Northern Gulf

Northern Tablelands Regional NRM Assessment

2015

Prepared by:

NRM Planning

@ Northern Gulf Resource Management Group Ltd

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Australian Government

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1. INTRODUCTION

The Tablelands sub region of the Northern Gulf has been defined to include the rural districts of Dimbulah, Mutchilba, Irvinebank, Julatten, MT Molloy and Watsonville, as well as the western sheds of the Mareeba and Bihboora districts. The area can be described as a mixed use rural area, as it includes a variety of land uses and lot sizes, accommodating intensive agriculture, tropical horticultural industries, rural townships, bush lifestyle blocks and many peri-urban residents who live on small acreages and rely on off-farm income.

The Tablelands economy is predominantly agricultural and relies on the irrigation infrastructure of the Mareeba-Dimbulah Irrigation Area (MDIA), which is mostly contained within the Walsh sub-catchment of the greater Mitchell catchment.

The MDIA supports a variety of horticultural industries, including bananas, sugar cane and mangoes. There is a further opportunity to diversify and expand this agricultural base. While Irrigation Infrastructure is a very important asset, currently it is underutilised; only 122,948 of the 204,424 ML. available from Tinaroo were used in 2013.

Current irrigation practices such as furrow irrigation in the area is having an impact on water quality in the Walsh catchment, and contributing to issues of dryland salinity in the Cattle creek catchment. Another saline basin causing concern in the region is located at Two Mile Creek in Bihboora - which flows into the Mitchell river - and is largely associated with the Mareeba sewage treatment plant.

Agriculture in the region relies on soil health. Trials are currently being undertaken in the MDIA on biochar, compost and mulches in improving this resource, by increasing the storage of soil carbon.

The Tablelands region straddles the dividing range, with the eastern shed flowing into the Barron catchment (within the Terrain NRM Wet tropics region) and the western shed flows to the Gulf via the Mitchell River catchment. This western shed falls within the Northern Gulf region.

The Julatten and Mt Molloy areas are located at the confluence of Einsaleigh Uplands, Wet Tropics and the Cape York bioregions. This area is home to a large percentage of lifestyle/peri urban residents who place a strong value on aesthetic and environmental values of the area. The region also represents many important cross-regional linkages between different ecosystems, and provides a strategic location for landscape scale and wildlife corridors to target with tree planting. Due to the ecological diversity of the area, it also contains a higher number of mammal, reptile and frog species than can be found anywhere else in the Northern Gulf region.

The Tablelands region is mineral rich and geologically diverse, and has been the focus of much historical mining activity, resulting in many abandoned mine sites. Abandoned mines can threaten the health of soils and waterways, as contaminated leachate from waste rock piles and tailings dams can seep into surface and groundwater in mining areas. This is particularly evident in the Upper Walsh sub-catchment, around Irvinebank and Watsonville which is littered with literally thousands of abandoned mine sites.

Weeds such as parthenium and belly ache bush are a problem in the Tablelands region. There is also concern about emerging weeds such as neem, which has the potential to spread throughout the Northern Gulf region. The containment of the pest fish tilapia continues to concern Natural resource managers, and attempts to contain small localized populations at the head of the Mitchell continue (such as Eureka Creek near Dimbulah).

The Northern Tablelands is wholly contained within the Mareeba Shire Local Government Area and includes the following communities:

Dimbulah is 114 km from Cairns by road. At the 2011 census, Dimbulah had a population of 1,414. The town was established in 1876 to service the Tyrconnell Gold Mine. In the early 1900s the area received an influx of Italian migrants and in 1928 tobacco was introduced, becoming the area's major industry soon after. At its peak, there were 800 growers in the area, producing over 8,000 tonnes (60% of national yield) of tobacco a year. While the tobacco industry has since subsided, the town still in a major centre for the agricultural industries of the Mareeba-Dimbulah Irrigation area.

Irvinebank is a village in the western foothills of the Atherton Tablelands. The town was founded in 1884 by John Moffat, who had purchased the mining leases from the original prospectors. He built a dam, a mill, smelters and other infrastructure that attracted settlers and miners to the area. It became a thriving town with an economy based on mining, milling and smelting. In the ten years up to the 1911 census the population had swelled from 619 to 1264, but another 10 years saw it reduced back to only 607 and continued to fall. At the 2006 census, Irvinebank had a population of 311.

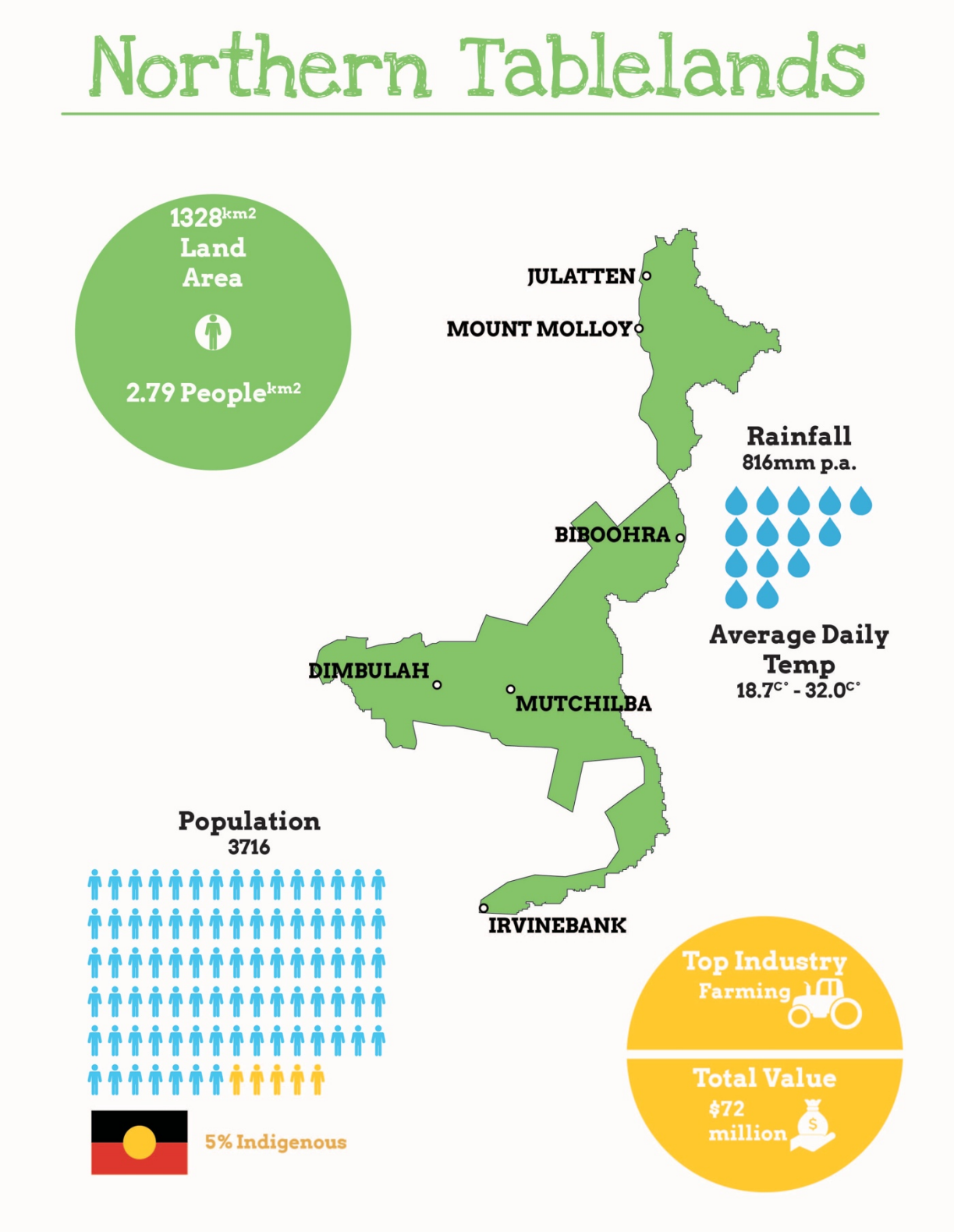
Julatten is a rural area within the Wet Tropics bioregion, at the head of the Mitchell catchment. The total population of Julatten was 998 people in the 2011. It is dominated by small acreages and does not have a formal town centre, despite having a significant population. Many Julatten residents rely on services in Port Douglas and Mossman, via access down the Rex range road.

MT Molloy is a historic mining and timber town lying 55km north of Cairns. At the 2011 census, the town and surrounding area had a population of 273. At its height MT Molloy was a copper mine in the 1890s. It was commonly used as camping grounds and Chinese market gardeners used to grow grain and other foodstuffs for the miners nearby. Today the dominant industry of MT Molloy is now cattle grazing and consists of a few shops and an old hotel. It also contains a high proportion of small acreage of "lifestyle blocks", and can be described as peri-urban in character.

