduction in particulate nutrients in the Burdekin catchment,
- a 90% reduction in pesticide (PSII herbicide) load for the Haughton catchment, and no net increase from other catchments, and
- a 1,600 kt per year reduction, or ~ 50 % of the current sediment (TSS) load. To meet the targets the following catchment specific load targets need to be achieved:
  - Bowen Broken Bogie reduction of 910 kt (57%),
  - Upper Burdekin reduction of 475 kt (53%),
  - Suttor reduction of 20 kt (31%),
  - Upper parts of the Lower Burdekin (commonly referred to as 'East Burdekin') reduction of 250 kt (57%), and
  - Belyando and Cape Campaspe catchments no net increase. (NQ Dry Tropics, 2016)

Agricultural activities are the largest contributors to anthropogenic loads in our region with 78.2 per cent of sediments coming from grazing land and 86.4 per cent of nitrogen load coming from sugarcane lands, see charts 2a and 2b on page 58 and the Burdekin WQIP.

In addition to sediments and nutrients, marine debris is a threat to habitats and wildlife in our region. Please refer to *Part B – Biodiversity* for information on marine debris in the Burdekin.

The Australian and Queensland Governments have adopted a collaborative approach to managing water quality issues in the GBR with the establishment of the Reef Water Quality Protection Plan (Reef Plan) in 2003, revised in 2009 and 2013, and more recently, the Reef 2050 Long-Term Sustainability Plan (Reef 2050 Plan). The timeframes associated with targets detailed in these plans will require focused effort and targeted investment over the next five to ten years from a wide range of stakeholders, including government, industry bodies, regional NRM groups and the wider community.

Water Quality Improvement Plans (WQIPs) have been developed for all GBR catchments to identify regional water quality issues, establish catchment-specific environmental values (EVs), water quality objectives (WQOs) and targets, and a suite of recommended management actions to achieve those targets, including:

- systems repair;
- treatment options;
- best management practices;
- education, engagement and extension; and
- research for knowledge gaps and science synthesis.

Water quality objectives, known are Environmental Values (EVs) are set and managed to protect specific ecologically-relevant qualities of waterways from adverse impacts, to ensure ecosystems are healthy and the water is safe for community use. The EVs for our region have been identified for freshwater, estuarine and marine areas in collaboration with community stakeholders, Local Government, State Government and the Great Barrier Reef Marine Park Authority (GBRMPA) (Department of Environment & Heritage Protection, 2013b).

Two WQIPs cover the Burdekin Dry Tropics region – the Burdekin WQIP and the Black Ross (Townsville) WQIP. These plans synthesize the best available water quality science and guide future investment for water quality improvement in the region.

1. Black Ross (Townsville) WQIP

The Black Ross (Townsville) WQIP area covers most waterways within the Townsville City Local Government area. The WQIP identified urban diffuse pollutant sources as the greatest overall contributors to water quality issues, as well as significant impacts from point source pollutants in the Black River, Bohle River and Stuart Creek catchments. Overall for the Black Ross region, 50 per cent of the waterways have achieved the total nitrogen and total phosphorus WQOs, and only 33 per cent have achieved the total suspended solids WQOs (Gunn & Manning, 2010).

Principal pollutants of urban areas include sediments, nutrients (principally nitrogen and phosphorus), oxygen-demanding materials (biodegradable organic material), metals, toxic organic wastes (garden and household chemicals), pathogenic micro-organisms (bacteria, viruses etc.), hydrocarbons and litter (Gunn & Manning, 2010). Wastewater treatment plants are significant point source pollutant emitters in the urban area. Most of the existing treatment plants discharge into freshwater, estuarine or marine receiving water, with the Cleveland Bay Wastewater Treatment Plant being the largest emitter (Gunn & Manning, 2010). An upgrade of the plant is proposed to accommodate a greater future population, and reduce nutrient discharge to waterways in the short-term,

however, it will inevitably increase overall nutrient loads as waste volumes increase with predicted population growth.

The Black Ross WQIP identifies a wide range of water quality improvement actions across urban, peri-urban and rural areas, including establishing a Total Water Cycle Management Plan (TWCMP) linking stormwater, wastewater, potable water and waterway management. For more detailed targets and outcomes refer to the Black Ross (Townsville) WQIP.

2. Burdekin WQIP

The Burdekin WQIP 2009 was updated in 2015-2016 with the latest scientific data and information. It was also expanded to cover urban as well as rural areas and to cover all catchments in the Burdekin Dry Tropics region; linking to the Black Ross (Townsville) WQIP and including the Don River catchment.

The Burdekin WQIP identifies eight catchments comprising water resources in various conditions, and a range of current land management practices. Distinct areas of land use occur in our region: grazing in the upper catchments, grains in the Suttor, horticulture in the Don and irrigated sugarcane cropping in the Lower Burdekin. Each land use raises different water quality concerns, priorities being erosion from grazing lands causing high loads of fine suspended sediment, and irrigated cropping lands in the Lower Burdekin associated with high levels of dissolved nutrient loads and significant levels of herbicide loads in freshwater and coastal ecosystems (Brodie, et al., 2013).

The Burdekin WQIP (2016) identified grazing land areas in the Bowen Broken Bogie, Lower Burdekin and Don catchments as contributing significantly to gully, stream bank and hillslope erosion: Bowen River, Bogie River, Pelican Creek, Little Bowen River, Burdekin Delta, Burdekin River (below dam), Glenmore Creek, Rosella Creek and Don River sub-catchments (Waterhouse, et al., 2016). Many of these areas are considered to be in poor land condition (refer to *Part B – Land*). Tracing data indicates that the Upper Burdekin and Bowen Broken Bogie catchments have the highest rate of kilograms per hectare erosion derived from exposed subsoils, highlighting a significant loss of fine sediment into the waterways (Lewis, et al., 2015).

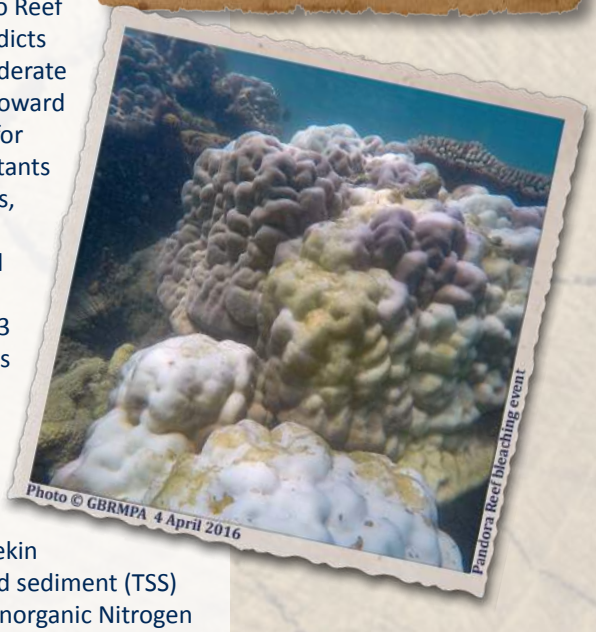
The WQIP promotes increasing the community's capacity to implement best management practices to reduce hillslope, stream and gully erosion, by maintaining, improving and restoring river frontage, and soil and pasture condition, as well as undertaking pest and weed control. For sugar production lands the WQIP also promotes reducing excess irrigation, nitrogen surplus, and herbicide and sediment losses. For more detailed targets and outcomes please refer to the Burdekin WQIP.

The most recent 2014 Reef Report Card identified that our region has made substantial progress towards the Reef Plan targets. The Paddock to Reef Program modelling predicts that we have made moderate to very good progress toward load reduction targets for our region's main pollutants of nitrogen, phosphorus, sediment and PSII herbicides (Queensland Government, 2015). Between 2008 and 2013 the following reductions in anthropogenic loads (estimated using the Source Catchments modelling by Dougall, et al., 2014) were estimated for the Burdekin Region: Total suspended sediment (TSS) 16 per cent, Dissolved Inorganic Nitrogen (DIN) 14 per cent, Particulate Nitrogen (PN) 14 per cent, Particulate Phosphorus (PP) 15 per cent and photosystem II inhibiting herbicides (PSII herbicides) 13 per cent (NQ Dry Tropics, 2016). Further reductions have also been estimated between 2013 and 2014 (Queensland Government, 2015), but not enough to meet the Reef Plan 2018 targets.

In our region, the existing significant collaborative effort, backed by investment, to achieve the management targets for the Burdekin catchment, include applying improved land and water management techniques similar to

Pandora Reef is an inshore reef in the northern waters of our region near Palm Island. It comprises some corals in the vicinity of 200-300 years of age. The photo below shows a 120 year old Porites coral which was bleached during the 2016 bleaching event. In clear water it has the potential to recover, however the fine sediments in the water at Pandora is smothering the coral. A healthy Porites produces mucous to slough-off fine sediments but under the stress of coral bleaching it has insufficient energy reserves to do this and is consequently dying. Reducing sediment inputs into the coastal waters can help the resilience of corals to recover from other threats such as bleaching events.

GBRMPA, 2016



"North Queensland rely on dams and underground water systems, and there needs to be an improved way of communicating to communities how water management is being managed on an annual basis. Local councils advise their towns or cities that we have xyz amount of water, but no advice as to how we can conserve or what improvements are being made. Primary and High schools have tapped into a wonderful program of reef rescue, and it is speaking volumes by starting the education with our youth."

Burdekin Community Survey 2015

practices mentioned in *Part B – Land*, managing stocking rates to maintain groundcover, remediating gully erosion, adjusting crop applications, minimizing nitrogen surplus and modifying irrigation practices. Adopting these best management practices has reduced the load of nutrients and sediments in runoff as well as improved land condition and farm productivity. The up-take of sustainable practices will increase as people become confident with new information and farming methods. However investment and support is required to maintain the momentum to achieve the long-term results.

Future water demands

There are a number of proposals for the expansion of agriculture and additional water supply infrastructure for our region, however, their viability depends on financial support, economic success of industry, environmental impacts and, most importantly, whether the allocable water exists (Gallant, et al., 2014).

The Australian Government's Our North, Our Future: White Paper on Developing Northern Australia (2015) identified the Burdekin River as one of nine basins across Northern Australia that has potential for increased irrigated agricultural production. It identified that there was capacity to improve agricultural output in the Burdekin River basin "*subject to overriding concerns of sediment and reef water quality management*" (Australian Government, 2015b).

CSIRO identified that raising the Burdekin Falls Dam wall could increase capacity by 590,000 megalitres to a total capacity of 2,445,000 megalitres. Other potential dam sites were also noted at Hells Gate and Mount Foxton, however, construction at these sites would reduce inflows to the Burdekin Falls Dam.

Raising the Burdekin Falls Dam wall and constructing new in-stream and off-stream storages throughout the catchment could support an additional 1000 km² of irrigated agriculture (Gallant, et al., 2014), (Commonwealth of Australia, 2014) – 100 km² in the Lower Burdekin, about 500 km² along the Elliot Main Channel to Bowen and potentially more than 400 km² along the Bowen River, upper Burdekin River and possibly Belyando–Suttor sub-catchments (Gallant, et al., 2014).

However the Burdekin WQIP has highlighted that an expansion of irrigated agriculture could potentially lead to a detrimental increase in nitrogen loads and herbicides and undo achievements made since Reef Plan 2009 initiatives. Any decision to expand water supply infrastructure and agriculture would need to consider:

- that captured water must be allocable and not already earmarked for other users and the environment;
- direct impacts on the land cleared for agriculture and inundated environments; and
- downstream impacts on the receiving waters and environments, including the internationally listed Ramsar wetland and the World Heritage-listed GBR.

Restoring Burdekin Coastal Ecosystems for the Great Barrier Reef and Ramsar.

NQ Dry Tropics, Lower Burdekin Water and Burdekin Shire Council are working together to strategically restore ecological function to priority coastal ecosystems (wetlands and waterways) connected to the Great Barrier Reef in the Lower Burdekin, including the Bowling Green Bay Ramsar wetlands. The project has modernised a key waterway culvert to improve the efficiency and control of water delivery to irrigators, and reduce unnecessary supplementary flows. This project clearly identified that improved management of the movement of water, resulted in multiple benefits for irrigators and the receiving natural environments (NQ Dry Tropics, 2015b).

While options for hard infrastructure exist, the Queensland Government has identified that growth in agricultural water demand in our region should first be met through soft methods such as improving water use efficiency, trading water allocations (particularly water entitlements not being fully used), and accessing uncommitted water held by SunWater (Department of Energy and Water Supply, 2014).

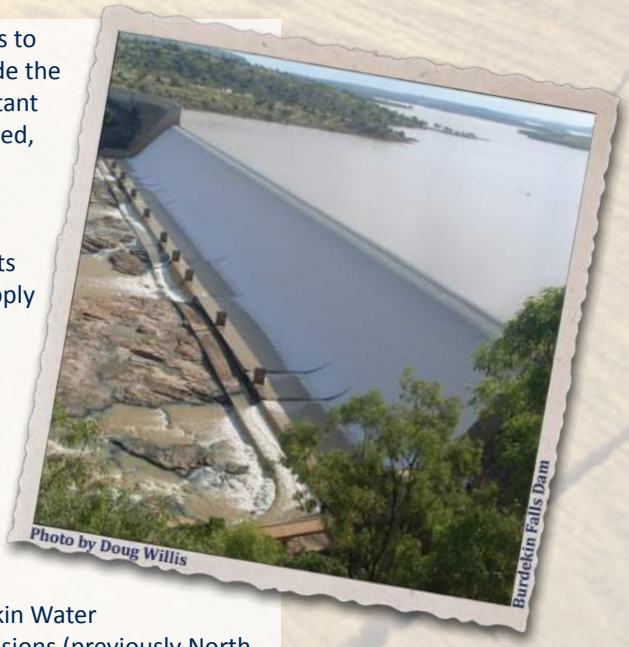
Water trading occurs in the supplemented areas of the Lower Burdekin below the Burdekin Falls Dam, and is managed under the WRP and ROP. There is currently an assessment underway to determine the viability for water trading in the unsupplemented reaches of the Burdekin catchment above the Burdekin Falls Dam. The intent is that demand for water would first be sought through this process before any release from the General Reserve identified in the table on page 58.

With longer, drier periods predicted as a result of climate change (Moise, et al., 2015), more efficient and productive use of our existing land and of water resources would provide a sustainable and strategic regional approach, and reduce the need to increase water infrastructure and alter water flow regimes.

Lower Burdekin catchment ground and surface water interaction issues

The Lower Burdekin is the largest floodplain system on the Australian east coast. It has a diverse assemblage of coastal ecosystems, including one the greatest concentrations of wetlands situated in the GBR catchment. Given the magnitude of its physical, biogeochemical and biological process functions, it is an important functional component of the overall catchment of the GBR, and provides a host of ecological functions and processes for the GBRWHA (Great Barrier Reef Marine Park Authority, 2013).