Mutchilba is a small farming settlement, situated on the Walsh River, 11km from Dimbulah. Its population was 410 people at the 2011 census. However it is estimated that if the wider farming district is accounted for, the population of Mutchilba is closer to 1,000 (source).

Watsonville is a smaller historic mining community, located on the Walsh river 11km from Irvinebank. At the 2011 Australian Census the town recorded a population of 344. This area and community is often described as the Irvinebank/Watsonville area, as the two small centres are closely linked.

2. DEMOGRAPHICS



While the Northern Tablelands is by far the smallest in terms of land areas, it is by far the largest, as represented by this pie chart, in which Mareeba Shire accounts for 50% of the Northern Gulf NRM region's entire community.

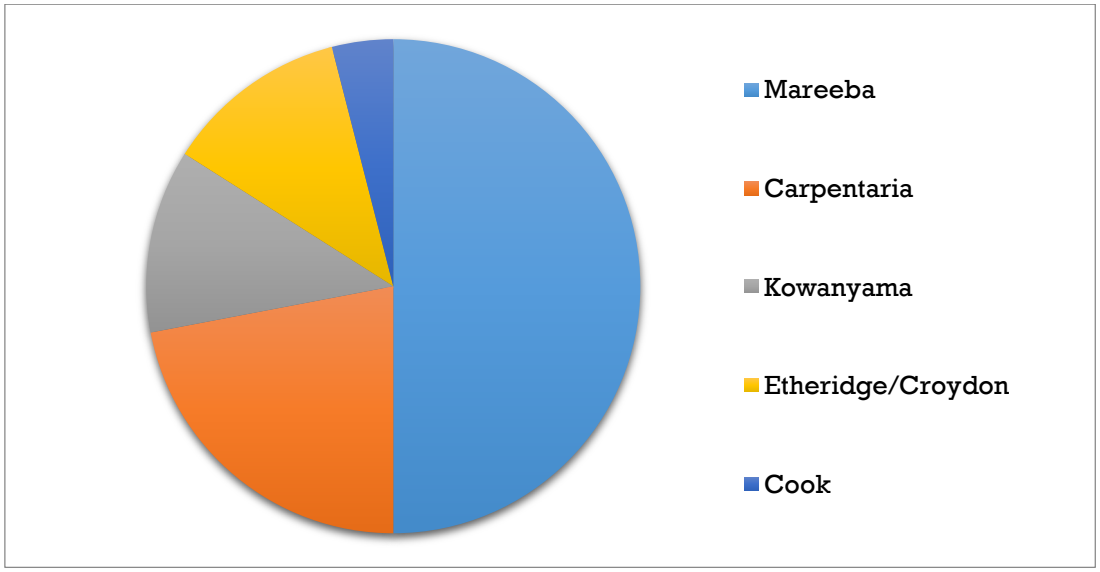


FIGURE 1: THE SHIRE'S AREAS AS A PERCENTAGE OF THE NORTHERN GULF REGION

3. SOCIAL ASSESSMENT

3.1 EMPLOYMENT

At the 2011 Census there were 1,633 employed persons in the Northern Gulf Tablelands region. Industries of employment were as shown in Graph 9 below:

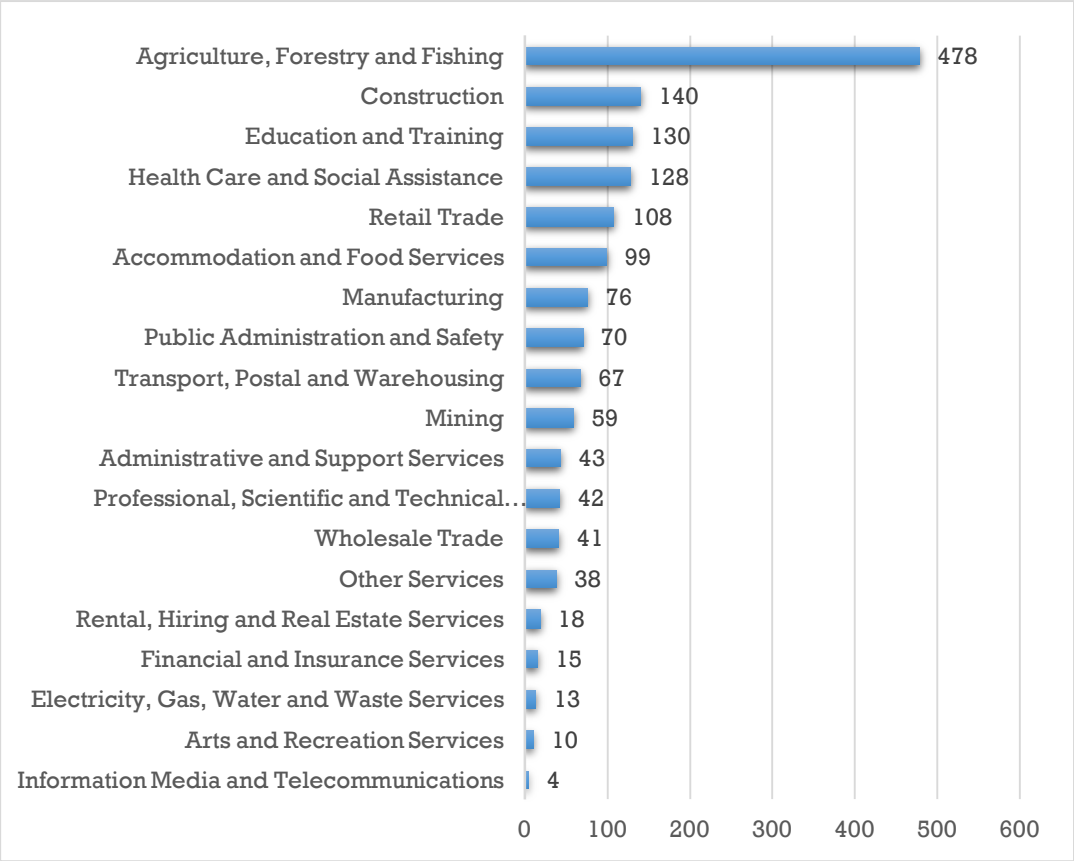


FIGURE 2: NORTHERN GULF TABLELANDS, EMPLOYMENT BY INDUSTRY, EMPLOYED PERSONS (USUAL RESIDENTS) AGED 15YRS AND OVER

Source: ABS 2011 Census, usual residents, Basic Community Profile

Of all employed people at the time of the 2011 Census in the Northern Gulf Tablelands region, 29.3% were employed in Agriculture, Forestry and Fishing. The top types of agricultural industry were:

TABLE 1: NORTHERN GULF TABLELANDS, TOP INDUSTRIES OF EMPLOYMENT IN AGRICULTURE, FORESTRY AND FISHING

Type of Agricultural Industry	Persons
Fruit and Tree Nut Growing	238
Other Crop Growing	59
Sheep, Beef Cattle and Grain Farming	51
Mushroom and Vegetable Growing	34
Agriculture, nfd	33
Agriculture and Fishing Support Services	15
Other Livestock Farming	12
Poultry Farming	8
Agriculture, Forestry and Fishing, nfd	6
Nursery and Floriculture Production	5
Aquaculture	3
Forestry and Logging	3
Fishing	3

Source: ABS 2011 Census, usual residents

3.2 INCOME

TABLE 2: REGIONAL AGE AND INCOME LEVELS

Community	Population	Median age	Median Weekly Income
Dimbulah	1,414	42	$371 (personal)
Biboobrah	554	43	$464 (personal)
Julatten	998	46	$424 (personal)
MT Molloy	273	44	$505 (personal)
Irvinebank/ Watsonville	344	49	$342 (personal)

Source: ABS, 2011

3.3 HEALTH AND WELL-BEING

Rural workers have relatively high levels of psychological distress. While much attention has been focused on those working on farms, the rural unemployed also have high levels of distress. Early intervention and vocational rehabilitation programs should be developed in rural communities to serve this hard-to-reach, but needy, rural population (Frager et al 2010).

Suicide in Queensland between 1999-2001 provided an indicator of the extent of variance in mental health status between metropolitan, rural and remote areas. Mortality rates for males in rural areas (42.3 per 100,000) were significantly higher than male rates for metropolitan areas and Queensland as a whole. Regional rates for males and all persons were significantly higher than those from counterparts in metropolitan areas (De Leo & Heller 2004 in Kreger & Hunter 200**5).**

3.4 Education

Between 2001-2011, the share of persons with a bachelor degree or higher in the Northern Gulf increased from 16.4% to 17.8%, but is still well below the Queensland average (Qld Government 2014). Of males aged between 25-44 in the Northern Gulf, 65.2% had a non-school qualification (eg. a bachelor degree or diploma). Only 55.4% of females aged 25-44 had a non-school qualification. This discrepancy is significantly larger than that of Queensland as a whole (Qld Government 2014). The fields of study with the largest share of non-school qualifications in the Northern Gulf in 2011 were Engineering and related technologies (16.0%), Management and Commerce (9.6%), and Society and Culture (7.3%). Only 4.6% of non-school qualifications were in Agriculture, Environmental and related studies (Qld Government 2014). Rate of school and post-school education in the Northern Gulf region is lower than the Queensland average (OESR, 2010).

This comparison indicates that education levels are higher in the Northern Tablelands than the other NRM sub-regions, largely attributable to the large number of peri-urban residents, many of whom are like to be professionals relying on off-farm income.

The Northern Tablelands contains six primary schools, listed in the table below.

TABLE 3: NORTHERN TABLELANDS PRIMARY SCHOOLS

School	Student population (2015)
Dimbulah state primary school	150
Irvinebank state primary school	6
Julatten state primary school	57
Muthchilba state primary school	23
MT Molloy state primary school	31
St Anthony's Catholic primary school	50
TOTAL	317

While the Northern Tablelands does not have any high school facilities, the region does benefit from services in the wider Tablelands and Cairns region, many of which are a practical day commute to Northern Gulf Tablelands communities.

3.5 Housing

In the 12 month period ending in March 2014, there were 120 approvals for building new houses and total value of residential building approvals was $36.2million. Of these approvals, 92 ($26.4million value) were in Mareeba (Qld Government 2014).

3.6 Social Services

Much of the region's population and businesses are reliant on larger settlements outside of the region (Mareeba, Atherton and Cairns) for various essential and non-essential services (NGRMG 2008). However due to the close proximity to these services, this is a practical arrangement for many Northern Tablelands residents, many of whom commute to work in these same centres. However in past engagement activities, lack of aged care (pensioners) housing has been highlighted as an issue, as many elderly people need to move to Cairns to access age and ability appropriate housing, although they do not wish to leave their own communities (TRC, 2012).

4. INDIGENOUS VALUES AND COMMUNITY

4.1 BAR BARRUM

The Bar Barrum people are the Traditional Owners of an area which extends from south of the Wash River, including the townships of Dimbulah and Mutchilba, and includes Petford through to the Irvinebank/ Watsonville area. They have a native title determination over an area of land of 316.4 sq.km (issued 28/06/2001).

While the Bar Barrum Aboriginal Corporation did not participate in NRM Planning, the Mbar Barrum people did. The Mbarbarrum are a clan within the wider Bar Barrum group, with affiliations with the Watsonville area and the upper Walsh River. They have formed the Watsonville Aboriginal Corporation to pursue their aspirations on country as Traditional Owners. Their strategic planning exercise was a review of an existing strategic plan undertaken several years ago. The strategic priorities identified through this process include:

1. Greater self-determination over Native Title lands;
2. Addressing illegal camping and squatting along the Walsh River;
3. Developing a camping block with ablutions to protect water quality;
4. Signage with Mbar Barrum cultural protocols;
5. Designated walking tracks;
6. Preserving Mbar Barrum language through the development of books and CDs.
7. Acquiring unallocated state land within their country (and subject to Native Title claims) ;
8. Ground truth regional ecosystem maps;
9. Conducting biodiversity surveys;
10. Rehabilitating country affected by abandoned mines.

4.2 DJUNGAN

The Djungan (or Kuku Djungan) are the Traditional Owners of an area which spans north of the Walsh River in the Dimbulah/Mutchilba area and goes north to borders with Western Yalanji lands. Notably, Djungan country includes the very significant site of Mt Mulligan, an iconic and distinctive escarpment west of Mt Carbine.

An area of about 1,490 square kilometres about 60 kilometres north-west of Mareeba in Queensland is under Native title through the Nguddaboolgan Native Title Aboriginal Corporation, which is the prescribed body corporate that represents the Djungan people.

The Djungan People's rights were recognised by the Federal Court of Australia to more than 182,000 hectares of land in North Queensland. The land includes Land Act reserves, pastoral leases and some leasehold and unallocated State Land situated in and around Mount Mulligan, west of Mareeba.

The Nguddaboolgan Native Title Aboriginal Corporation did not participate in the NRM Planning process.

4.3 MULURIDJI

Muluridji traditional country includes 12,030 ha north-west of Mareeba, including the Hann Tableland National Park, Mareeba Tropical Savanna and wetland reserve at the headwaters of the Mitchell catchment.

Muluridji people have Native Title rights and interests to 12,030 hectares of land and waters in the locality of, and to the north-west of Mareeba. The area includes Hann Tableland National Park, Mareeba Tropical Savannah, Wetland Reserve and unallocated state land, pastoral leases and other reserve lands. The Muluridji People hold exclusive Native Title rights in relation to 745 hectares of land and 11,285 hectares of non-exclusive rights.

The Muluridji Aboriginal Corporation has a new board of directors after being placed under administration. They are optimistic about the future and the opportunities to embark on a "new journey" by embracing opportunities, "focusing on what they can do and pulling the mob together in a positive way".

Some strategic priorities identified include:

1. Establishing a Muluridji office;
2. Negotiating to acquire land;
3. Developing a ranger program;
4. Traditional Knowledge recording;
5. Developing Muluridji language resources such as books and courses;
6. Working with job agencies to get Muluridji people working with wildlife;
7. Ensuring that elders are not isolated.

MULURIDJI

OUR GOALS	OBJECTIVE
UNIFY THE MOB	We want to focus on the positive things, have fun together, and bring our families closer for the benefit of our children and country
SELF SUFFICIENCY	To manage our funds carefully and to raise money for our organisation, projects and Muluridji community
SELF DETERMINATION	To have control in the decisions that are made that affect our people, country and customs
NATIVE TITLE	Ensure the rights of our people are actively applied and within our mob establish agreement of our clan estates as the basis of governance and engagement in decisions
CARE FOR CULTURE	Protect and practice our customs
CARE FOR COUNTRY	Protect and manage the natural balance of land, water and wildlife
GOVERNANCE	That the organisation serves the interests of the Muluridji people as well as remaining compliant with meetings, reports and law
LOOKING AFTER YOUTH	To grow the understanding and knowledge of our country, custom, lore, pride and happiness in our youth
LOOKING AFTER ELDERS	To make sure our old people are not lonely
PARTNERSHIPS	To work cooperatively with others to achieve our goals
SPIRITUALITY	To heal the souls of our people of the 'hurt' they feel by reconnecting with our land and custom

MULURIDJI

THE ORGANISATION

The Muluridji Tribal Aboriginal Corporation is a Prescribed Body Corporate (PBC), also more formally known as Registered Native Title Body Corporate (RNTBC). When the Muluridji determination recognising Native Title was made, the Native Title Act required that the Muluridji Traditional Owners establish a corporation to represent our interests.

Currently our PBC has had directors appointed by ORIC. This appointment follows the special administration period that our corporation was placed under in December 2013. The organisation was placed into special administration after the Registrar and an examination in August 2013 revealed that internal disputes were affecting the governance of the corporation. Following the end of special administration in May 2014 a new board of directors were appointed to take the corporation forward, including two independent directors. Importantly, the special administrator secured funding from the North Queensland Land Council (NQLC) to support Muluridji's Native Title functions and engaged an external bookkeeping service to ensure the financial accounts are kept up-to-date.

The rule book of the corporation has also been reviewed and redrafted to better reflect membership eligibility and the corporation's important Native Title functions. The corporation is set to move forward as the Native Title representative body for the Muluridji people.

This Strategic Plan outlines our Vision and our Mission as the pathway for our new journey, and the values we use to represent our mob as we travel down this new pathway. We have also identified strategies that if we can action together will make this journey prosperous and fun for all. We owe it to the struggles that our families have been through, the honour we have for our ancestors and the determination we have for our children to come to make the most of this organisation and the strategies in this Strategic Plan. We need to come together, focus on the things we CAN do, and be unified so that we can do good for our mob.

MULURIDJI STRATEGIC PLAN

This Strategic Plan begins a new journey for the Muluridji people and is made with good intention to embrace our opportunities, focus on the things we can do, and pull
our mob together in a positive way. Our future, and the legacy we leave our children, starts today.

OUR NATIVE TITLE

In 2011 the Federal Court of Australia recognised the Muluridji people's Native Title rights and interests over 12,030 hectares of land and waters north-west of Mareeba. Our PBC has a significant role to play in the management of our land and water. We also need to operate effectively so that we can discharge our land management obligations, participate in the future Acts' processes and take advantage of opportunities to derive economic and other benefits from Native Title.

Our Native Title Determination area includes the Hann Tableland National Park, Mareeba Tropical Savannah, Wetland Reserve and unallocated state land, pastoral leases and other reserve lands. We hold exclusive Native Title rights in relation to 745 hectares of (where we control access to the land) and 11,285 hectares of non-exclusive rights (where we do not control access to the land). The nature and extent of the Native Title rights and interests existing in the balance of the determination area are as follows:

- the right to access and be present on the area, to hunt, fish and gather on the land and waters of the area for personal, domestic, and non-commercial communal purposes; and
- to maintain places of importance and areas of significance to the Native Title holders under their traditional laws and customs.