However, these high value wetlands within the Lower Burdekin in and adjacent to the Ramsar wetlands of Bowling Green Bay are significantly impacted upon by changes in the landscape, particularly those changes associated with hydrological processes and pollutant inputs (Davis, et al., 2016) (O'Brien, et al., 2016). Consequently, the capacity for these wetlands to continue to provide the services so important to the GBR is limited, and now many of these areas act as permanently inundated conduits for bulk water supply and runoff from sugarcane farms.



Three irrigation districts exist in the Lower Burdekin sub-catchment:

- BHWSS;
- Lower Burdekin Water Northern Divisions (previously North Burdekin Water Board); and
- Lower Burdekin Water Southern Divisions (previously South Burdekin Water Board).

BHWSS is operated by SunWater and is upstream and on the north-west bank of the Burdekin River. Lower Burdekin Water operates downstream towards the coast in the Burdekin River Delta and supplies and manages the uplift of groundwater.

The main matters of concern – including the effects of seawater intrusion, a rising groundwater table, and increasing concentrations of salts – relate to the health of the Burdekin River Delta aquifer and coastal wetland ecosystems. There is increasing urgency to mitigate these issues, because adverse impacts on crop productivity, hydrology, habitat quality, and downstream ecosystem function are becoming more evident. Contributing factors include the amount of water being released through watercourses and channels for irrigation access, deep drainage and channel leakage, and irrigation practices (Milla, 2013).

Changes to the landscape and the oversupply of supplemented water through irrigation delivery / channel systems have led to the loss of seasonality in the coastal wetland ecosystems flowing into the GBR. Relatively high ground water levels and perennial surface flows have resulted in a loss of natural water detention, fish passage and nursery habitat, productive native pastures and biogeochemical cycling. One of the


Photo © Dept of Agriculture and Fisheries

major consequences to the wetland ecology is the change and distribution of native plant species and proliferation of invasive exotic weed species. The distribution of weeds also has an economic impact due to a significant loss of productive coastal grazing land as weed chokes spread across the landscape and clog distribution channels, block pump stations and in floods can cause damage to infrastructure (Connolly, 2012).

In 2014 the Queensland Government adopted groundwater harvesting dewatering provisions in the *Burdekin Groundwater Management Area Water Sharing Rules*. This allows for the harvesting of groundwater when the table rises to a particular level. While this can assist in removing some of the groundwater during rising events, its long-term effectiveness is yet to be determined.

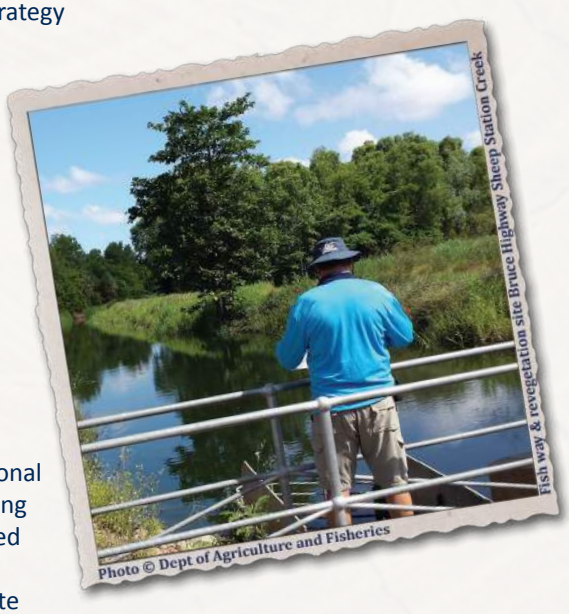
Multiple stakeholders, including researchers, government, and industry groups, have identified the above issues and strategies for the Lower Burdekin (Williams, et al., 2009) (Bristow, 2003). Suggested methods to mitigate rising groundwater have included dewatering, groundwater harvesting, improving irrigation application practices, and modernising water supply infrastructure. The updated WQIP identifies priority areas for restoring ecosystem function, or 'system repair'. Given the complex nature of water resources, a coordinated implementation systems repair strategy is needed to identify clear targets and provide leadership, management direction, and mitigation measures for all stakeholders.

Bowen Gumlu Agricultural District

The Bowen Gumlu Agricultural District is presently Australia's largest winter vegetation production area (Bowen Gumlu Growers Association Inc., 2016). Unlike the Lower Burdekin, additional water is not supplied to the growing area and instead water is harvested during flow events and also from local groundwater systems. Despite limited availability and quality of water, the district has grown approximately 20 per cent in a decade due to the adoption of new farm management opportunities and stewardship for the sustainability of natural resources (Mullins, 2016). Water use is approximately two megalitres per hectare compared to 10-12 megalitres per hectare in the Lower Burdekin area primarily due to water availability. Best management irrigation practices in this region include determining crop water use, drip systems, fertigation, as well as evaporation reduction methods.

As mentioned previously, any consideration to expand water supply infrastructure and agriculture must assess and mitigate potential increases in sediment and nutrient loads onto the GBR that would undo achievements made since Reef Plan 2009 initiatives.

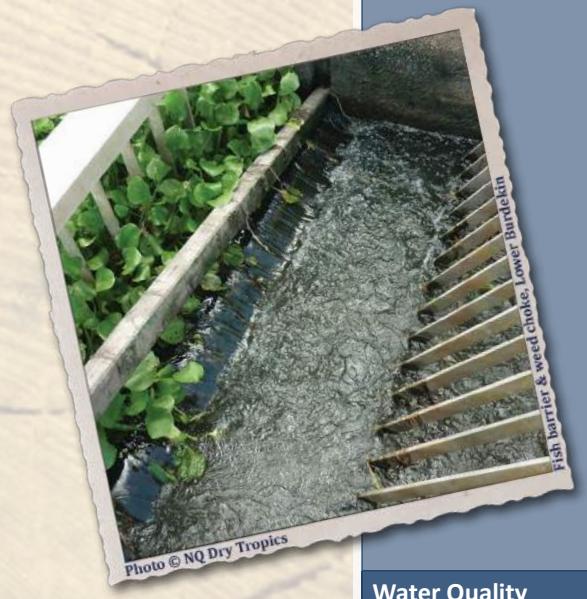
Substantial investment has been made to better understand local and regional water resources, including their quality, quantity, demand, supply and interactions with environmental processes. Continued coordinated effort is still needed however, to improve management practices that deliver sustainable water resources that are efficiently used and delivered. As innovative technologies and improved water management practices become more affordable, a whole-of-community effort at a landscape scale could ensure the future sustainability of our water resources (Refer to the Burdekin WQIP for further information).


Fish way & revegetation site Bruce Highway Sheep Station Creek
Photo © Dept of Agriculture and Fisheries

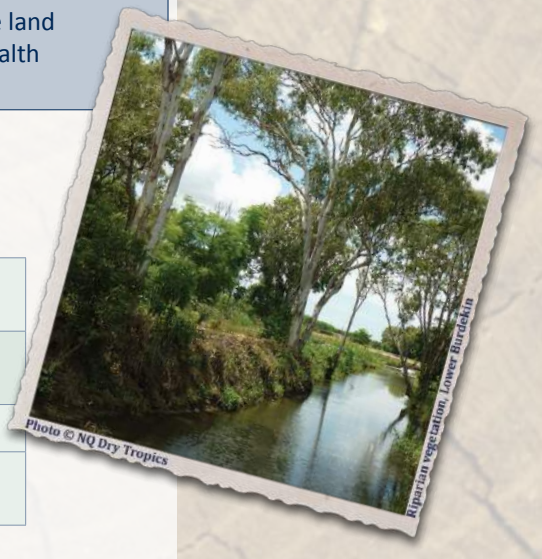
Delivery

Objectives	Strategies
Water Allocation	
Water allocation and use does not exceed sustainable water supply capacity.	a) Ensure that sustainable planning and management of water resource volumes incorporates environmental values as well as pressures from climate change, increased demand and development. *Note: water planning includes adequate reserves for the welfare of stock animals and domestic purposes during extended dry conditions.*
	b) Investigate and promote more efficient bulk water supply to irrigators in the Lower Burdekin.
	c) When developing sustainable planning and water restriction policies, include adopting water efficient technology as a common practice. *For example: leak detection, evaporation reduction and irrigation application efficiency.*
	d) When planning any expansion of surface water supply and its associated infrastructure, to the Bowen Gumlu Growing District, consider potential adverse impacts on soil, groundwater interactions and the Great Barrier Reef.
	e) Investigate crops and cropping practices that align more productively with the sustainable use of local natural resources.
Efficient water use practices are used.	a) Support the investigation, promotion and implementation of water efficient technology and management techniques to reduce urban, rural and industrial water use. *For example: Urban use – automated leak detection. Rural use – for cropping lands, closely manage irrigation efficiency at a farm scale; and for grazing land, maximize rainfall infiltration through improved groundcover and appropriate water storage infrastructure.*
	b) Identify barriers that prevent the implementation of best practice water and land management; and develop and implement mitigation options to promote practice change. *Note: this should include acknowledging the link soil science has with water availability.*

Environmental flow characteristics are maintained for the health of natural ecosystems.	a) Investigate and manage the effects of excess drainage water travelling through water supply systems.
	b) Manage environmental flow allocations in a way that provides for necessary drying and wet seasonal flushes, as required by dry tropical wetland ecosystems. *For example: allocate supplemented water so that it is delivered in a manner that is sustainable to receiving environments.*
Groundwater resources are maintained at optimal levels.	a) Monitor and maintain groundwater at appropriate baseline depth/level, for sub-artesian areas that are in demand for groundwater resources.
	b) Maintain a salt export bore head plan in locations where demand for groundwater resources are high and may impact on neighbouring bores.
	c) Investigate groundwater vulnerability to potential pollution when undertaking land use planning and development design.
	d) Promote and implement improved water delivery and management techniques in sub-artesian areas, to reduce the impact of changes in groundwater table levels and salinity. *For example: using variable flow pumps; irrigating only during required periods, and dewatering.*
Water Quality	
Suspended sediment and nutrient loads, pesticide concentrations and other contaminants are managed to meet the WQIP ecologically relevant targets and Reef 2050 Plan targets.	a) Coordinate and maintain a network to share information between those involved with researching, monitoring, managing and using water resources, including: • land holders; • industry; • NRM groups; • researchers; and • state and local government officers.
	b) Support the development of, and promote, innovative technology and methods for improving the quality of water entering and leaving waterways and wetlands.
	c) Investigate, trial and implement cost-effective best management practices to: • remediate, control and prevent gully erosion in dry tropical climates in the Bowen catchment; and • reduce nutrient and pesticide loads from cane lands in the Lower Burdekin catchment.



Suspended sediment and nutrient loads, pesticide concentrations and other contaminants are managed to meet the WQIP and Reef 2050 Plan targets (cont.).	d) Develop, adopt and continually improve best practice methods for avoiding and mitigating point source and diffuse water contamination.
	e) Support land managers to implement best management practices to conserve water resources and incorporate environmental outcomes into their management systems. *For example: capturing nutrient and herbicide runoff from crop land and adopting sustainable grazing land management practices to reduce runoff and increase infiltration.*
	f) Establish a systems repair and prevention approach for the wider NRM community to address holistic sub-catchment issues, and what is needed to restore and maintain healthy coastal wetland ecosystem function. *For example: managing black water events to prevent fish kills, fish barrier remediation, and wetland rehabilitation.*
	g) Maintain a coordinated multi-stakeholder water quality monitoring programme for our region, which includes the monitoring and assessment of: • water quality (including nutrients, sediments, pesticides and salinity); • geomorphologic processes; and • wetland and riparian condition, and aquatic biodiversity. *For example: regional partnerships investigate low-cost sensing opportunities for fine grade data on water quality.*
Health of freshwater aquatic ecosystems are known and protected.	a) Conduct catchment scale land capability and in-stream health monitoring and planning.



SUCCESS INDICATORS

Resource condition and management targets identified in our regional WQIPs are achieved.	
The water quality targets and objectives in Reef 2050 Plan are achieved.	
By or before 2026	• there is a reduction in per capita water use.
	• there are no reported exceedances of ANZEC water quality guidelines across the region.

BIODIVERSITY

REGIONAL GOAL

The unique biodiversity of the Burdekin Dry Tropics region is protected and enhanced to increase the resilience of native species, ecosystems and ecological processes

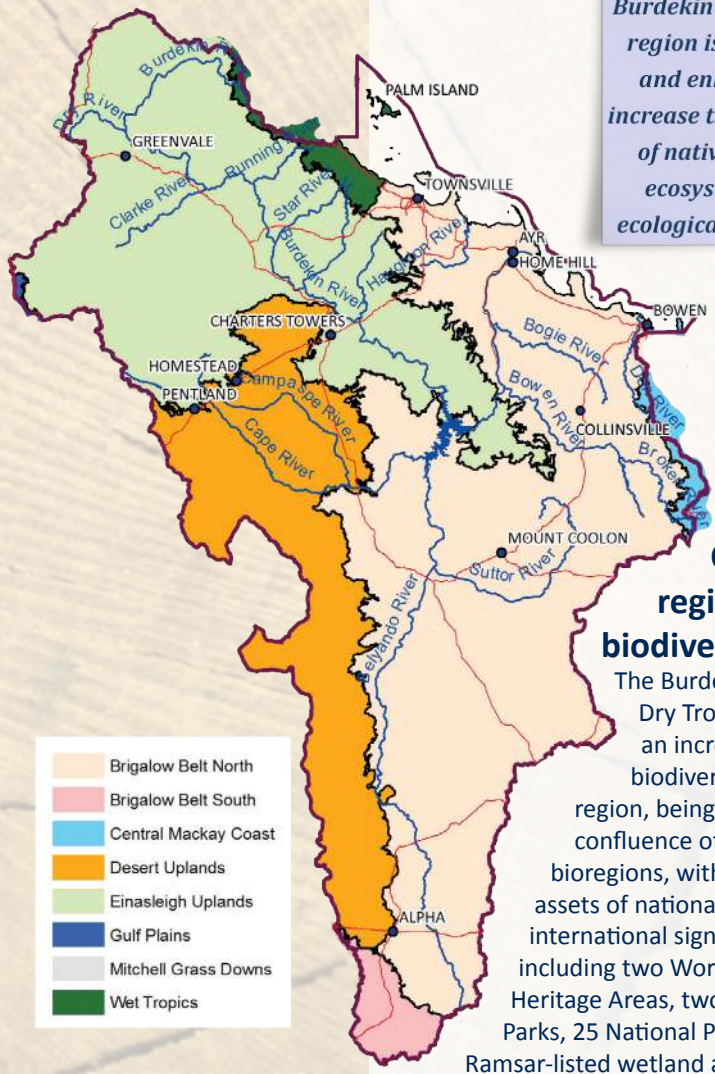


Figure 16 - Bioregions within the BDT region

SNAPSHOT

Our region's biodiversity

The Burdekin Dry Tropics is an incredibly biodiverse region, being the confluence of seven bioregions, with natural assets of national and international significance, including two World Heritage Areas, two Marine Parks, 25 National Parks, one Ramsar-listed wetland and 34 Nationally-Important Wetlands. Additionally, there are 1,621 km² of Nature Refuges, and other Voluntary Conservation Agreements covering sites of high biodiversity within our region. Landholders play an important role in protecting biodiversity, as the majority of our region consists of private land. Figure 18, p 68 shows the high biodiversity areas and habitat corridors, which were identified in the Queensland Government's biodiversity planning assessments for our region.