DEVELOPING THE STRATEGIC PLAN

Letters were sent to all addresses held by the PBC as members of the organisation inviting them to an initial workshop which was held in Mareeba (July 2014). The workshop produced plans and strategies but there was a desire to allow as many Muluridji people as possible to participate. Therefore this Plan is here as a Draft with ongoing consultation to take place.

OUR VISION

We will have a unified voice and to the best of our knowledge and ability we will be upholding the lore/law, rites/rights, traditional customs and practices for our people and country while maintaining our custodial rites in providing a sustainable future for all our people.

OUR MISSION

We will empower our Elders and our People to have a strong belonging and kinship so that together we share and maintain our lore and custom and cultural responsibilities to land and family with integrity.

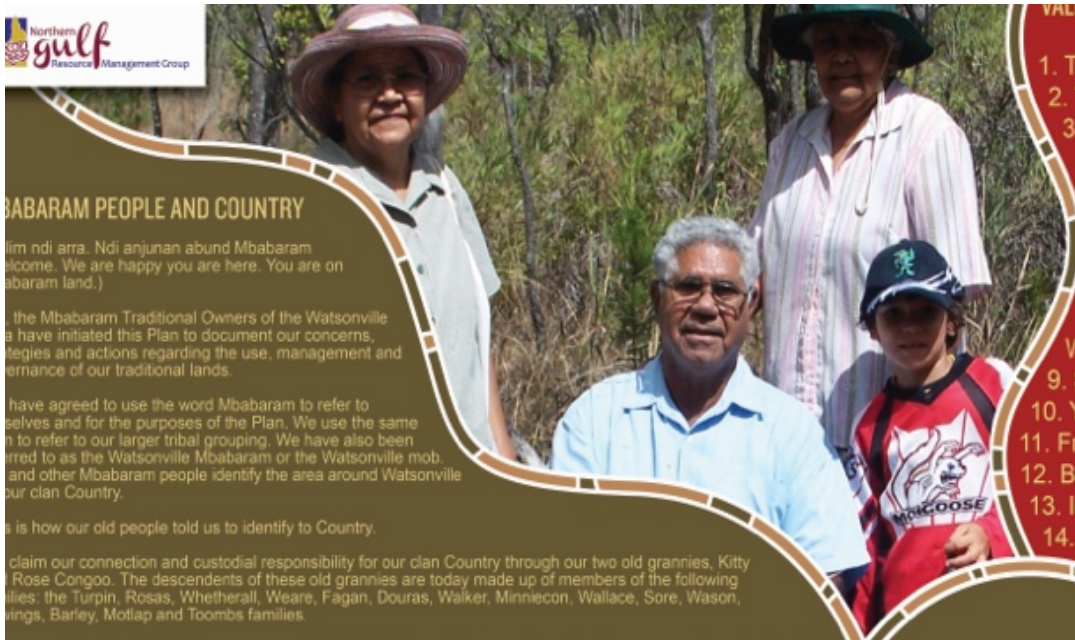
OUR VALUES

- We value honesty
- We value Integrity
- We value our family and kinships
- We value respect for others and ourselves
- We value the wellbeing of our mob and customs
- We value our country
- We value our spirituality and our connections
- We value our custodial rites and lore
- We value the need to be confidential and protect some of our cultural knowledge
- We value caring for and protecting our sacred sites, stories, art, language, music and dance
- We value caring & sharing between our mob & with others
- We value money in terms of being self-sufficient and careful and having funds to do the things we want to do for our mob
- We value our history – the past, recent and present
- We value our future generations and the acknowledge the long term consequences of our decisions and behaviours of today
- We value education, knowledge and skills

OUR ETHOS

- We will support each other
- We will work in partnership with others
- We will respect each other
- We will act with courage and boldness
- We will act with prior knowledge and inform ourselves of all view points
- We will be culturally appropriate and sensitive
- We will share decision making
- We will have commitment for our Muluridji mob and organisation
- We will delegate and share responsibilities

MBABARAM



BABARAM PEOPLE AND COUNTRY

lim ndi arra. Ndi anjunan abund Mbabaram
lcome. We are happy you are here. You are on
abaram land.)

the Mbabaram Traditional Owners of the Watsonville
a have initiated this Plan to document our concerns,
tegies and actions regarding the use, management and
ernance of our traditional lands.

have agreed to use the word Mbabaram to refer to
selves and for the purposes of the Plan. We use the same
to refer to our larger tribal grouping. We have also been
rred to as the Watsonville Mbabaram or the Watsonville mob.
and other Mbabaram people identify the area around Watsonville
our clan Country.

s is how our old people told us to identify to Country.

claim our connection and custodial responsibility for our clan Country through our two old grannies, Kitty
Rose Congoo. The descendents of these old grannies are today made up of members of the following
ilies: the Turpin, Rosas, Whetherall, Weare, Fagan, Douras, Walker, Minniecon, Wallace, Sore, Wason,
ings, Barley, Motlap and Toombs families.

are anxious about upholding our responsibilities to Mbabaram Law passed on to us by our ancestors. Our Country
tains many important cultural landscapes and special places and a great diversity of animals, plants and natural places
we want to protect and manage. We continue to visit our Country, we still hunt and fish our Country, we use the
ural resources of our Country, we protect our cultural heritage and we continue to teach our children about
abaram language and culture. All of these things come together as part of our culture and
ntity as Mbabaram.

VALUES OF MBABARAM

1. To honor our elders and the roles they have played
2. To have a leadership role and to respect and be respected
3. To maintain integrity and respect with the other stakeholders
4. Our people on our country looking after our country
5. To heal our generational trauma, spirit, soul and body
6. Respectful of old culture but accepting of new methods (culture is dynamic)
7. We need to connect families
8. Include Mbabaram as a whole – not just Watsonville
9. Self determined - running Country as we see fit.
10. Younger generations
11. Freedom
12. Belonging
13. Identity
14. Sharing

CREATING ECONOMIC DEVELOPMEN OPPORTUNITIES

Strategy – Determine the feasibility of establishi economic enterprises on Country.

Actions:

- Consult with the Bar Barrum Aboriginal Corporati and the North Queensland Land Council to determi the legality of establishing enterprises on Mbabara Native Title determined lands.
- Establish partnerships with business service provid to assist business developments.
- Consult with the Tablelands Regional Council, an other relevant authorities to canvass approval processes.
- Develop decision making process for ethical/appropriate business approvals on country (policies and procedures)
- Establish business training for interested Mbabaram people
- Develop marketing strategy (research the market

PRINCIPLES

The following principles were developed with the 20 Traditional Owner groups (whose Country falls within the Wet Tropics bioregion) during the consultation phase for the development of the Regional Natural Resource Management (NRM) Plan and the Aboriginal Cultural and Natural Resource Management Plan. The principles were reaffirmed and modified during the development of this Strategic Plan. Recognition and support for these principles by government and non-government agencies, industry and community groups who wish to engage with the Watsonville Mbabaram, is the foundation for the development of equitable partnerships for managing cultural and natural resources on Mbabaram Country.

(1) The Wet Tropics NRM region is recognized as a diverse set of living Aboriginal cultural landscapes of 20 Traditional Owner groups of which the Mbabaram are one.
(2) The Mbabaram people are recognised as the Traditional Owners of Country with ongoing rights and obligations in the Watsonville area.
(3) It is a core protocol of the Mbabaram people to be involved in cultural and natural resource management at all stages of project planning, from inception through to implementing and monitoring. This is a core protocol for all all cultural and natural resource management activities.
(4) The Mbabaram people's protocols for cultural and natural resource management of their Country must be acknowledged by all and co-funded and adopted by other stakeholders and partners.
(5) The intellectual and cultural property rights held by Mbabaram people are respected in all cultural and natural resource management activities.
(6) Native Title rights and Mbabaram lore is properly negotiated and adopted by all stakeholders.
(7) Mbabaram knowledge of Country is recognised as being parallel to and included in mainstream scientific knowledge systems in cultural and natural resource management activities.

REVITALISING & STRENGTHENING THE MBABARAM LANGUAGE

Strategy – Determine the current state of the Mbabaram language.

Actions:

- Seek verification of intonation and authenticity of tone.

Strategy – Implement an Mbabaram language program.

Actions:

- Prepare books and CD's of language
- Linguistics workshops for young and old
- Update and modernise tools in education kit
- Re-record CD's.

Strategy – Increase the use and awareness of the Mbabaram language

Actions:

- Train/increase linguistic knowledge within Mbabaram (train the trainer)
- Protect intellectual property of language and properly archive records
- Promote the use of the Mbabaram language through community awareness and educational campaigns.
- Develop culturally appropriate signage on country.