An intact biodiversity is critical to the integrity of natural ecosystems and their services which make a vital contribution to our quality of life and wellbeing, and underpin the region's prosperity (Department of the Environment, Water, Heritage and the Arts, 2009). As ecosystems and their services form the basis for many natural assets of the region (eg. soil, water, vegetation), the sustainability strategies included in the previous four sections - People connections, Climate change, Land, and Water also work to protect and enhance our region's biodiversity which supports healthy industries and communities in our region.

1. Terrestrial diversity

Our region forms a biogeographic feature known as the 'dry corridor' that adjoins wet tropical bioregions to the north and south and extends the range of fauna and flora more typical of the drier interior to the coast (Kikkawa & Pearce, 1969). The three main bioregions of our region are the Brigalow Belt North, the Desert Uplands and the Einasleigh Uplands. Portions of the Wet Tropics, Central Queensland Coast, Southern Brigalow Belt and Gulf Plains bioregions also occur within our region (see Figure 16). All of these bioregions are closely associated with a particular combination of geology, landform and soil that supports a very high diversity of regional ecosystems.

The terrestrial regional ecosystems span the full suite of tropical biodiversity from inland to the coast (see Figure 17, p 68). They vary from rangelands (which dominate our region) including open

"Ecosystem services are the benefits provided to humans through the transformation of resources (or environmental assets, including land, water, vegetation and atmosphere) into a flow of essential goods and services; eg clean air, water and food" (Costanza, et al., 1997).

Priority ecosystem services include:

- pollination;
- regulation of climate eg carbon sinks and greenhouse gas absorption;
- biological control of pests;
- provision of genetic resources – future sources of food and medicine;
- maintenance of habitat;
- provision of shade and shelter;
- maintenance of soil health;
- maintenance of healthy waterways;
- water filtration and erosion control;
- regulation of rivers and groundwater; and
- waste absorption and breakdown.

woodlands and grasslands, through to dry coastal areas with open dry forests, rainforests, vine thickets, sedgelands, swamps, coastal dune communities and mangroves. Species that dominate vegetation communities in our region include Eucalypt and Corymbia (Ironbark, Poplar Gum, Moreton Bay Ash, Blue Gum, Bloodwood and Swamp Mahogany), Acacia (Brigalow, Gidgee), Grevillea (Beefwood), Casuarina (She-oak), Melaleuca (Tea trees), rainforest trees and mangroves.

Biodiversity values associated with this habitat diversity include recognised centres of species richness and endemism for birds (>300 species), mammals (>70 species), reptiles, amphibians, eucalypts and acacias (Department of Environment and Heritage Protection, 2016). Areas in the Brigalow Belt, Desert Uplands and the Einasleigh Uplands bioregions are identified as National Biodiversity Hotspots as discussed in the Flora and Fauna Species Diversity of this section.

The relatively small proportion of native habitat conserved in National Parks and other reserves in our region (approx. six per cent) highlights the important role that landholders and the community play in protecting, maintaining and restoring the diversity, extent and condition of our region's plants, animals and ecosystems. The previous sections highlight strategies to promote and support the community and land managers to restore or maintain the long-term health of our region's natural resources.

Intact ecosystems provide our region and community with resilience in the face of extreme events such as droughts and cyclones. The impact of a rapidly warming climate (*Part B – Climate Change*) on the region's ecosystems and on species' ability to adapt, increases the urgency for governments, communities and land managers to commit to sustainably manage land for protection of species and ecosystem biodiversity.

The Nature Refuges program is an example of collaboration between government and land holders to manage land for long-term biodiversity outcomes, including providing habitat for threatened species, movement corridors and refugia for native species, and protecting threatened or poorly represented ecosystems. Scientists have identified that to address climate change, land acquisitions and conservation agreements should be focused in areas resilient to changes such as valleys or elevated areas where animals could survive projected warming (Reside, et al., 2013).

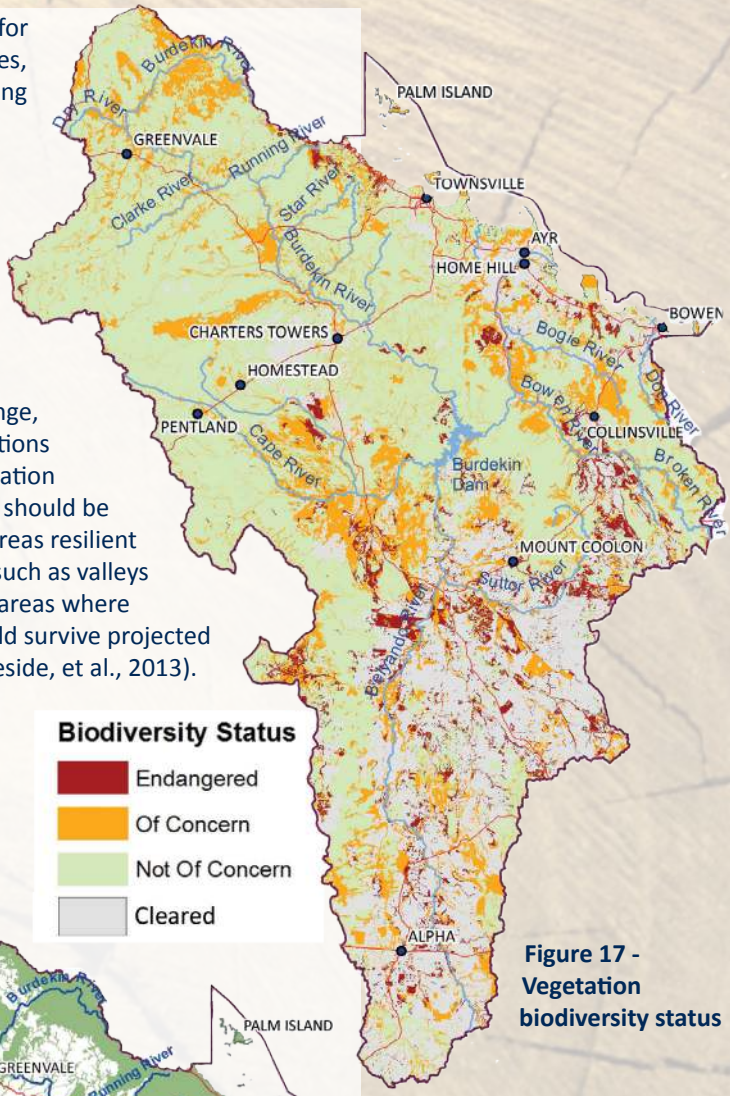


Figure 17 - Vegetation biodiversity status

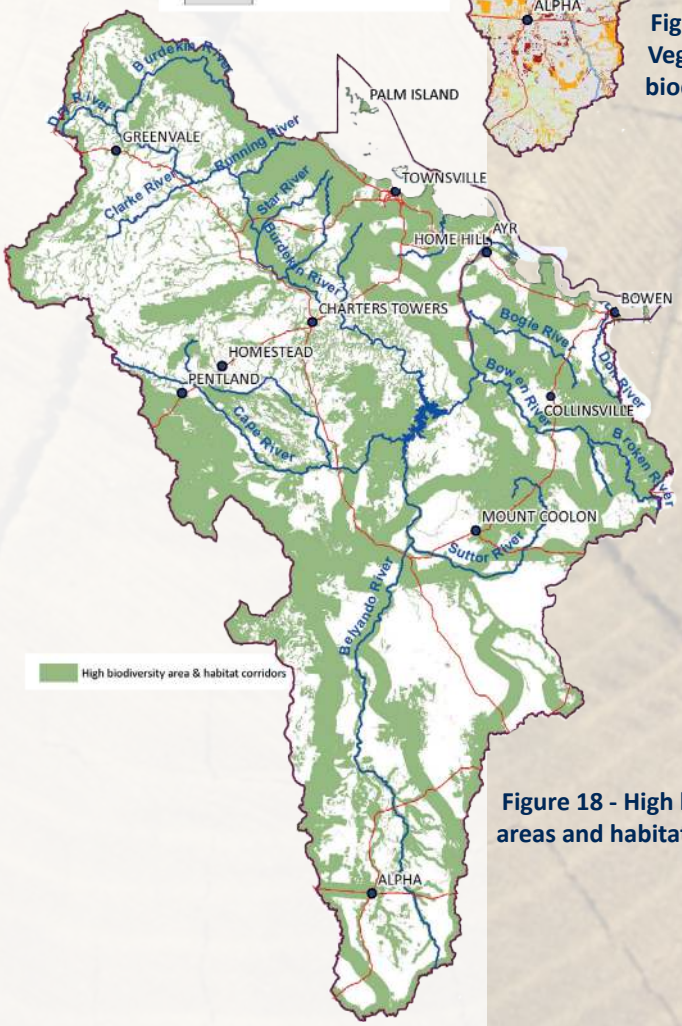


Figure 18 - High biodiversity areas and habitat corridors

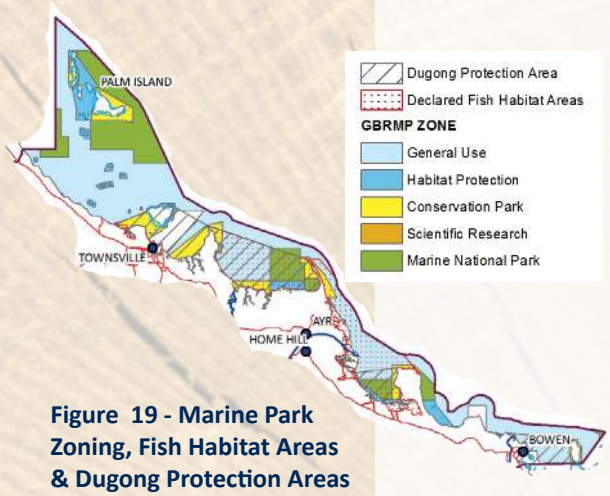


Figure 19 - Marine Park Zoning, Fish Habitat Areas & Dugong Protection Areas within the BDT region

Partnerships to protect biodiversity

WetlandCare Australia, with support from the Australian Government's funding, is working with multiple stakeholders to protect, manage and enhance the high ecological functional values of Barratta Creek Catchment. The catchment forms the main artery of the Bowling Green Bay wetlands, the only Ramsar site in North Queensland.
Some key highlights in the past four years include:

- 21,500 native plants planted;
- Six Land Management Agreements with landholders focusing on native tree plantings and fencing to exclude feral animals;
- a constructed wetland established on a Sunwater drain to filter and treat nutrients and pesticides; and
- worked with a landholder to manage fire to meet hazard reduction targets that protect crops and infrastructure, while reducing impacts on native plants and animals.

2. Wetlands and coastal diversity

The Burdekin Dry Tropics' rivers and associated wetlands are significant features, with 34 wetlands listed in the National Directory of Important Wetlands (see Appendix C, p 89). The Bowling Green Bay wetlands host regionally-significant populations of breeding waterfowl and waterbirds and are an internationally significant migratory wader bird habitat. Up to 50 per cent of the migratory species listed under the Japan-Australian Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) occur in these wetlands. These are agreements between the Australian, Japanese and Chinese governments for the protection of migratory birds in danger of extinction, and their environment. Coastal wetlands are also important links to adjacent coastal waters and seagrass meadows that provide regionally-significant fish habitat and nursery areas, and are recognised as a productivity hotspot that supports major commercial and recreational fisheries.

Our region contains approximately 280km^2 of estuarine systems (mangroves, saltmarsh/saltflats and intertidal flats); 26 of these were assessed as near pristine (30%), largely unmodified (40%) or modified (30%) (Australian Government, 2015c). The modified estuaries are Barratta Creek, Burdekin River, Don River, Haughton River, Ross River, Bohle River and Sandfly Creek. Catchment modifying factors include altered catchment hydrology, effluent pollution, irrigation tailwater, groundwater extraction, sand extraction in estuaries and floodplains, sewage treatment plants, dams, floodplain barrages and tidal weirs. Information on wetlands, including their values and management requirements, is contained in the WQIP and is are available on a number of tools via Queensland Government's Wetland*Info* - Wetland Summary Tool, Aquatic Conservation Assessment and Walking the Landscape.

3. Offshore diversity

Our region's marine environment is within the GBR World Heritage Area, the world's largest and most complex reef system. Our region's near-shore reefs include fringing reefs such as those around the Palm Islands, and Magnetic Island. Near-shore reefs have close connections with coastal habitats (such as mangroves and wetlands), and are exposed to greater impacts from coastal and catchment activities than the outer reefs in the adjacent *Oceans NRM* regional area. Our region's reefs are centrally located among the 3,000 coral reefs stretching 2,300 kilometres along the Queensland coast. Reefs create critical habitat for countless marine organisms, and also provide essential ecological processes. The reef is a centre of species richness and endemism and its structure buffers the coast from waves and storms, its organisms support commercial fisheries and tourism, and it is strongly linked to Indigenous and broader Australian cultural identity.

The coastal bays of the World Heritage Area provide significant habitat for many iconic marine species and are covered by four declared Fish Habitat Areas (Bohle River, Cleveland Bay, Bowling Green Bay and Burdekin) and four Dugong Protection Areas (Cleveland Bay, Bowling Green Bay, Upstart Bay and Edgecumbe Bay) (see Figure 19).

The coastal waters within our region include seagrass-dominated, shallow marine environments of the GBR Lagoon and provide important fish habitat and nursery areas. The meadows are frequented by dugongs and turtles as witnessed by feeding trails and scars. Sediments within this habitat are mud and sand that have been discharged into the marine environment in flood plumes following large storm events, in particular from the Burdekin River.

As mentioned in previous sections of the plan, major pressures and threats, particularly to Burdekin wetlands, coasts

and marine assets, include pollutants (sediment, nutrients and pesticides), altered hydrology and loss of seasonality, coastal development, marine traffic and climate change (Great Barrier Reef Marine Park Authority, 2013).

4. Flora and fauna species diversity

In our region, the Brigalow Belt, Desert Uplands and Einasleigh Uplands bioregions contain National Biodiversity Hotspot areas, which are strongholds for large populations of native plants and animals as well as endemic species that are under threat from impacts such as unsustainable grazing pressure, vegetation clearing, inappropriate fire regimes, weeds, feral animals and salinity (Australian Government, 2015a). In hotspot areas, timely intervention may prevent long-term and irreversible loss of values, and provide a high return on the conservation dollar.

The Brigalow Belt hotspot includes the only remaining wild population of the Northern Hairy-nosed Wombat, listed populations of Bridled Nail-tailed Wallaby as well as King Blue Grass grasslands and Brigalow vegetation communities. The Desert Uplands biodiversity hotspot has 11 near threatened or threatened animals, including the Masked Owl (northern subspecies) and Julia Creek Dunnart, and eight near threatened or threatened plants. The Einasleigh Uplands hotspot has several specialised ecological habitats and climatic regimes, and supports important centres of biological diversity due to the microhabitats created by our region's extensive basalt flows. The Toomba and Undara basalt flows of the Nulla and McBride sub-provinces harbour cave-adapted biota providing refuge for specialised cave faunas and relict rainforest faunas.

Threatened species in Queensland are identified under the Commonwealth *Environment Biodiversity and Conservation Act 1999 (EPBC Act)* (Critically Endangered, Endangered, Vulnerable and Conservation Dependent) and the *State Nature Conservation Act 1992 (NCA)* (Endangered, Vulnerable or Near Threatened (EVNT)). NQ Dry Tropics' online information hub provides further detailed information on each of the listed species identified for our region.

Recovery plans have been prepared for 21 of the 46 listed threatened native wildlife species in our region (Refer to Appendix D, p 90). These plans are more targeted to individual species, their biogeographic region and the specific threats they face. Actions within these plans include surveying species and undertaking education and conservation programmes with landholders to implement actions, such as pest control, that focus on maintaining or rehabilitating habitat and listed native species populations.

Main threats to biodiversity

Biodiversity loss affects most areas of our region to varying levels. Overall, inappropriate land management practices, weeds and pests, and climate change are the biggest threats to biodiversity in our region (Department of Environment and Resource Management, 2010). This includes vegetation clearing in inappropriate areas, overgrazing, lack of weed and pest control, changes to hydrology and inappropriate fire regimes. These practices result in:

- species extinction;
- reduced landscape resilience (ability of country to absorb disturbance and recover quickly without dramatically changing) resulting in a change in thresholds (the point where there is no recovery and the country changes);
- the loss and fragmentation of habitat and movement corridors;
- changes to ecosystem functions (soil generation, water cycles, native fauna and flora compositions);
- loss of seasonality;
- competition for food and predation

Summary of the functional role of vegetation for biodiversity and indicators of those functions

Vegetation functions	Attributes that act as indicators of the functions
Structural aspects	
Provision of reliable foraging resources for wildlife (nectar, leaves, seeds)	Large trees Shrub cover Tree canopy cover Native perennial grass Coarse woody debris Organic leaf litter Ground cover
Provision of reliable sheltering resources and / or breeding sites for wildlife	Large trees and/or hollow-bearing trees Coarse woody debris Tree canopy cover Shrub cover Organic litter Perennial grass cover
Functional aspects	
Nutrient and water cycling	Tree canopy cover Organic litter cover Coarse woody debris
Maintenance of soil condition	Organic litter cover Native perennial 'decreaser' grass species basal area Native perennial non-grass cover Coarse woody debris
Retention of plant propagules	Organic litter Coarse woody debris
Retention of plant propagules	Organic litter Coarse woody debris
Compositional aspects	
Maintenance of plant species diversity	Native plant species richness Recruitment of canopy species Native perennial 'decreaser' grass species basal area Non-native plant species cover (lack of)

(Eyre, 2015)

A prickly acacia stronghold at Inkerman Station was successfully controlled thanks to collaboration between Burdekin Shire Council, NQ Dry Tropics, State Government and a dedicated landholder.

The partnership regained control of the land and improved its overall productivity by establishing a Property Pest Management Plan.

They trialled various approaches to tackle the problem, including:
- using an Ellrott blade plough and cutter bar to suit different conditions;
- carefully-timed aerial seeding; and
- fencing stock away from weeds.

from feral animals;
- soil erosion;
- sedimentation or erosion of watercourses and wetlands;
- eutrophication in wetlands; and eventually
- pollution of marine waters that support the GBR.

1. Native vegetation clearing and condition

The single most significant cause of biodiversity decline is loss of habitat, particularly through the clearing, fragmentation and degradation of native vegetation. Maintaining and improving the integrity (extent, distribution, connectivity and condition) of native vegetation at landscape and catchment scales continues to be a priority for biodiversity in our region.

The Burdekin catchment has been subjected to a significant level of clearing in some areas, while other areas are less affected and only show pockets of clearing. The Upper Burdekin retains greater than 90 per cent remnant vegetation, however coastal areas and large tracts of land in the Belyando and Suttor catchments have been cleared. Coastal areas are also extensively cleared, with the main native vegetation remnants being riparian and coastal wetlands and in non-arable hill country. With the exception of town centres, the majority of past clearing was undertaken for grazing and irrigated cropping. In total 25.5 per cent or 36,000 km^2 of the Burdekin catchment has been cleared with the Belyando and Suttor catchments having only 50 per cent and 53 per cent respectively of vegetation cover remaining (Queensland Herbarium, 2015).

The major impacts of past clearing include:
- soil erosion;
- loss of species diversity and localized extinction and changes in biodiversity composition;
- loss of ecosystem function;
- fragmentation of corridors and loss of contiguity;
- changes to water balance, particularly groundwater, with implications for dryland salinity; and
- reduced buffering capacity against other threatening processes.

2. Weeds and feral pests

The proliferation of non-native plants, and the unnatural spread of some native plants, leads to multiple impacts that affect the overall biodiversity of our region. They have dramatic effects on vegetation structure, proportional abundance of species, water flow characteristics and quality, aquatic flora and fauna, and ecosystem processes. They occur in terrestrial systems from savannas, scrubs and rainforests through to aquatic areas such as riparian zones and wetlands. Riparian zones are especially susceptible to colonisation and spread of certain weeds because water and nutrients are in greater supply in these areas.

Weeds have been introduced either historically as a food source for humans and livestock, or as gardening plants that subsequently spread into natural environments. Illegal dumping, especially of household green waste in natural areas, helps to spread weeds and diseases into rural areas, which can significantly impact on the natural ecology as well as the productivity of agricultural enterprises.

Populations of feral pigs, deer, horses and rabbits have all been listed as priority species in the our Burdekin Dry Tropics Regional Pest Management Strategy. The *EPBC Act* recognises impacts particularly from feral cats, pigs, foxes, tilapia and rabbits, as key threatening processes. In general, feral animals:
- outcompete native species for resources;
- reduce landscape resilience;
- disturb the ground;
- damage vegetation communities;
- destroy culturally-sensitive areas;
- spread weed seeds;
- consume small vertebrates and eggs (for instance, native frogs and lizards);
- spread disease;
- pollute and damage riparian and wetland areas; and
- impact on agriculture and other industries.

The *Biosecurity Act 2014* provides the statutory direction for managing pests in Queensland. However, the resources available for managing pest plants

and animals are limited in contrast to the enormous costs of the pests. Collaboration and alignment of effort are key to ensuring that we maximize the value of those resources and support land managers to control pests on-ground. In the Burdekin Dry Tropics, a Regional Pest Management Group (RPMG), whose membership includes landcare and industry representatives, infrastructure managers, and local and state governments, oversees the strategic and collaborative delivery of the Regional Pest Management Strategy (2014-2019). The group prioritises our region's pest plant and animal management efforts at a landscape level and across local government boundaries to maximize the effectiveness of limited resources (NQ Dry Tropics, 2014).

3. Fire regime

Appropriate fire management practices, over the short and long term, are an important contributor to biodiversity. The impact of fire regimes is complex and affects various vegetation communities and species differently, for example the Burdekin rangelands is believed to be well adapted to fire (Ash, 2004), however this is not the case for rainforests. Appropriate fire management will vary depending on factors such as desired management outcomes, climate, terrain, flora and fauna, and the scale and patchiness of the ecosystems. Establishing a fire regime that varies in intensity, season, frequency and scale is essential for managing biodiversity and vegetation species compositions. Inappropriate or lack of fire regimes have been implicated as a threat for many fauna and flora species (McCullough & Musso, 2004).

The absence of an appropriate fire regime can result in:

- a change in woodland structure (thickening);
- loss of riparian vegetation;
- loss of rare fauna and flora species;
- an increase in woody weeds; and
- poor land condition.

Thickening in particular is a widespread phenomenon on uncleared native vegetation where there is also a reduced frequency of fires. The lack of fire changes the structure of open woodlands by allowing saplings to grow out of the fire-sensitive phase (McCullough & Musso, 2004). This also causes a loss or change in ground layer plant species as the tree canopy becomes denser.

4. Active land use

Overgrazing has been noted as one of the main threats to biodiversity in the rangelands (Department of Environment and Resource Management, 2010). More specific impacts on biodiversity from overgrazing include loss of priority plants, trampled habitat, reduced ground cover, decline of soil structure, erosion of watercourses, eutrophication, competition of water needs with native animals and plants, decreased composition and diversity of native plants species, and reduced diversity and abundance of soil crust organisms caused by hoof damage (McCullough & Musso, 2004) (Department of Environment and Resource Management, 2010).

Other sections of the NRM plan identify that managing stock rates within the carrying capacity of the land-type helps to maintain land condition, improves water infiltration and quality, and maintains or improves biodiversity. Sustainable grazing land management has also been identified to be financially worthwhile in the long-term (McIvor, 2012) .

5. Marine debris

Marine debris can have a detrimental impact on marine wildlife such as seabirds and turtles. There is a gap in our knowledge about the toxic impacts, especially in our rivers and estuarine environments, where trapped plastic debris will continue to leach into those environments, triggering long-term impacts.

The Australian Marine Debris Initiative is an on-ground network of volunteers, communities, organisations and agencies around the country monitoring the impacts of marine debris along the coastlines. In the Burdekin catchment area local volunteers have removed one and a half tonnes of debris during 14 clean up events in 2015 alone, with about 75 per

Managing weeds across the region

Delta Arrowhead (*Sagittaria platyphylla*), a nationally-significant aquatic weed species has been identified in Townsville. If this weed spreads it will potentially become a major problem for the cane industry and threaten significant nationally and internationally-recognised natural coastal wetlands in the Lower Burdekin.

NQ Dry Tropics has brought together Townsville City Council, Burdekin Shire Council, Biosecurity Queensland and Coastal Dry Tropics Landcare to collaborate to contain this weed and reduce the risk of it spreading to other areas in the Burdekin Dry Tropics region where it would be exponentially more difficult and expensive to control.

cent being plastics. Much of this plastic litter begins its journey to the ocean from towns and cities. The further downstream it travels, the harder it is to manage with increasing costs for clean-up operations. Plastic litter is a hazardous pollutant which is expected to persist in environments around the globe (Tangaroa Blue, 2016).

6. Offshore use

The health of the Great Barrier Reef is declining and its overall outlook is poor and expected to further deteriorate in the future (The Great Barrier Reef Water Science Taskforce, and the Office of the Great Barrier Reef, Department of Environment and Heritage Protection, 2016).

- Between 1985 and 2012 almost half the coral cover on mid-shelf and off shore reefs has declined;
- Seagrass abundance south of Cooktown has declined since 2009; and
- The dugong population south of Cooktown has drastically declined from 1962 levels.

The GBR is facing a number of serious challenges. As previously discussed climate change (ocean warming, ocean acidification, intensification of storm events) is the most significant long-term threat to the GBR and while there are efforts to reduce global emissions, the focus must also be on reducing the full range of pressures on the GBR to improve its resilience. Improving water quality now is the highest priority to building the GBR's resilience and its capacity to recover from climate change related disturbances (refer to *Part B – Water*).

It is also imperative to the GBR's resilience that there is coordinated management of activities that directly use or access the GBR, including port development, increased use of shipping passages, dredging as well as commercial and recreational fishing and tourism. Development and traffic within the sensitive marine environment risk directly destroying offshore ecosystems, including displacing seagrass meadows and reef ecologies.

Planning and decision making for competing activities in the GBR need to give consideration to long-term environmental impacts, as well as the long-term sustainability and contributions to the community of the competing industries. While some industries may lead to short-term increases in our regional economies, if their impacts are irreversible this will lead to the long-term demise of not only our natural asset, but also dependent industries and communities. Known impacts to the GBR should be actively remediated where possible to re-establish ecosystem processes and values, thereby ensuring the long-term sustainability of reliant industries such as fishing and tourism.

Improving biodiversity management

It is vital that the data and mapping of our region's ecosystems is comprehensive, up-to-date and reliable, because all statutory and non-statutory biodiversity planning and management decisions are based on this information. If the data is outdated, unreliable, inaccurate or doesn't even exist, this can lead to uninformed decisions that have serious consequences for our region's biodiversity. As an example, Essential Habitat mapping for EVNT species in our region is either outdated or doesn't include all listed species, resulting in loss of habitat for listed species through region-wide incremental clearing.

Furthermore, we must provide opportunities for information sharing between 'science' and the community on our region's significant biodiversity, the significant threats and the opportunities to increase the community's capacity to participate in managing and protecting it for future generations.

In 2015, NQ Dry Tropics implemented the internationally recognised 'Open standards for the practice of biodiversity conservation' as formalised in a Conservation Action Planning (CAP) framework. The CAP process brings together the regional community to make decisions on biodiversity management in a collaborative and coordinated fashion and then strategically invest in on-ground operational activities to protect, maintain and restore biodiversity. The process will deliver this by:

- identifying the area's biodiversity of interest and its current and desired status;
- identifying the most critical current

or likely threats that could degrade biodiversity;
- recognising the social, economic, political and cultural factors contributing to the threats or representing opportunities to enhance the biodiversity;
- developing strategies to abate the threats and maintain or restore the biodiversity based on the situation at hand; and
- implementing the strategies, monitoring the outcomes and using that information to adapt and learn throughout the life of the project (The Nature Conservancy, 2016).

It will bring together scientists, policy makers, regional land managers and community, to collaboratively develop a plan that will:
- facilitate a local network of interested and involved members;
- consolidate current biodiversity information (condition, regulation, management);
- increase local knowledge of biodiversity condition;
- create awareness and capacity among landholders about how improved land and water practices can benefit biodiversity; and
- ensure appropriate consideration by state and local governments when developing strategic plans for the community and regional economy, and assessing development applications.

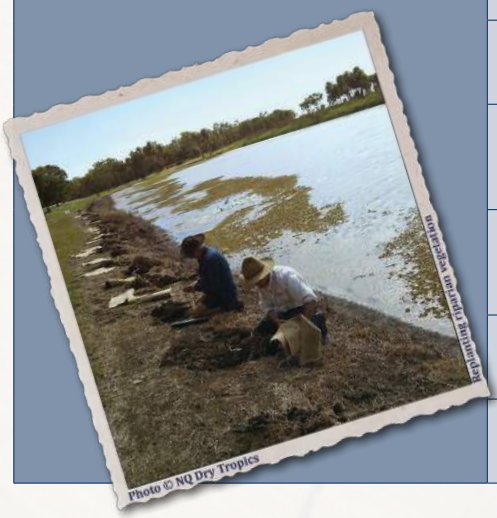
DELIVERY

The strategies for protecting biodiversity have been created as a two-part process. Currently NQ Dry Tropics is developing the CAP that will specifically outline the necessary conditions and management targets to maintain and enhance biodiversity in our region. In the interim, a number of strategies have been included below to ensure identified biodiversity elements are being appropriately considered and managed.