Mbabaram Traditional Owners are working in collaboration with the Centre's staff to implement the strategies and actions. It is crucial that the work done links into the language database component of the Cultural Heritage

Australian Governmen

This project is supported Northern Gulf Resou Management Group through funding f the Austra Governm

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MBABARAM

USING AND MANAGING COUNTRY

Mission: "Putting back together what was broken apart"

We need to heal our people, culture and country and empower ourselves so that we drive and determine our own decisions and future management.

- Community re-established on Country with families reconnected with a strong sense of belonging, purpose and future.
- Armed with knowledge, skills and capacity to strengthen our authority to control activity on our lands and stop squatters and abuse of land and culture.
- Our old culture will be preserved and there will be respect for ancestors.
- Our culture will be practiced, and Country and family celebrated.
- Young people will love and live with cultural values and principles instilled but will also have flexibility to be dynamic and adapt as life changes.
- We will have created and implemented economic opportunities that generate income for our organisation, projects and families.

LOOKING AFTER AND MANAGING COUNTRY

Major concerns:

- No ablution blocks on sites hence concerns for water quality
- Squatters continue to build and remain on Mbabaram Country
- No signage. Any signage proposed would need to take into account Mbabaram cultural protocols.
- No designated walking tracks

Strategy - Develop Management Plans for the four identified areas

Actions:

- Prioritise concerns and develop an interim action plan.
- Incorporate action plan and implementation of management strategies within the Cultural Heritage Assessment and Management project.

HEALING GENERATIONAL TRAUMA

Strategy – Get people together on Country a talk

Actions:

- Run healing on Country programs.
- With permission, document the story for family sharing (audio recording capacity needed).
- Regularly have 'day out' on Country and maintai database on family contacts for invites and communications.
- Set up a closed Facebook site for family discussion
- Establish a fund for scholarships as part of an education program.
- Look at cemetery options and by-laws to have a special resting place for Mbabaram.
- Apply for funds and build toilets and showers fo Mbabaram camping ground.

To heal the traumas brought on our mob from th past that have transferred to our current generations we need to be on Country.

IMPLEMENTING THE STRATEGIC PLAN

ues, Strategies and Actions for working on Country.

implementation of the Plan overall will require co-ordinated action driven by the Mbabaram people and with ticipation from government and other stakeholders.

roving Governance

ategy – Strengthen the current governance arrangements to ensure that there are solid ndations to progress the aspirations of the Watsonville Mbabaram.

ions:

ncourage Mbabaram representatives to sit on key indigenous and non-indigenous tnership groups.
rengthen the current governance arrangements of the Watsonville riginal Corporation
rengthen the Watsonville Mbabaram representative arrangements on the Bar rum Aboriginal Corporation
eet with Department or Natural Resources and Mines to get full derstanding of how to acquire 'ownership' of Watsonville 'State' land.
ontinue to engage with the Mitchell River chment group, NRM bodies and ntify opportunities that can duplicated on abaram Country.
vestigate portunities to ure funds to ablish an ce.
gage young ple to ticipate & with etings.

Strategy –
Participate in country rehabilitation

Actions:

- Develop partnerships with stakeholders to manage and rehabilitate country such as Rural Fire Brigade, Irvinebank Landcare, Mining companies etc
- Seek opportunities for ranger programs

Strategy – Minimising the threats to Cultural Heritage & Biodiversity

Actions:

- Ground truth regional ecosystems
- Document threats to endangered or 'of concern' regional ecosystems
- Conduct surveys to identify threats to cultural sites and the region's biodiversity

MANAGING THE REGION'S CULTURAL AND NATURAL HERITAGE

Strategy – Increase and protect the number of plant and animal species

Actions:

- Compile existing information on plants and animals listed under the Queensland Nature Conservation Act and the Commonwealth Biodiversity Conservation Management Act.
- Conduct surveys and map results detailing number and distribution of species

Strategy – Protect and preserve culturally significant landscape features

Actions:

- Identify culturally important sites
- Identify culturally important features
- Map the important sites and features

Strategy – Increase and protect the number of culturallysignificant plants and animals

Actions:

- Consult with Elders to determine culturally significant plants and animals
- Conduct a literature search to obtain regional information on these species
- Conduct surveys and map results detailing number and distribution of species

A DESCRIPTION OF THE NATURAL VALUES OF THE WATSONVILLE AREA.

The Traditional Country of the larger Mbabaram mob straddles the Great Dividing Range at the head waters of the Walsh and Herbert Rivers. It extends west from the Wild River to the Mount Garnett region, north to the Walsh River and Rocky Creek near Mareeba & includes the townships and settlements of Mount Garnet, Herberton, Emuford, Watsonville, Dimbulah, Mutchilba, Leafgold, Petford, Irvinebank, Lappa Junction and Almaden. It is recognized as a unique area of great natural beauty & biological diversity. The Watsonville area in particular is a unique place for flora with many species only found in this area of Queensland and most notably the Purple Wattle, (Acacia purpureopetala) & Grevillea Glossadenia.

The area is traversed by a unique geographical feature, the Great Dividing Range, and is joined to features in this landscape and to the west to Undara, by very ancient volcanic formations.

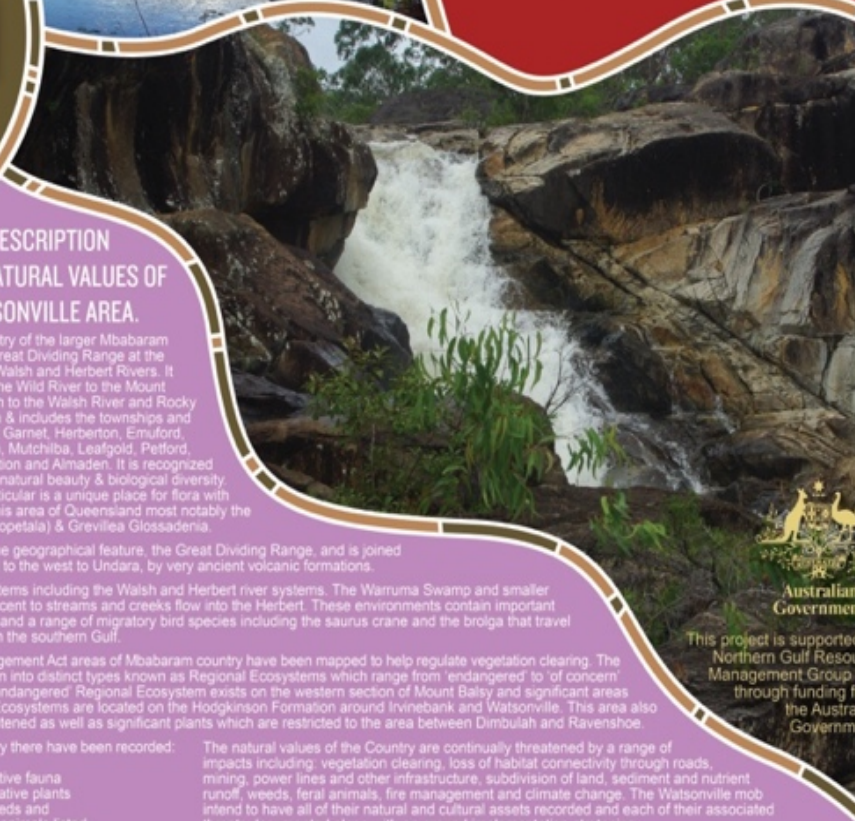
It has a range of aquatic ecosystems including the Walsh and Herbert river systems. The Warruma Swamp and smaller seasonal swamps in areas adjacent to streams and creeks flow into the Herbert. These environments contain important habitat for fish, turtle, platypus and a range of migratory bird species including the saurus crane and the brolga that travel from their breeding grounds in the southern Gulf.

Under the Vegetation Management Act areas of Mbabaram country have been mapped to help regulate vegetation clearing. The mapping places vegetation into distinct types known as Regional Ecosystems which range from 'endangered' to 'of concern' or 'not of concern'. An 'endangered' Regional Ecosystem exists on the western section of Mount Baisy and significant areas 'of concern' Regional Ecosystems are located on the Hodgkinson Formation around Irvinebank and Watsonville. This area also has a number of threatened as well as significant plants which are restricted to the area between Dimbulah and Ravenshoe.

For Mbabaram country there have been recorded:

(1) 436 species of native fauna
(2) 1450 species of native plants
(3) 102 species of weeds and

The natural values of the Country are continually threatened by a range of impacts including: vegetation clearing, loss of habitat connectivity through roads, mining, power lines and other infrastructure, subdivision of land, sediment and nutrient runoff, weeds, feral animals, fire management and climate change. The Watsonville mob intend to have all of their natural and cultural assets recorded and each of their associated



Australian Governme

This project is supporte Northern Gulf Reso Management Group through funding f the Austra Governm

5. ENGAGEMENT OUTCOMES

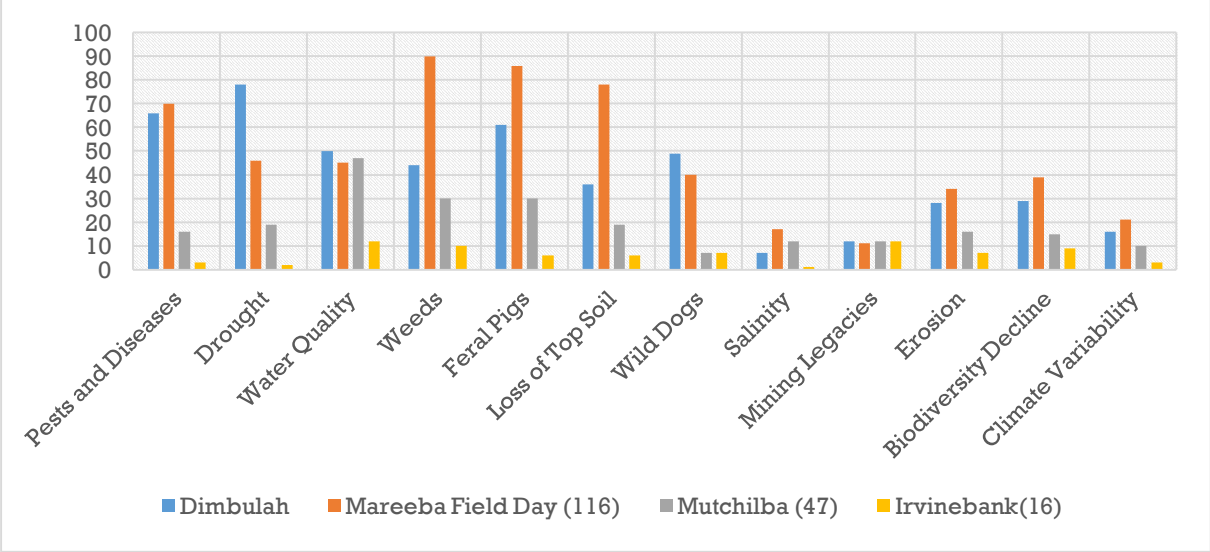
The Northern Tablelands engagement involved the following activities:

27-28 May	Mareeba Rotary field day
13 June	Eureka Creek Rodeo- Dimbulah
3 July	Mutchilba Social evening
5 July	Irvinebank Community BBQ
6 July	Gulf kids in Ag – Mt Molloy
1 August	Mt Molloy Community BBQ and market stall
12 August	Tablelands NRM Dilemma's workshop- Dimbulah Memorial Hall
13 August	Julatten & Mt Molloy Area Residents and Ratepayers Association (JAMMARR) meeting
30 August	A day at the swamp- Abbatoir swamp, Julatten
31 August	Mareeba District Fruit and Vegetables Growers Association meeting

The Northern Tablelands engagement targeted local community events across the Irvinebank-Watsonville, Dimbulah, Mutchilba, Julatten and Mt Molloy districts, including consulting a range of different horticultural industries as well as peri-urban and town based communities.

STICKER DOT SURVEY

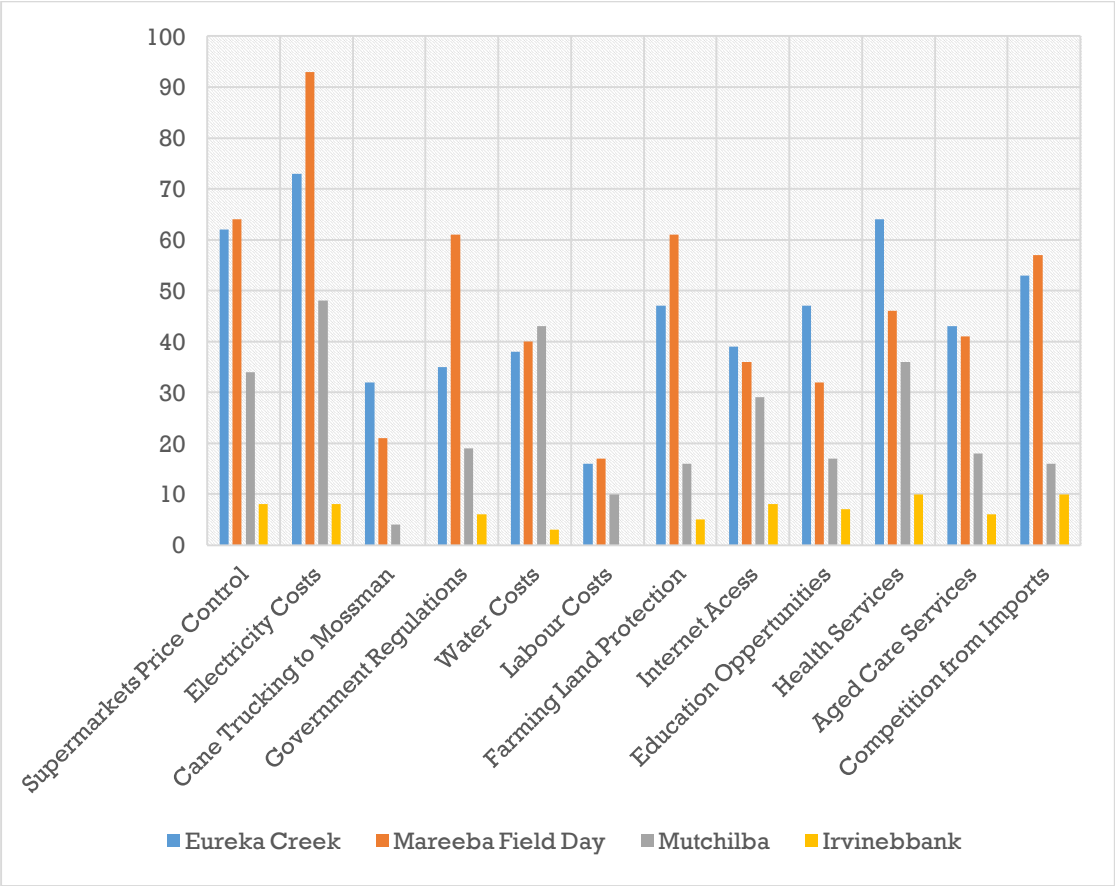
5.1 ENVIRONMENTAL PRIORITIES



Biosecurity issues dominated the results for the sticker dot survey for the Tablelands, with loss of top soil and drought also consistently ranking high, particularly in drier areas such as Dimbulah. Mining legacies was a low priority with the exception of Irvinebank, where it was one of the highest. Salinity ranked quite low which indicates that while the problem is quite bad, effects are localised and the broader Tablelands community has low awareness of the issue. Wild dogs also featured highly in both Dimbulah and at the Mareeba Rotary field day.

5.2 COMMUNITY PRIORITIES

Electricity costs appeared as the number one concern amongst the farming communities of Dimbulah, Mutchilba and the Mareeba rotary field day participants. Other prominent results around competition from exports, supermarket price control and farming land protection indicate that farmers are feeling pressure to maintain healthy margins in the context of a range of commodity price pressures. Water costs and government regulations came through as mid-range concerns, whereas labour costs do not appear to be a problem.



Please note: Julatten and Mt Molloy results still to be entered.

5.3 TABLELANDS NRM DILEMMAS WORKSHOP

On the 12th August 2015, 30 stakeholder representatives from across the Tablelands convened in Dimbulah to prioritise and deliberate on NRM dilemmas across the Tablelands sub-region of the Northern Gulf, which includes the combined districts of Julatten and Mt Molloy, Dimbulah, Mutchilba and Irvinebank and Watsonville, and also contains the Mareeba Dimbulah Irrigation Area (MDIA), which support the horticultural industry sector of the Walsh sub catchment.

The sectors and organisations which were represented at this workshop included:

1. Julatten community centre
2. Julatten and Mt Molloy Area Residents and Ratepayers
3. Dimbulah community centre
4. Irvinebank Progess Association
5. Mareeba District Fruit and Vegetable Growers Association
6. Banana council
7. Tablelands cane growers
8. Mareeba Shire Council
9. Queensland Department of Agriculture and Forestry
10. Terrain NRM (neighbouring NRM region, which includes part of the MDIA).

The top dilemmas were rated as (in order of highest to lowest rating):

1. How can we change practices which result in a decline in water quality through the Walsh River?
2. Will we have water security issues into the future? How can these be resolved?
3. How can we protect our food production systems from bio-security threats such as disease, weeds and pests?
4. How can we address the rising salinity in the Arriga Plains?
5. How can we physically improve our soil and water quality?
6. How can we protect our production systems from erosion and soil fertility decline?

5.3.1 KEY MESSAGES

1. How can we change practices which result in a decline in water quality through the Walsh River?

Water quality in the Walsh River is influenced by several point sources and diffuse sources of contamination. This major sub-catchment of the Upper Mitchell supports the most population and intensive agriculture of our region - both currently and historically - and as such is the most compromised in the Northern Gulf region in terms of its environmental health. Given its significance, it is perhaps unsurprising that it emerged from the prioritisation process at the workshop as the number one NRM dilemma.