Objectives	Strategies
Landscapes in good biodiversity condition are maintained and landscapes in poor biodiversity condition are rehabilitated to protect biodiversity and resilience of ecosystem services.	a) Form and support a collaborative representative group to develop a regional Conservation Action Plan (CAP) that: • collates existing information; • describes regional biodiversity; • assesses biodiversity condition at a land systems level; • identifies appropriate integrated biodiversity and land management strategies; • identifies and implements rehabilitation and recovery programmes for fragmented habitats and threatened species; and • creates and implements a monitoring, evaluation and review programme.

Objectives	Strategies
Landscapes in good biodiversity condition are maintained and landscapes in poor biodiversity condition are rehabilitated to protect biodiversity and resilience of ecosystem services (cont.).	b) Engage, support and promote the wider community to: • understand the location of high conservation value areas (including habitat for near threatened and threatened species) within their properties, their value and the importance of protecting them; • improve management of areas with high conservation values (including near threatened and threatened species) within their properties; • use land management techniques that improve biodiversity condition; • implement programmes to rehabilitate priority locations such as highly-fragmented areas, riparian zones and threatened remnant vegetation; and • participate in a biodiversity monitoring programme that considers site and landscape/regional perspectives.
The distribution, composition and diversity of regional ecosystems and native plants and animals are continually improved.	a) Maintain and improve a comprehensive and representative regional conservation network, consisting of remnant habitat areas with biodiversity values in good condition across freehold and leasehold lands, as well as conservation parks and reserves.
	b) Identify and preserve areas of high ecological significance.
	c) Support land managers to adopt environmentally sustainable land management systems.
Effectively manage the adverse impacts of pest plants and animals on our region's biodiversity, environment, economy, society and culture.	a) Implement a regional biosecurity strategy through the Burdekin Dry Tropics Regional Pest Management Implementation Committee that: • captures information on the proliferation and management of declared pest species; • develops integrated regional biosecurity information management systems and decision support tools; • builds the awareness and capacity of the community to undertake appropriate management techniques; • supports collaborative and coordinated operational management activities; and • includes an ongoing monitoring, evaluation and review programme.
	b) Engage, support and promote Indigenous community participation in biosecurity management, to reduce the negative impact of pest plants and feral animals on Aboriginal culture.
Terrestrial habitats and environments are of sufficient size and condition to maintain functioning ecosystems and support healthy and viable populations of native plants and animal species.	a) Support partnerships between government and landholders to undertake conservation agreements, such as Nature Refuges, to commit to sustainable land management practices and protect biodiversity.
	b) Update natural asset mapping for our region, particularly essential habitat mapping, to include listed EVNT species habitat and ensure this is reflected in statutory planning and development assessment mapping.
	c) Map, monitor and assess connectivity and functionality of remnant vegetation, to ensure it is maintained at landscape and regional scales. *For example: there is no net decrease in remnant vegetation cover for our region.*

Objectives	Strategies
Terrestrial habitats and environments are of sufficient size and condition to maintain functioning ecosystems and support healthy and viable populations of native plants and animal species (cont.).	d) Ensure land development does not compromise the contiguity and connectivity of remnant vegetation at property, landscape and regional scales in local and state planning instruments. *For example: retaining existing clumps of vegetation that provide connectivity across a landscape.*
	e) Support land managers to implement best management practices to maintain or improve the size and condition of remnant vegetation and reduce threatening processes.
	f) Educate land managers and the wider community about the role of fire management in our regional landscape, and provide support where its application is appropriate.
Riparian vegetation is maintained in a way that protects: • **habitat connectivity throughout a catchment;** • **bank stability;** • **stream processes; and** • **water quality.**	a) Identify critically fragmented riparian corridors for rehabilitation.
	b) Provide extension and encourage the community to implement land management techniques that rehabilitate riparian habitat corridors such as: • riparian fencing; • rotation wet season spelling; and • planting vegetation.
	c) Maintain existing partnerships and networks between parties undertaking works and rehabilitative measures within waterways including landholders, government, river improvement trusts, NRM groups, researchers and industry.
	d) Include appropriate watercourse buffers in land use planning and development design decisions.
Natural wetlands' conservation values and ecological processes are protected, including their water quality, aquatic and terrestrial habitat, naturally-occurring aquatic species and hydrological cycles.	a) Identify priority systems and, where required, implement waterway/wetland rehabilitation/conservation programmes.
	b) Provide extension and encourage the community to employ land management techniques that improve wetland ecosystem processes and habitat such as: • maintaining buffers; • water management practices that allow for natural seasonal drying; and • managing pest species within the wetland.
	c) Include appropriate wetland buffers in land use planning and development design decisions.
	d) Remove unnecessary barriers to allow natural flow regimes.
	e) Conduct fishway and fish passage design, monitoring and rehabilitation to ensure native fish can move along watercourses and between freshwater wetlands and lagoons.
	f) Re-establish connections between freshwater wetlands and lagoons so they are able to support native aquatic species expected for that system.
	g) Identify groundwater-dependent ecosystems and determine their requirements to maintain their health and sustainability.
	h) Manage the Bowling Green Bay wetland in a way that maintains its ecological character.



Objectives	Strategies
Estuarine, coastal and Great Barrier Reef environments (and the quality of water entering these environments), are improved through enhanced land and coastal marine management practices.	a) Implement strategies to improve the ecosystem processes, connectivity and condition of estuarine, coastal and marine environments, including: • identifying and rehabilitating priority areas where connectivity between fragmented coastal and marine ecosystems can be achieved; • removing impediments (either by complete removal, or modifying structures) between marine and freshwater environments; • removing and monitoring marine debris, and implementing appropriate strategies to prevent it; • promoting land and water techniques that improve the quality of water entering coastal and marine environments; • closely managing activities that occur in marine environments and directly impact the GBR, including dredging, ship movements and fishing; • rehabilitating degraded marine ecosystems; and • quantifying and protecting Indigenous cultural fishing.
	b) Promote opportunities and support the community, including schools, businesses and councils, to build capacity to protect reef-connected ecosystems. *For example: the 'Reef Guardians' programme and the Australian Marine Debris Initiative.*
	c) Specify benchmarks for the maintenance, monitoring and improvement of coastal and marine assets in statutory planning instruments.
	d) Facilitate agreements with communities and local governments to effectively maintain natural coastal processes and coastal zones, by maintaining connectivity, and buffering from inappropriate land use through land tenure options, as well as planning and development decisions.

SUCCESS INDICATORS

By or before 2026:	• a Conservation Action Plan (CAP) for our region is established and identified targets are achieved.
	• connectivity of functioning biodiversity areas has continually improved/ been maintained by a network of conservation parks/reserves and remnant habitat areas on freehold and leasehold land.
	• there is a reduced impact of pest plant and animal species in priority areas as identified through the Regional Pest Management Strategy.
The Reef Plan 2050 targets are achieved.	


Photo by Greg Calvert
Black-Throated Finch


Photo © NQ Dry Tropics
Bellyache Bush after weed treatment


Photo by Greg Calvert

PART C: NRM PLANNING FRAMEWORK

NQ Dry Tropics developed the NRM plan under the direction of, and in collaboration with, the Burdekin Dry Tropics community. The successful delivery of the plan will depend on people continuing to work together to achieve our shared vision, goals and strategies for natural resource management (NRM) in our region. NQ Dry Tropics will facilitate the delivery of this plan, and report on its progress, in partnership with the Australian and Queensland governments, land managers, Traditional Owner groups, NRM community groups, industry groups and the wider community.

NRM planning framework

NQ Dry Tropics, in collaboration with the Governance Group (see below for description), developed a framework to focus the NRM plan's delivery. The plan is the central point of this planning framework, which integrates NRM information with the efforts of everyone who manages our region's natural resources. The goal of the framework is to:

- ensure community oversight of delivery and monitoring of the plan's strategic direction;
- provide our regional community with easy access to the latest information; and
- facilitate enduring community networks.

The framework includes an implementation governance group, online tools, and a promotion, monitoring and evaluation process (refer to the top diagram page 80).

Governance Group

The NRM plan addresses a wide range of natural resources on which our region's inhabitants depend for their economic and social wellbeing. For the plan to be successfully adopted and implemented, it is critical that the community's views are captured, their work coordinated and aligned, and their contributions recognised. A multi-sector governance group will represent the community during the plan's different delivery stages.

The priority roles of the multi-sector governance group will be to:

- collectively represent community NRM interests in our region, including a representative from each sub-regional area;
- provide knowledge and expertise;
- support the development and maintenance of partnerships;
- be involved with promoting the plan; and
- assist with monitoring, evaluating, reviewing and improving its delivery.

Online support tool

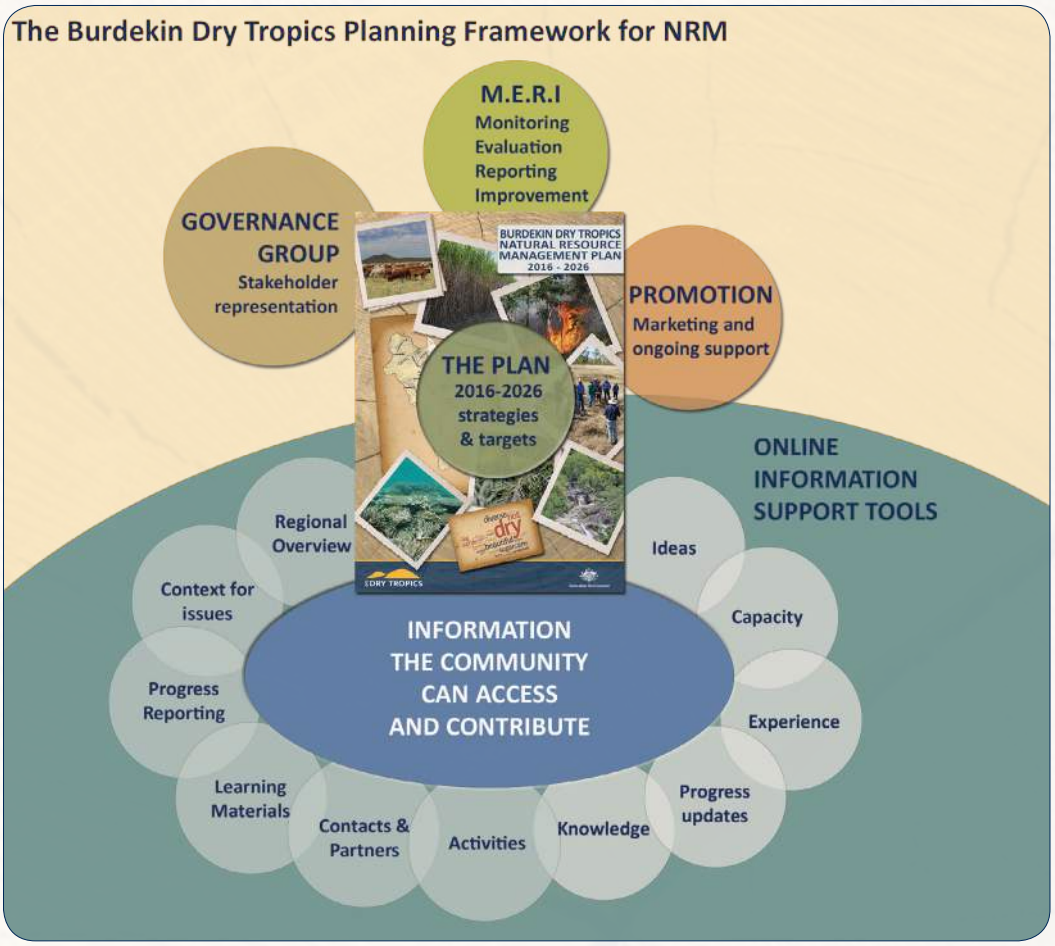
Good decision making relies on well-researched, high-quality information, and this can be found on NQ Dry Tropics' online information hub, which is an updatable knowledge library focused on NRM in the Burdekin Dry Tropics region. It contains a wealth of information on subjects such as landscapes and wetlands, native animals and plants, invasive pests and how to control them, water quality and catchment condition, and cultural information. It supports the plan by featuring up-to-date monitoring and research data, contributed by all interested sectors of the community. The hub includes information on projects that individuals and groups are undertaking, making it easy for people interested in NRM to connect and work together. It also features learning materials and tools that can be used to develop NRM skills.

Promotion

Community members will play an important role in promoting the plan via their networks and partnerships. NRM plan 'champions', such as specialised organisations or institutions, may have a more specific role that focuses on promoting sections of the plan that relate to their particular areas of expertise.

Successful promotion will be measured by whether:

- the plan is used to inform regional and state statutory management decisions;
- the online plan and digital knowledge hub is well used and regularly updated; and
- on-ground actions are based on the delivery packages presented in the plan.



Monitoring, evaluation and adjustment

The plan is supported by an adaptive Monitoring, Evaluation, Reporting and Improvement (MERI) strategy, which will measure and report on the success indicators identified in the plan's five themes – People connections, Climate change, Water, Land and Biodiversity.

The plan has been designed to span a ten-year operational period, from 2016-2026, without changing its broad structure, vision and goals. However, the plan and supporting planning framework are designed to be adaptive to meet the Australian Government's expectation on plan renewal, defined in the National Landcare Programme (NLP). This also includes a review of the plan every three years, which takes into account:

- adoption of best emerging science;
- ongoing stakeholder contributions & perspectives;
- implementation performance; and
- lessons learnt – in the Burdekin and other NRM regions.

Monitoring, evaluation and reporting will support decisions to improve NRM delivery processes, adapt or prioritise activities and ultimately improve natural resources in our region. The community and stakeholders will be involved if any major modifications are proposed.

The plan and planning framework provide the strategic oversight to guide the Burdekin Dry Tropics community to better protect and manage our region's natural resources for future generations.

The NRM Plan's MERI process

APPENDIX A

NRM REGIONAL PLANNING

The purpose of the plan

The scope of natural resource planning

Natural resources are the building blocks on which societies are created. They include everything that is not made, grown or bred by people. Some classify these resources as natural assets such as soils, water, air, minerals, nutrients, animals, plants, biodiversity and ecosystem services. Others prefer to think in terms of landscape features such as plains, mountains, rivers, wetlands, reefs, coastlines and oceans. All these terms describe our region's natural resources, which we depend on for our health, wealth and wellbeing. Indigenous leaders integrate all this in their use of the word 'country'.