Impacts on water quality come from mining at its head waters in the Irvinebank/Watsonville area, including active and abandoned mines of various scales. It is also degraded by weeds such as rubber vine, belly ache bush; giant rats tail grass, which damage and undermine riparian health. Run-off from chemical fertilisers, pesticides and herbicides and sediment, as well as rising salinity profiles of groundwater in the catchment, are all drivers of environmental decline of this river system. Outdated irrigation practices are exacerbating these problems.

The question was raised during the discussion over whether water from the Walsh River is over- allocated, further compromising the health of this river system.

Wet season impacts of mining activities and dams and holding ponds associated with mines over flowing were discussed.

Climate change impacts could compound environmental problems by creating more stagnant water in the projected drought conditions (changing the pH of the water) and reducing aquatic biodiversity values.

Opportunities to improve this important environmental asset included more grower education, improved nitrogen use efficiency and reductions of chemical use. Other opportunities for change include improved road work construction practices from council works crew, as well as limits on extractive industries and continued reductions of over watering crops.

2. Will we have water security issues into the future? How can these be resolved?

Water security was the second highest ranking priority, and specifically relates to predicted climate change impacts, and the associated potential for diminishing water supplies. On an area highly dependent on irrigation as the natural resource base for the economy and employment, this is clearly a strong concern among the community.

The influences on water security and ongoing supply include modes of storage and distribution, land use patterns and regional population growth (including Cairns), water quality, water cycles and climate and rainfall variability. The water needs of the types and diversity of crops also has implications for water security.

The security of water supply will influence rates of production, and consequently the economic vitality and prosperity of individual properties and the whole Northern Tablelands region. The health and abundance of water in this system will also influence ecosystem functions and services.

Current instruments for managing water security include water resource plans and allocations, and channels and distribution systems. Opportunities to improve water security include the modernisation of these schemes, as well as alternate water sources such as Nullinga dam and more bores. However the main influence that NGRMG can have on this matter is to continue our work in irrigation use efficiency to reduce wasteful practices, and work closely with service providers such as Sunwater, and individual growers on water conservation and efficiency advances.

3. How can we protect our food production systems from bio-security threats such as disease, weeds and pests?

Strategies to protect agricultural land from disease included maintaining good soil health. In terms of weed threats, NGRMG could work more closely with other agencies such as Council and Sunwater to manage their weed responsibilities on their own land.

The development of a regional plan to address weeds was raised as a solution, which includes all stakeholders, and provides emergency response plans and funds for early interventions on emerging biosecurity threats.

Education is a key need in terms of combating new and existing weed and pests, as currently the state government has very little resources to support community education. This is a key role that NGRMG could fill in the future.

4. How can we address the rising Salinity in the Arriga Plains?

This topic focused on the rising salinity profile in the Arriga Plains, which is the primary NRM concern of the Tablelands cane industry, and possible strategies to address it.

Currently the problem of rising salinity is becoming increasingly exacerbated by current agricultural practices, and resulting in the loss of high quality agricultural land.

Opportunities for change include improving water use efficiency and changing irrigation practices from flood to trickle, which NGRMG is currently engaged in promoting through their Tropical Agriculture Program. Focus also needs to be given to improving aging water infrastructure, including leaking channels and balancing ponds. Improved ground water monitoring and crop diversification, including developing salt tolerant cane varieties was discussed.

Identifying areas to target for tree planting using native plants was raised. NGRMG has recently completed two such projects. There are currently several agencies actively engaged in this area including Tableland cane growers, Department of Natural Resources and Mines (Qld) and Sunwater. Opportunities exist to expand our efforts to date through better alignment with these partners, plus growers themselves.

5. How can we physically improve our soil and water quality?

Soil health in the MDIA is declining, and the need for a more long term perspective on maintaining soil biology, fertility and health was discussed in this session. The decline of soil health is influenced by a combination of poor practices and agricultural pressures such as supply chains and the strangle hold of big food retailers. However the gradual decline or soil health and water quality is resulting in decreased production and ecosystem health and increased inputs & costs to growers.

Opportunities for change include containing irrigation water on farms (for water quality), crop rotation, inter-cropping with legumes, reduce to zero tillage, increased use of ground cover and mulches. Education clearly has a big role to play in these efforts. Embracing methods to increase soil biology through the use of composts and biodynamics has been successful in some operations, but it's generally spurned by mainstream farmers. NGRMG can continue to do useful work in this area.

6. How can we protect our production systems from erosion and soil fertility decline?

Once again, this dilemma focused on the agricultural industries of the Tablelands. Horticultural industries are concerned about productivity into the future and soil health and biosecurity issues are seen as significant threats. There is significant overlap from this dilemma and Dilemma 4 (improving soil and water quality), however other opportunities for change that were raised include:

- Providing land owner financial incentives to improve practices;
- Communicate industry best management practices;
- Support research and development into improving practices;
- Educate the benefits of maintaining soil fertility and reducing erosion.

5.4 Community survey- Northern Tablelands

NGRMG conducted an online and phone survey of the Northern Gulf community. 141 people in the region completed this survey. The results have been separated into Gulf Coasts, Grazing lands and Northern Tablelands for the purposes of the NRM Plan. There were 50 responses from the Northern Tablelands.

Of the Tablelands survey respondents, 30% were farmers and 21% were from small acreages, which is consistent with the mixed rural uses characteristic of this area. The two most commonly cited values for the area were water and then nature (also described as biodiversity, environment and wildlife) which indicates that the Northern Tablelands community put a high value on the natural landscape and resources of their region. Climate change came up often as what is changing about the area, including references to "hotter, less water and drought".

A total of 47% of respondents have been affected by natural disaster, and of these 58% listed cyclones and only 18% were drought affected, which compares starkly with the Grazing lands results. Also in contrast to the Grazing lands, 60% of respondents felt they got enough support through their natural disaster experience, but only 15% got support from NGRMG. The top impacts of natural disaster were 1- loss of income, 2- damaged infrastructure and 3- crop damage, which is consistent with cyclone impacts. Similarly to the Grazing lands, funding assistance and an information/communication role was identified for NGRMG as a post-disaster support service.

The most supported programs and funding priorities were tracking heavy metal contaminants in the Walsh River, then supporting school programs and finding a way to value ecosystem services (which is the same as the Grazing lands) followed by the need for better weather.

6. COMMUNITY RESILIENCE TO CLIMATE CHANGE

Primary industries employment is strongly impacted by cyclones and debt. Increased costs to industry associated with disaster recovery limits capacity to employ, expand, develop and grow. It is expected that there will be a higher unemployment rate and some degree of redeployment of workforce in response to climate change because changes to precipitation affect seasonal employment opportunities. There is new local realisation that farm assets and stock are vulnerable to more cyclonic and flood events. The primary industry sector has been and is providing stability to the regional economy however this sectors resource base is vulnerable to change and is impacted upon immensely by severe weather which, over the past number of years has been slower to recover and has resulted in an increase in farm debt (Dale 2014). However, the Northern Tablelands are less prone to cyclone damage than coastal areas, which is a factor that has contributed to more acreages of bananas being planted in the area (Mareeba Chamber of Commerce 2014).

Awareness levels of natural resource sustainability in the region have been benchmarked in eastern parts of the region (Emtage et al 2007), and some categories of NRM practices benchmarked. Surveys found that there are different types of farmers and that they differ systematically with respect to factors related to the climate change adaption. It identified three types of farmers: "cash-poor long-term adapters" (55% of the sample), "comfortable non-adapters" (26%) and transitioners (19%) (Hogan et al 2011).

The region is highly vulnerable to food and petrol shortages when main access roads are closed of flooded after major weather events such as cyclones. Cyclone Yasi (category 5) caused significant environmental and property damage between the east coastline and Mt Isa due to wind, flooding and torrential rain (Felderhof 2011). The environmental damage from Cyclone Yasi led to increased fuel loads and an increased wildfire risk (Felderhof 2011). Cyclones are fully covered by most insurers meaning most policy-holders claiming loss or damage from Cyclone Yasi were compensated by their insurers (AGT 2011). Following Cyclone Yasi some insurers increased their premiums by up to 300% (AGT 2011). Government NDRRA are relatively centralised, bureaucratic and inflexible, resulting in reduced betterment outcomes post-disaster.

Food security is vulnerable and the region is a net importer. More extreme events with flooding will make communities more vulnerable based on current limited transportation. On farm infrastructure assets that are annually increasingly vulnerable, could be better managed through real time data and information management of climate events (Dale, 2014).