Our region is experiencing changes in climate, industry, technology, community and land use. If we fail to protect and maintain our resource base we will lose the foundations on which we can continue to build our regional community and economy. Natural resource management (NRM) is about recognising that we need to sustainably access some of these resources, while protecting others. It is critical that our activities today do not limit opportunities for future generations.

This plan's scope

The people who live and work in our region and whose health, wealth and wellbeing depend on its natural resources, own this plan. There are many organisations, landholders, industries and others in our community who manage, research and invest in our region's natural resources. This plan sets out the strategic direction for how we will work together, combining our knowledge and experience to protect and sustainably use our natural resources over the next 10 years. The plan identifies our natural assets, as well as how to manage threats and capitalise on opportunities to ensure they will be around for future generations. Good decisions will enhance and protect natural resources, stimulate renewable natural resource production and make use of non-renewable resources, without compromising the socio-ecological system. The traditional custodians of land and sea ask us all to follow their lead to 'care for Country so that Country can care for us'.

Planning context and linkages

This community plan outlines the high-level strategies that will help natural resource managers and users to make robust decisions, coordinate our combined regional NRM efforts and direct regional investment. This is an umbrella plan which links with a myriad of statutory and non-statutory plans and policies with differing scope, scale and intents to achieve and deliver common goals and objectives for our region.

It considers international and national agreements, Australian and Queensland government legislation, programmes, strategies and plans. Of particular relevance to our region are the GBR World Heritage Area plans and strategies. The plan will establish priorities that will guide future regional action plans, such as an update of the Regional Pest Management Strategy. Conversely, the priorities outlined in existing action plans have guided this plan's development. The diagram opposite illustrates some of the key linkages that potentially overlap in area or topics with this plan.

Why we are updating the 2005 plan

The original Burdekin Dry Tropics NRM plan (2005 plan) was prepared primarily as a blueprint to guide expenditure for the Australian Government's initial National Heritage Trust funding programme. By 2013, the NRM funding model had changed significantly and some of the resource and community issues and actions had been progressed or changed. Many lessons have been learned and achievements made. Since 2005, increased regional developments, pressures associated with the global resource market and pollution have posed new challenges for effective NRM delivery.

In 2013, the Australian Government announced funding to address climate change risks and determine appropriate regional responses. One identified priority was to update NRM plans across Australia, to incorporate climate knowledge and provide practical landscape-based climate change mitigation and adaptation strategies.

NQ Dry Tropics has taken this opportunity to update the 2005 plan to address:

- climate information;
- other emerging regional NRM issues;
- changing community perceptions of NRM; and
- new NRM information, practices and technological opportunities.

This plan is a summary of important information and provides links to more detailed information which may be required to make reliable and coordinated decisions about managing our natural resources. It aims to help us understand where our own contributions might fit in, and how they might influence the collective effort towards making the most of the natural resources we share.

Planning context and linkages

How the plan was updated

The plan draws on the best available knowledge and was developed in close consultation with our regional community and 14 NRM groups operating across Queensland, including seven adjacent NRM planning regions and, five other regions from Australia's Monsoonal North climatic zone.

The figure on page 84 depicts the three main phases of updating the plan:

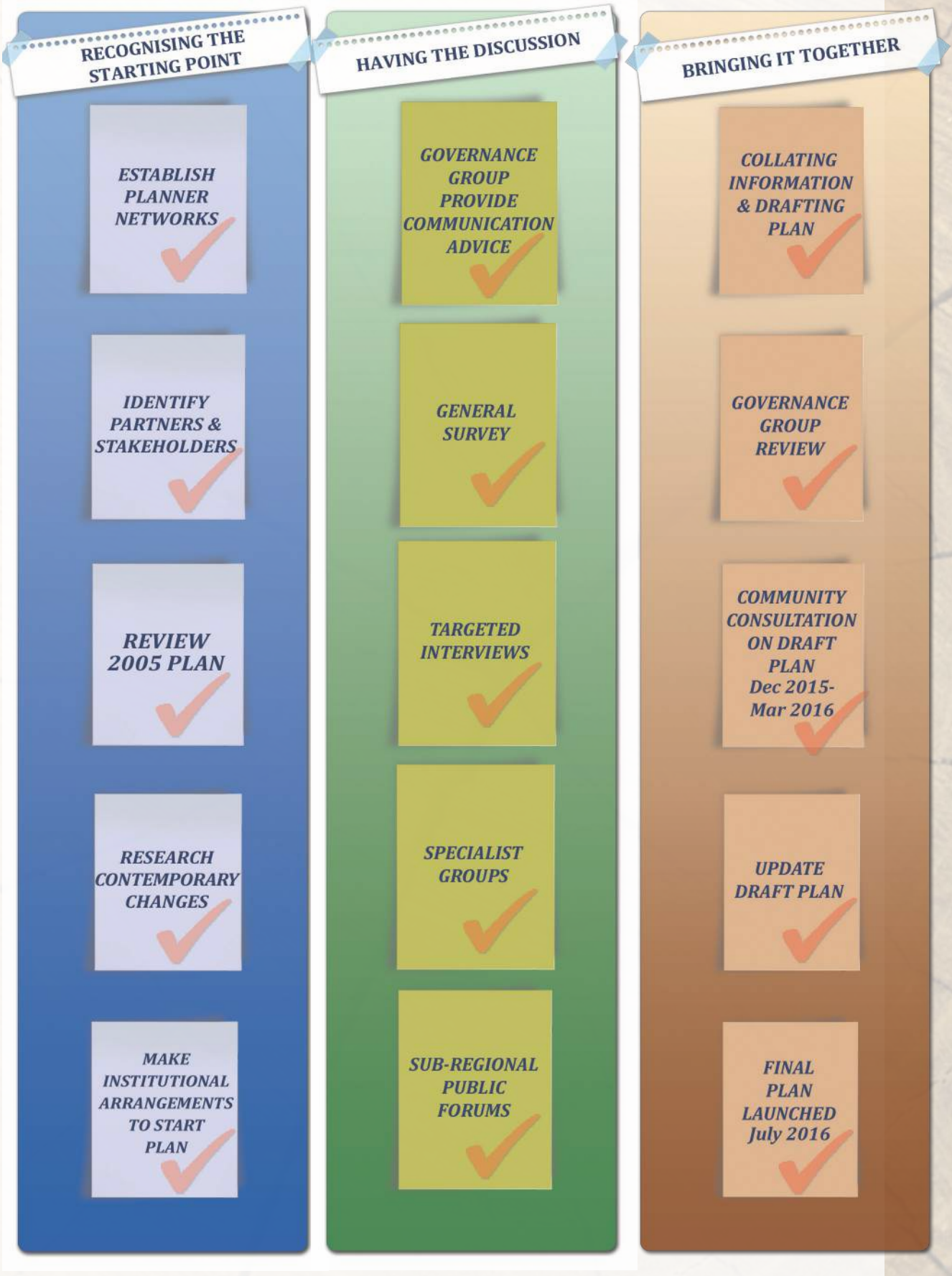
1. The starting point: Research and review
Since the 2005 plan there have been many studies of environmental, social, cultural, economic and development issues in the region. As a starting point for the update, we reviewed the ideas and content in the 2005 plan, and conducted research on new NRM issues, focusing on regional natural resources and communities, and climate change.

2. The discussion: Community governance and consultation
In preparing this plan, every effort was made to represent the views of those who value and actively care for our region's natural resources. Community consultation was guided by a multi-sector 'plan transition governance group'. Between March 2013 and May 2016, ongoing consultation took place with the community, technical experts and NRM practitioners.

The plan captures hundreds of community suggestions and requests. Contributions came from a range of individuals and representatives of groups, organisations, industries, social sectors and geographic areas. Suggestions were also provided by technical experts, NRM industry leaders, and researchers from within the region and across Australia. The plan also draws heavily on experiences, processes and content associated with three previous plans:

- The Indigenous Caring for Country Plan (2005);
- The original Burdekin Dry Tropics NRM Plan (2005);
- The Burdekin Water Quality Improvement Plan (2016); and
- The Regional Pest Management Strategy 2014 - 2019.

3. Bringing it together: Consolidation and approval
We prepared this plan by analysing, synthesising and consolidating the information from our review of the original plan, background research, and community and governance input. Not all the information can or should be in the plan. Strategic NRM information has been collated not only in this document, but also on NQ Dry Tropics' online information hub. Together these 'documents' describe a broad continuous planning framework, of which this plan is the centrepiece.



The three main phases of updating the plan.

Review of previous plan

The first plan was developed through an extensive consultation process in 2003-4 and published by the Burdekin Dry Tropics Board in May 2005 as the Burdekin Dry Tropics Natural Resource Management Plan (2005-2010). The 2013-15 review highlighted the following update requirements:

A systems approach: Delivery must recognise that resource management inherently balances the interconnected social, cultural, environmental and commercial values of country for present and future generations.

Continuous and flexible planning: Some elements of the plan need to be updated annually as new information, risks and opportunities come to light, while others, like the goals, need to remain as a clear long-term commitment for a decade or more.

Up front human capacity building: The plan needs to address human elements of NRM because an NRM plan is about much more than government allocating financial resources. It is used and delivered by those with the understanding, skills, motivation, time and tools to take action.

Simple options: The region and our community are complex, but the plan should be neither complex nor prescriptive. Detailed planning targets can restrict uptake in a constantly changing environment, and non-statutory plans mean people need to choose how, when and where they will 'opt-in' to deliver NRM.

Measurable and realistic success indicators: We need to identify indicators that show actions are having the expected result. There needs to be a clear mechanism for determining progress, so that people will remain connected to delivering against the indicators.

Ownership of decision making: Interest in delivering an old plan naturally declines as those involved move on. Processes allowing for continuous community involvement and motivation to participate in decision making around plan delivery and renewal are critical.

Commitment to monitoring: A review of the 2005 plan highlighted the importance of making an ongoing commitment to monitoring. Achievements were strongest in areas such as water quality, where this commitment had been made. The review also demonstrated better results in areas where strategic approaches had been updated and renewed during the plan's delivery rather than at the end of its operational life.

Principles used to update the plan

The plan is intended to support people contributing to the sustainability and resilience of regional systems. NRM issues are complex and need a variety of approaches to create a desired outcome. The plan is focused on delivering outcomes for the biophysical, social and economic components of the whole regional system. It recognises that integrative and collaborative management requires flexibility and adaptation.

In principle, this plan was designed to:

1. **be an update, and not a new plan:** Carry forward the enduring ideas and strengths of the previous regional plan (2005) (BDTBoard, 2005) and link to the regional Traditional Custodians of the Burdekin Dry Tropics Caring for Country Plan (2005) (Traditional Custodians of BDT region, 2005);
2. **be inclusive, and collaborative:** Recognise the variety of cultural, social and economic values people associate with natural resources and involve people in developing and delivering the plan;
3. **be informed, and informing:** Summarise information about the region's natural resources, as well as help people understand why managing these resources is important and what they can do to help;
4. **be adaptable, and usable:** Use an approach that can be easily updated and changed to reflect social, economic and ecological resource changes, and accessible to the community as a practical guide and tool to help everybody manage resources;
5. **be empowering:** Motivate and enable individuals and organisations to improve the value of natural resources for everybody; and
6. **be continuously improved:** Be subject to ongoing monitoring, evaluating, and reporting, to improve delivery.

APPENDIX B

Australian and Queensland Government Legislation and scope in relation to NRM

Natural Resource	Legislation/ Mechanism	Scope	Department
Sustainable Planning	*Sustainable Planning Act 2009*	Managing a process and effects of development.	Qld Gov DLGP
Sustainable Planning	State Planning Policy	Provides information to local governments when making and amending local planning instruments and assessing development applications and assists applicants in preparing development applications.	QLD Gov DILGP
Water Allocation	*Water Act 2000*	Management and allocation of water resources.	QLD Gov DNRM
Water Supply	*Water Supply (Safety and Reliability) Act 2008*	Management of treating, transmitting or reticulating water for drinking and sewerage purposes. The regulation of referable dams. Flood mitigation responsibilities.	QLD Gov DEWS
Native Vegetation	*Vegetation Management Act 1999*	Management of remnant and regrowth vegetation clearing within particular areas. Over the years there have been significant changes to sections of the VMA, which have had a bearing on the amount of vegetation that has been cleared, particularly the phasing out of broadscale clearing in 2006, the introduction of high-value regrowth provisions in 2009, and the introduction of new "relevant purposes to clear" such as high-value agriculture and environmental purposes in 2013.	QLD Gov DNRM
Native Vegetation	Australia's Native Vegetation Framework	Sets national directions to guide actions across government strategies, policies, legislation and programs related to native vegetation management on the Australian continent and its island.	Aus Gov
Land Resources	*Land Act 1994*	Administration and management of land owned by the State of Queensland.	QLD Gov DNRM
Agricultural Land	Queensland Agricultural Land Audit	Identifies land important to current and future production and the constraints to development.	QLD Gov DAFF
Threatened flora and fauna species	*Nature Conservation Act 1992*	Managing and conserving threatened plants and animals.	QLD Gov EHP
Protected Area Estates and Nature Refuges	*Nature Conservation Act 1992*	Preserving the natural condition of parks while: involving Indigenous people in the management; allowing the use and enjoyment of protected areas by the community and providing for the social, cultural and commercial use in a way consistent with the natural, cultural and other values of the areas.	QLD Gov NPRSR and EHP
Fisheries	*Fisheries Act 1994*	Provides for the use, conservation and enhancement of the community's fisheries resources and fish habitats.	
Landscape and biodiversity planning	Biodiversity Planning Assessments	Identifies the terrestrial ecological values in a region, or bioregion, according to their conservation significance. BPAs are used by governments, members of the community and landholders to make planning decisions about appropriate land use.	QLD Gov EHP
Environmental Protection	*Environmental Protection Act 1994*	Defines environmental objectives, develops and implements environmental strategies into resources management, ensures accountability of environmental strategies.	QLD Gov DEHP
Environmental Protection	*Environmental Protection and Biodiversity Conservation Act 1999*	Provides for the protection of the environment that are matters of national environmental significance.	Aus Gov Dept Env
Environmental Protection	*Environmental Protection (Water) Policy 2009*	Establishes framework for identifying environmental values and water quality objectives to protect/enhance environmental values; criteria for healthy waters management plans; management hierarchy and management intent for an activity releasing waste water or contaminants to Queensland waters.	Qld Gov EHP
Environmental Offsets (for protection of Prescribed Environmental Matters)	*Environmental Offsets Act 2014* Environmental Offsets Regulation 2014 Queensland Environmental Offsets Policy	To counterbalance the significant residual impacts of particular activities on prescribed environmental matters through the use of environmental offsets.	Qld Gov EHP

Great Barrier Reef	The Great Barrier Reef Intergovernmental Agreement	Provides a framework to help the Australian and Queensland governments cooperatively manage the complex landscapes of the Reef.	Aus Gov GBRMPA Qld Gov EHP
Great Barrier Reef	*Great Barrier Reef Marine Park Act 1975*	Provides for the long term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region.	Aus Gov
Great Barrier Reef	Reef 2050 Long-Term Sustainability Plan	Overarching framework for protecting and managing the Great Barrier Reef from 2015 to 2050. The Reef Plan 2050 restricts capital dredging for the development of new port facilities – or expansion of existing ones – to within the regulated port limits of Abbot Point and Townsville within BDT region.	Aus Gov
Coast and reef	*Marine Parks Act 2004*	Provides for conservation of the coast and marine environment.	Qld Gov NPRSR
Coast and reef	*Sustainable Ports Development Act 2015*	Provides for the protection of the Great Barrier Reef World Heritage Area through managing port-related development in and adjacent to the area.	Qld Gov
Natural Resource Management	*Natural Resources Management (Financial Assistance) Act 1992*	Provides for the funding and administrative arrangements relating to natural resources management in Australia.	Aus Gov
Climate Change Mitigation	*Carbon Credits (Carbon Farming Initiative) Act 2011*	Creates incentives for people to carry out offset projects in order to increase carbon abatement and reduce greenhouse gas emissions.	Aus Gov
Climate Change Mitigation	Emissions Reduction Fund	Provides incentives for emissions reduction activities across the Australian economy.	Aus Gov
Biosecurity	*Biosecurity Act 2014*	Deals with pests, diseases and contaminants. It provides a risk-based and less prescriptive approach to biosecurity in Qld. It introduces general biosecurity responsibilities for the public, property owners and agricultural industry bodies. Local governments are also required to develop a pest management plan, under the Land Protection (Pest and Stock Route Management) Act 2002 (Qld).	Qld Gov DAF
Biosecurity	*Biosecurity Act 2015* replacing the *Quarantine Act 1908*	Provides a regulatory framework for the management of biosecurity risks to support Australia's biosecurity system.	
Mining Resources	*Mineral Resources Act 1989* *Petroleum and Gas (Production and Safety) Act 2004* *Petroleum Act 1923* *Greenhouse Gas Storage Act 2009* *Geothermal Energy Act 2010.* Note: The above Acts are in the process of being consolidated under a new Resources Act	Administrate and provide tenure for mining activities.	Qld Gov DNRM

Directory of Important Wetlands occurring in the BDT region

Bioregion	Wetland Aggregation
Brigalow North	Abbot Point - Caley Valley Barrattas Channels Bingeringo Bowen River: Birralee – Pelican Creek Broken River, Urannah Creek & Massey Creek Burdekin-Bowen Junction & Blue Valley Weir Burdekin-Townsville Coastal Aggregation Bowling Green Bay wetlands Burdekin Delta Eungella Dam Haughton Balancing Storage Junction of the Bogie River and Kirknie Creek Lake Dalrymple RAAF Townsville Rollston River and Molly Darling Creek Ross River Reservoir Scartwater Southern Upstart Bay Serpentine
Desert Uplands	Doongmabulla Springs
Einasleigh Uplands	Great Basalt Wall Lake Lucy Wetlands Minnamoolka Area Poison Lake Turkey Mound Spring & Iron Pot Spring Wairuna Lake Walters Plains Lake Valley of Lagoons Why Not
Wet Tropics	Bambaroo Coastal Birthday Creek

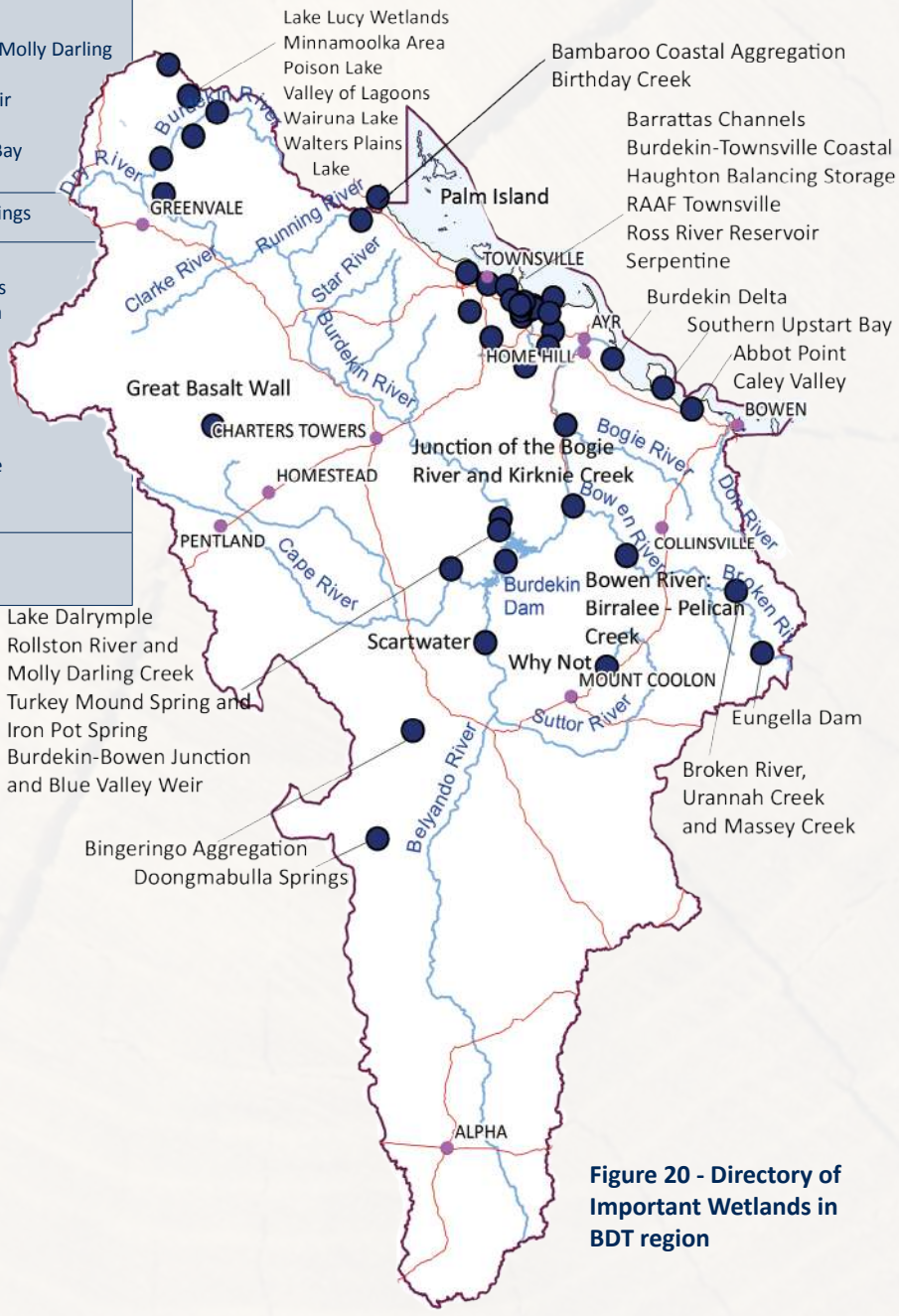


Figure 20 - Directory of Important Wetlands in BDT region

APPENDIX C

Endangered (E) and Vulnerable (V) listed species and recovery plans

Scientific Name	Common Name	NCA	EPBC	Recovery Plan
Bettongia tropica	Northern bettong	E	E	Yes
Caretta caretta	Loggerhead turtle	E	E	Yes
Casuarius casuarius johnsonii (southern population)	Southern cassowary (southern population)	E	E	No
Dasyurus maculatus gracilis	Spotted-tail Quoll	E	E	Yes
Dermochelys coriacea	Leatherback turtle	E	E	No
Collared delma	Collared Delma	V	V	Yes
Eriocaulon carsonii	Button Grass	E	E	Yes
Eryngium fontanum	Blue Devil	E	E	Yes
Erythrotriorchis radiatus	Red goshawk	E	V	Yes
Erythrura gouldiae	Gouldian finch	E	E	Yes
Lasiorhinus krefftii	Northern hairy-nosed wombat	E	E	Yes
Lepidochelys olivacea	Olive ridley turtle	E	E	Yes
Lerista allanae	Allan's lerista	E	E	No
Litoria dayi	Australian lacelid frog	E	E	Yes
Litoria nannotis	Waterfall frog	E	E	Yes
Macronectes giganteus	Southern giant-petrel	E	E	Yes
Macrotis lagotis	Greater bilby	E	V	Yes
Neochmia ruficauda ruficauda	Star finch (eastern subspecies)	E	E	No
Onychogalea fraenata	Bridled nailtail wallaby	E	E	Yes
Petaurus gracilis	Mahogany glider	E	E	Yes
Petrogale persephone	Proserpine rock-wallaby	E	E	Yes
Poephila cincta cincta	Black Throated Finch (white rumped species)	E	E	Yes
Rheobatrachus vitellinus	Northern gastric brooding frog	E	EX	No
Rhinolophus philippinensis	Greater large-eared horseshoe bat	E	E	Yes
Saccolaimus saccolaimus nudicluniatus	Bare-rumped sheathtail bat	E	CE	Yes
Taudactylus eungellensis	Eungella dayfrog	E	E	Yes
Delma mitella	Legless Lizard	NT	V	No
Psephotus pulcherrimus	Paradise parrot	PE	EX	Extinct
Chelonia mydas	Green turtle	V	V	Yes
Denisonia maculata	Ornamental snake	V	V	No
Egernia rugosa	Yakka skink	V	V	No
Eretmochelys imbricata	Hawksbill turtle	V	V	Yes
Eucalyptus raveretiana	Black ironbox	V	V	No
Geophaps scripta scripta	Squatter pigeon (southern subspecies)	V	V	No
Lerista vittata	Mount Cooper striped lerista	V	V	No
Livistona lanuginosa	Waxy Cabbage Palm	V	V	No
Megaptera novaeangliae	Humpback whale	V	V	No
Myrmecodia beccarii	Ant Plant	V	V	No
Natator depressus	Flatback turtle	V	V	Yes
Ozothamnus eriocephalus	Ozothamnus eriocephalus	V	V	No

APPENDIX D

Polianthion minutiflorum	Polianthion minutiflorum	V	V	No
Rostratula australis	Australian painted snipe	V	E	No
Tyto novaehollandiae kimberli	Masked owl (northern subspecies)	V	V	No
Bidyanus bidyanus	Silver perch	Not Listed	CE	No
Neoceratodus forsteri	Australian lungfish		V	No
Phascolarctos cinereus	Koala	SL	V	No

NCA – *Nature Conservation Act 1994*
EPBC – *Environment Protection and Biodiversity Conservation Act 1999*
E – Endangered
CE – Critically Endangered
V – Vulnerable
NT – Near Threatened (NT can be found at https://www.ehp.qld.gov.au/wildlife/threatened-species/near-threatened/)
PE/EX – Extinct

Landtypes of the BDT region

Land Type	Preferred 3P Grasses	Erosion Susceptibility	Safe utlisation rate (%)
Black basalt	Queensland blue grass, curly blue grass, black spear grass, curly and hoop Mitchell grass, tall cup grass	Limited soil erosion hazard. Prone to rill and gully erosion along tracks and fence lines and on sloping lands.	30
Brown basalt	desert blue grass, black spear grass, kangaroo grass, curly blue grass, giant spear grass, plume and brown sorghum		30
Clayey alluvials	Queensland blue grass, desert bluegrass, curly blue grass, curly and hoop Mitchell grass, tall cup grass, native millet, green couch* (naturalised)	Variable soil erosion hazard. Prone to rill and gully erosion, highly erodible along tracks, fence lines and drainage lines.	30% (native); 35% (sown).
Downs	hoop and curly Mitchell grass, curly blue grass, kingblue grass, Queensland, blue grass, native millet, buffel grass*	Limited soil erosion hazard. Prone to rill and gully erosion along tracks and fence lines and on sloping lands.	25
Goldfields country – black soils	desert blue grass, Queensland blue grass, curly blue grass, buffel grass*, urochloa*, black spear grass, kangaroo grass		25
Goldfields country – red soils	desert blue grass, forest blue grass, curly blue grass, buffel grass*, urochloa*, cotton panic, black spear grass, kangaroo grass	Generally limited soil erosion hazard. However, past land uses, including mining and grazing, have had a widespread legacy effect in terms of sheet, rill and gully erosion.	25
Loamy alluvials	desert blue grass, black spear grass, kangaroo grass, cotton panic, giant spear grass, green couch* (naturalised)	Variable soil erosion hazard. Highly erodible where sub-soil is exposed, particularly along fence lines, tracks and drainage lines and on sloping lands. Prone to gully erosion adjacent to major watercourses.	30% (native); 35% (sown).
Narrow-leaved ironbark on deeper soils	black spear grass, kangaroo grass, desert blue grass, hairy panic, forest blue grass, spinifex (west)	Variable soil erosion hazard. Highly erodible where sub-soil is exposed, particularly along fence lines, tracks and on sloping lands and drainage lines.	25
Red basalt	desert blue grass, black spear grass, kangaroo grass curly blue grass, giant spear grass, plume and brown sorghum	Limited soil erosion hazard. Prone to rill and gully erosion along tracks and fence lines and on sloping lands.	30
Blackwood scrubs on structured clays	desert bluegrass, buffel grass*,curly blue grass, brigalow grass	Limited soil erosion hazard. Prone to sheet, rill and gully erosion along tracks and fence lines and on sloping lands.	25% (native); 30% (sown).
Box and Napunyah	soft spinifex, desert blue grass, kangaroo grass	Variable soil erosion hazard. Highly erodible dispersible soils wheresub-soil is exposed, particularly along fence lines, tracks and on sloping lands and drainage lines.	15
Box country	desert bluegrass, curly blue grass, black spear grass, kangaroo grass, cotton panic, buffel grass*, urochloa*	Variable soil erosion hazard. Highly erodible where sub-soil is exposed, particularly along fence lines, tracks and on sloping lands and drainage lines.	25
Brigalow gidgee scrubs	Queensland blue grass, curly blue grass, native millet, curly Mitchell grass, buffel grass*, brigalow grass	Limited soil erosion hazard. Prone to rill and gully erosion along tracks and fence lines and on sloping lands.	30% (native); 35% (sown).
Narrow-leaved ironbark on shallower soils	black spear grass, kangaroo grass, desert blue grass, hairy panic, forest blue grass, golden beard grass	Moderate soil erosion hazard. Prone to sheet, rill and gully erosion on sloping lands.	20
Silver-leaved Ironbark	golden beard grass, desert bluegrass, black spear grass kangaroo grass, Queensland blue grass (south), native millet (south – clay soil), forest blue grass	Limited soil erosion hazard. Prone to sheet, rill and gully erosion along tracks and fence lines and on sloping lands.	25
Yellowjacket with other eucalypts	soft spinifex, black spear grass, silky umbrella grass, hairy panic, giant spear grass, cotton panic, kangaroo grass, plume sorghum, golden beard grass		20

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Blackwood scrubs on massive soils	Desert blue grass, brigalow grass, bull Mitchell grass, windmill grasses	Very high soil erosion hazard. Particularly prone to scalding, gully and tunnel erosion along tracks, fence lines and on sloping lands.	15
Lancewood-bendee-rosewood	cotton panic, tableland couch, hairy panic, kangaroo grass, spinifex	Generally low soil erosion hazard, apart from areas with steep broken slopes	10
Softwood scrub	buffel grass*, urochloa*	Limited soil erosion hazard. Prone to sheet, rill and gully erosion along tracks and fence lines and on sloping lands.	30% (native); 35% (sown).
Ranges	black spear grass, giant spear grass, kangaroo grass, blady grass, buck spinifex	Limited soil erosion hazard. Prone to rill and gully erosion along tracks and fence lines and on sloping lands.	10
Box country	black spear grass, kangaroo grass, forest blue grass, desert blue grass, golden beard grass, buffel grass*, soft spinifex	Variable soil erosion hazard. Highly erodible where sub-soil is exposed, particularly along fence lines, tracks and on sloping lands and drainage lines.	25
Coolibah flats	buffel grass*, curly Mitchell grass, black spear grass, forest blue grass golden beard grass, kangaroo grass, Queensland blue grass	Variable soil erosion hazard. Highly prone to sheet erosion despite gentle slopes.	25
Downs country	Mitchell grasses (curly, barley, bull) , Queensland blue grass, native millet		25
Frontage	black spear grass, desert blue grass, kangaroo grass	Variable soil erosion hazard. Prone to rill and gully erosion, highly erodible along tracks, fence lines and drainage lines.	25
Ironbark country	black spear grass, soft spinifex, kangaroo grass, Queensland blue grass, desert blue grass, forest blue grass, curly blue grass, golden beard grass	Variable soil erosion hazard. Prone to sheet erosion.	25
Channels and swamps associated with major streams	green couch grass, bull Mitchell grass, forest blue grass, desert blue grass, golden beard grass, kangaroo grass	Limited soil erosion hazard. Prone to streambank erosion during peak flow periods.	25
Frontal dunes	marine couch grass, buffel grass*	High erosion hazard. Prone to wind erosion, limited sheet and rill erosion due to high soil permeability.	15
Hard ironbark Country	kangaroo grass, soft spinifex, buck spinifex	High erosion hazard. Prone to sheet erosion and shallow gullying.	20
Scrubs on deep Clays	buffel grass*,bull Mitchell grass, curly Mitchell grass, blue grasses blue grasses (e.g.desert)	Limited soil erosion hazard. Prone to sheet, rill and gully erosion along tracks and fence lines and on sloping lands and drainage lines.	30
Scrubs on shallow clays	Mitchell grasses (barley, bull, hoop, curly)), desert blue grass, Queensland blue grass, forest bluegrass, silky browntop		25
Yellowjacket country plus/ minus wattles	soft spinifex, kangaroo grass, black spear grass, golden beard grass, forest blue grass	Limited soil erosion hazard. Prone to sheet, rill and gully erosion along tracks and fence lines and on sloping lands.	20
Jump-ups	soft spinifex, buck spinifex, kangaroo grass, golden beard grass, Seca stylo*	Generally high erosion hazard associated with steep slopes.	15
Lakebeds	marine couch, saltbush	Generally low erosion hazard. Can be prone to wind erosion along open areas.	10

Sub-catchments of the BDT region

CATCHMENT	SUB-CATCHMENT NUMBER	SUB-CATCHMENT NAME
UPPER BURDEKIN CATCHMENT	1	Allingham Creek
	2	Basalt River
	3	Burdekin River (above Dam)
	4	Burdekin River (Blue Range)
	5	Camel Creek
	6	Clarke River
	7	Douglas Creek
	8	Dry River
	9	Fanning River
	10	Gray Creek
	11	Hann Creek
	12	Keelbottom Creek
	13	Kirk River
	14	Lolworth Creek
	15	Running River
	16	Star River
	17	Upper Burdekin River
CAPE CAMPASPE CATCHMENT	18	Campaspe River
	19	Cape River
	20	Lower Cape River
	21	Rollston River
BELYANDO CATCHMENT	22	Belyando Floodplain
	23	Carmichael River
	24	Fox Creek
	25	Mistake Creek
	26	Native Companion Creek
	27	Sandy Creek
	28	Upper Belyando River
SUTTOR CATCHMENT	29	Diamond Creek
	30	Logan Creek
	31	Lower Suttor River
	32	Rosetta Creek
	33	Sellheim River
	34	Upper Suttor River

CATCHMENT	SUB-CATCHMENT NUMBER	SUB-CATCHMENT NAME
BOWEN BROKEN BOGIE CATCHMENT	35	Bogie River
	36	Bowen River
	37	Broken River
	38	Glenmore Creek
	39	Little Bowen River
	40	Pelican Creek
	41	Rosella Creek
LOWER BURDEKIN CATCHMENT	42	Barratta Creek
	43	Burdekin Delta
	44	Burdekin River (below dam)
	45	Haughton River
	46	Landers Creek
	47	Stones Creek
DON CATCHMENT	48	Upstart Bay
	49	Abbott Bay
	50	Don River
TOWNSVILLE COASTAL PLAIN CATCHMENT	51	Black River
	52	Ross River

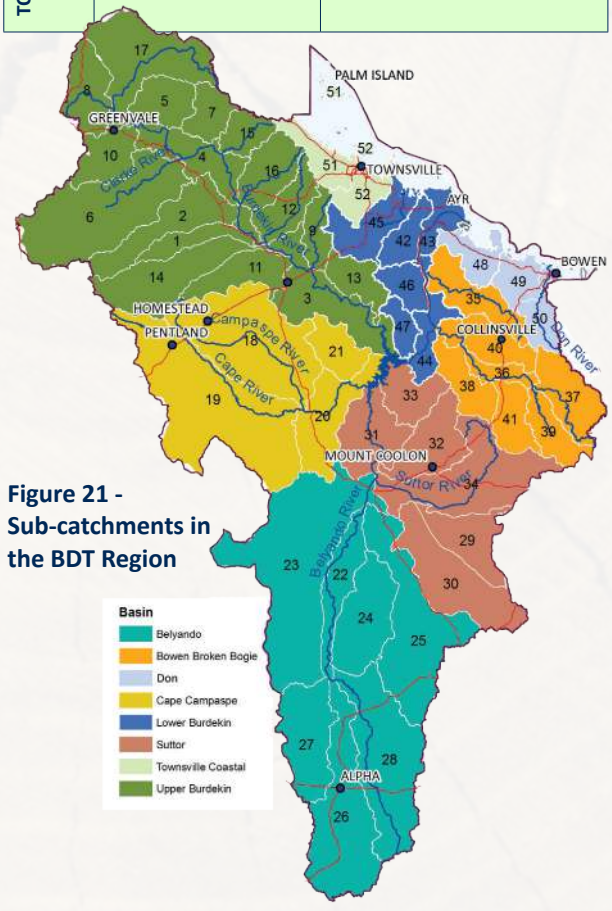
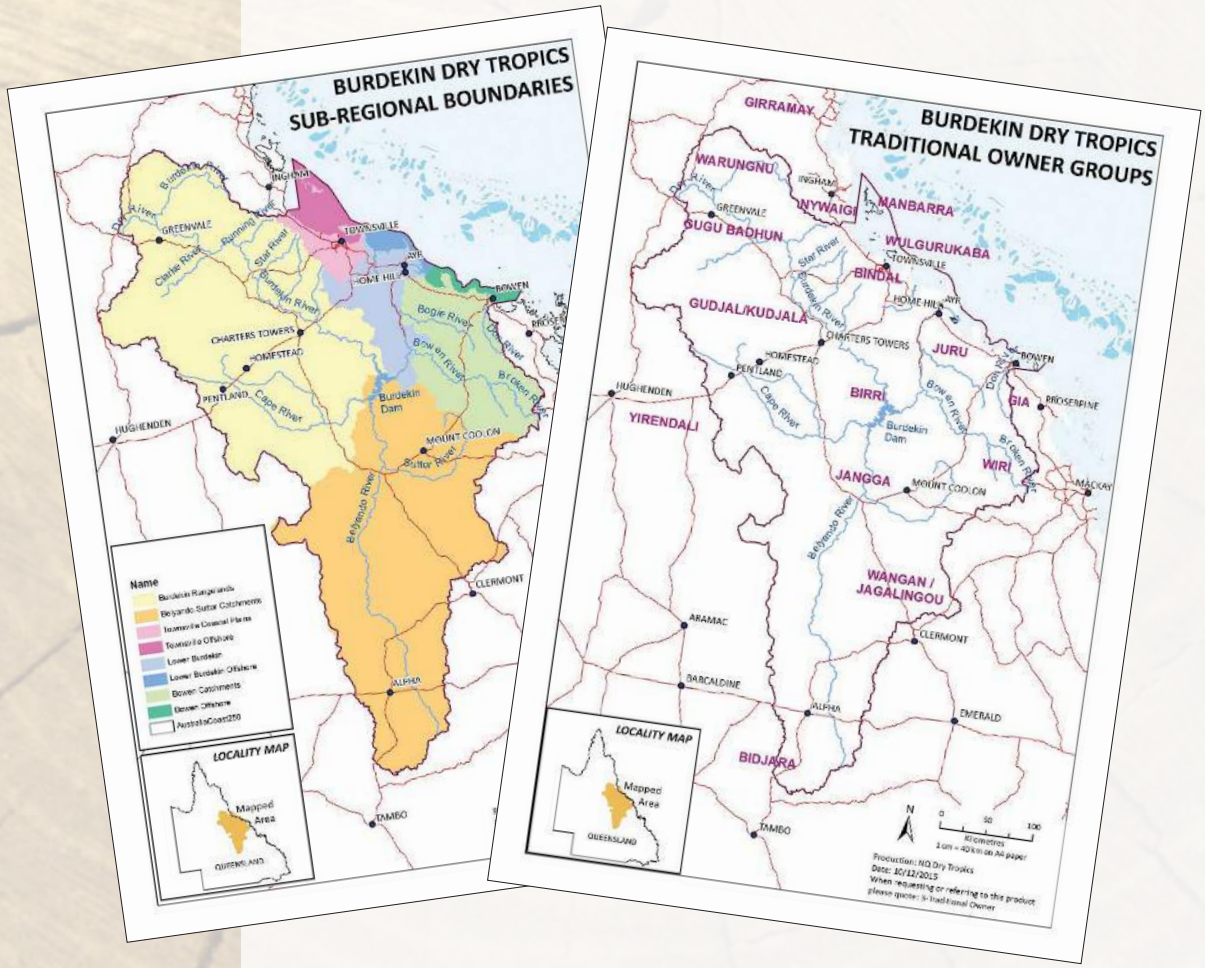


Figure 21 - Sub-catchments in the BDT Region

APPENDIX F

FIGURE LIST



All figures are available to download as PDF maps from the NQ Dry Tropics website.

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Spatial Data References

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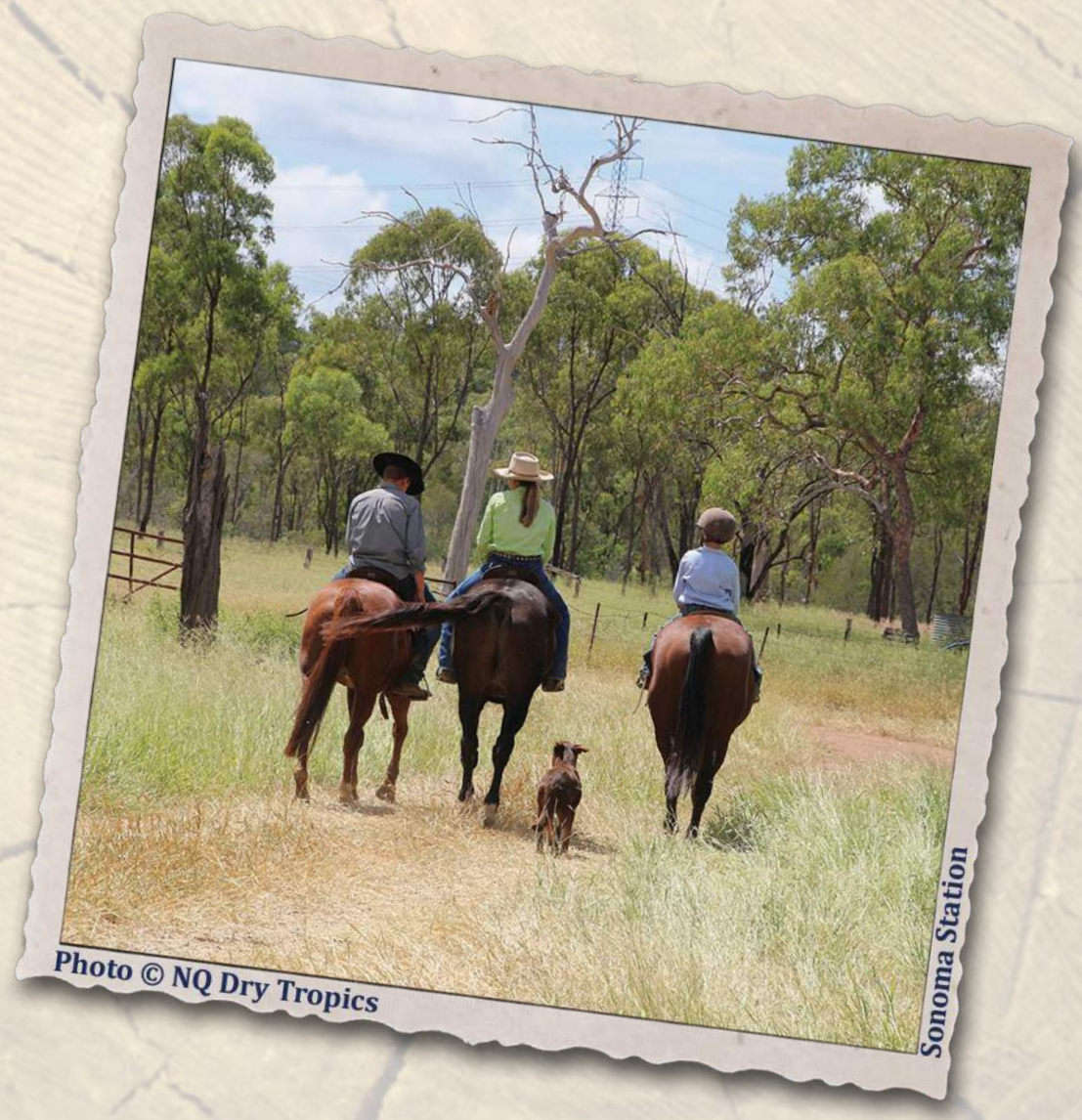

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