7. Regional Drivers

7.1 Tropical Agriculture

The Tablelands agricultural production area, defined by the boundaries of the Tablelands Regional Council (TRC) and Mareeba Shire local government area in far north Queensland, covers an area of 65,000km². Most agricultural activity within the TRC occurs on the elevated, eastern highlands (6,000km²) from Julatten in the north, to Dimbulah in the west and to Ravenshoe in the south. Approximately one third of this area falls within the Northern Gulf NRM region (i.e. The Northern Tablelands). Tablelands agriculture includes a large diversity of plant and animal industries and production of both tropical and subtropical crops. Thirty-nine large agricultural industries were identified in the Tablelands region in 2010/11. These represent four industry groups: Tree crops, field crops, animal industries and lifestyle horticulture. The success and resilience of the Tablelands agriculture sector can be attributed to this industry diversity, which provides options to farmers to change crops and farming systems to adapt to market cycles and consumer demands.

There is wide variation in climate across the Northern Tablelands region, influenced by changes in altitude and the proximity of the Great Dividing Range. The western shed of the ranges in which the Northern Tablelands agricultural areas are located are hotter and drier. Winds from tropical cyclones are often of lower speed and are less damaging on the Tablelands than in adjacent coastal regions.

TABLE 4: CLIMATE AND RAINFALL CONDITIONS

District	Elevation (m)	Annual rainfall	Average temperature range (Co) -July	Average temperature range (Co) -January
Mareeba	400	918	21-31	11-25
Dimbulah	407	783	22-34	11-27

Source: Dickinson, 2012

The typical agricultural soils of the Mareeba/Dimbulah area are derived from granite and have inherent low fertility. Soil profiles for these soils often comprise a sandy loam/sandy clay loam over a red, structured, coarse sandy clay soil with a slightly acid pH.

Water for the Mareeba-Dimbulah Irrigation Area (MDIA) is supplied from Tinaroo Dam through an extensive network of channels and streams.

Agricultural industries realised a gross value of production (GVP) of over $404 million to the Tablelands economy for the 2010/11 financial year. This represents an increase in the GVP of the Tablelands agricultural sector of approximately 23% over the past seven years, when compared with similar estimates for the 2003/04 financial year. Of this figure, it is estimated that approximately $72million (20%) share falls within the Northern Tablelands sub-region of the Mitchell catchment.

7.1.1 Tree crops

Tree crop industries, valued at $220 million, are the largest component of the Tablelands agriculture sector. Field crops ($90 million), animal industries ($79 million) and lifestyle horticulture ($15 million) also contributed significantly to the local economy. The banana industry is now the most valuable agricultural industry on the Tablelands ($95.2 million), and is the dominant industry of the MDIA. Significant new areas have been planted and banana prices in late 2010/11 were high due to damage from TC Yasi to coastal banana crops (Dickinson, 2012).

The mango industry, representing the largest area of tree crops on the Tablelands was valued at $45.0 m. The Tablelands avocado industry has expanded in recent years although 2010/11 values ($29.0 m) were impacted by yield losses from TC Yasi. Other tree crop industries which have experienced significant growth over the past seven years include the citrus industry, particularly limes ($17.4 m), and the papaya industry ($15.6 m), which have both nearly doubled in size. Smaller Tablelands tree crop industries(include: lychee ($7.6 m), longan ($3.6 m), table grapes ($1.9 m), custard apples ($0.7 m), passionfruit ($0.5 m), macadamias ($0.4 m) and cashews ($0.2 m). Mixed fruits: carambola, jackfruit, dragonfruit, low-chill stone fruit, and persimmons were collectively valued at $1.0 m. Forestry plantations (Caribbean & hoop pine) were valued at $2.2m (Dickinson, 2012).

7.1.2 Field crops

The potato ($19.5 m), peanut ($6.0 m) and maize ($4.5 m) industries, all traditional, well-known Tablelands field crops, have experienced declines in value and area planted over the past seven years. The sugar ($27.9 m), grass seed ($6.7 m), legume seed ($3.0 m) and associated hay ($1.9 m) industries have remained relatively stable over this same period. Other important Tablelands field crop industries that have remained stable or have grown in value over the past seven years include: pumpkins ($6.5 m), mixed vegetables ($3.3 m), pineapples ($3.3 m), basil ($0.9 m) and melons ($0.8 m). The tea and coffee industries are valued at $2.6 m each. The tea-tree oil and mulch industry, which was in decline for many years, is now valued at $0.7 m (Dickinson, 2012).

TABLE 5: NORTHERN TABLELANDS AGRICULTURAL SECTOR – VALUE AND PRODUCTIVITY OF FARMS

Agricultural sector	Area (ha)	Number of farms	Volumes p.a	Net value p.a
Aquaculture	30	17	423 tonnes	$5,990,000
Avocado	850	70	6,300 tonnes	$28,978,206
Banana	1,272	33	34,660 tonnes	$95,188,720
Basil	38	9	729,600 bunches	$875,520
Citrus	402	250	6,672 tonnes	$17,384,357
Coffee	215	7	323 tonnes	$2,580,000
Custard apples	22	12	220 tonnes	$726,000
Flowers	40	28	4,995,000 stems	$3,996,000
Forestry plantations	3600	10	32,000 cubic m	$2,162,000
Grass seed	2,061	35	730 tonnes	$6,679,600
Hay	3,168	55	11,406 tonnes	$1,900,998
Honey	NA	124	117 tonnes	$386,595
Legume seed	853	20	1,275 tonnes	$2,986,500
Longans	135	20	1,192 tonnes	$3,575,700
Lychee	280	40	1,019 tonnes	$7,642,500
Macadamia	58	3	145 tonnes	$435,000
Maize	3,416	45	16,876 tonnes	$4,472,140
Mango	2,500	200	13,975 tonnes	$44,981,250
Melons	32	5	1,072 tonnes	$841,312
Mixed fruit	17	18	207 tonnes	$1,015,000
Mixed vegetables	71	24	2,156 tonnes	$3,248,000
Nursery production	NA	100	20 n/a	$10,100,000
Papaya	200	15	7,781 tonnes	$15,561,000
Passionfruit	15	20	225 tonnes	$540,000
Peanuts	1,700	45	7,000 tonnes	$5,950,000
Pineapples	60	1	2,688 tonnes	$3,327,100
Potatoes	1,200	65	30,000 tonnes	$19,500,000
Pumpkins	220	25	8,700 tonnes	$6,525,000
Sugar	7,941	68	716,564 tonnes	$27, 874,340
Table grapes	54	8	324 tonnes	$1,944,000
Tea	750	4	2,625 tonnes	$2,625,000
Tea-tree	70	10	21,000 litres	$665,000
Turf	27	2	221,645 meters^2	$787,922

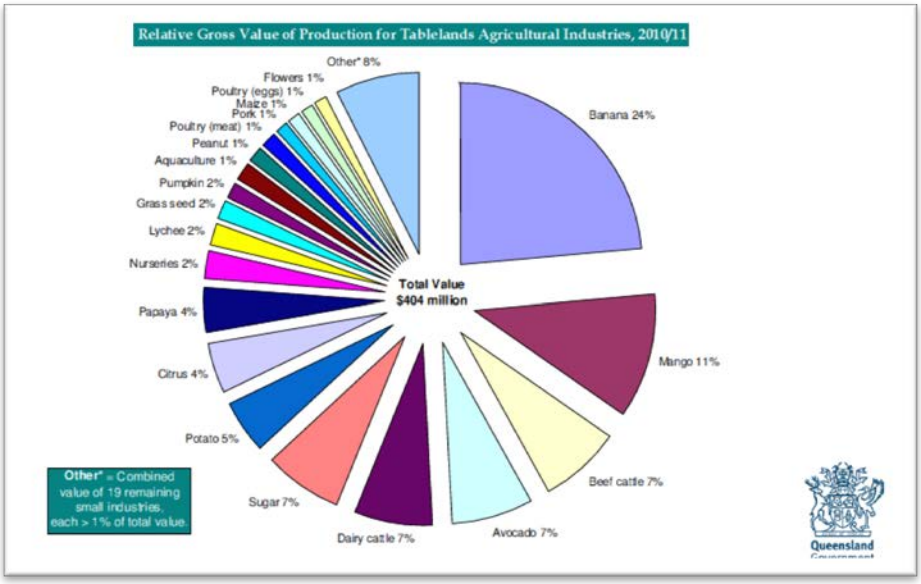


FIGURE 5: RELATIVE GROSS VALUE OF PRODUCTION FOR TABLELANDS AGRICULTURAL INDUSTRIES

Source: Dickinson, 2012

Note: These figures relate to all of the Tablelands of Far North Qld, of which Northern Tablelands only represents a portion.

7.2 WATER INFRASTRUCTURE

The original Mareeba-Dimbulah Irrigation supply scheme proposal was centred on two major supply storages: Nullinga and Tinaroo dams. Tinaroo Dam was completed in 1958, and since then has been able to supply the irrigation needs of the Mareeba-Dimbulah Irrigation Area (MDIA). Blurb on MDIA plus.

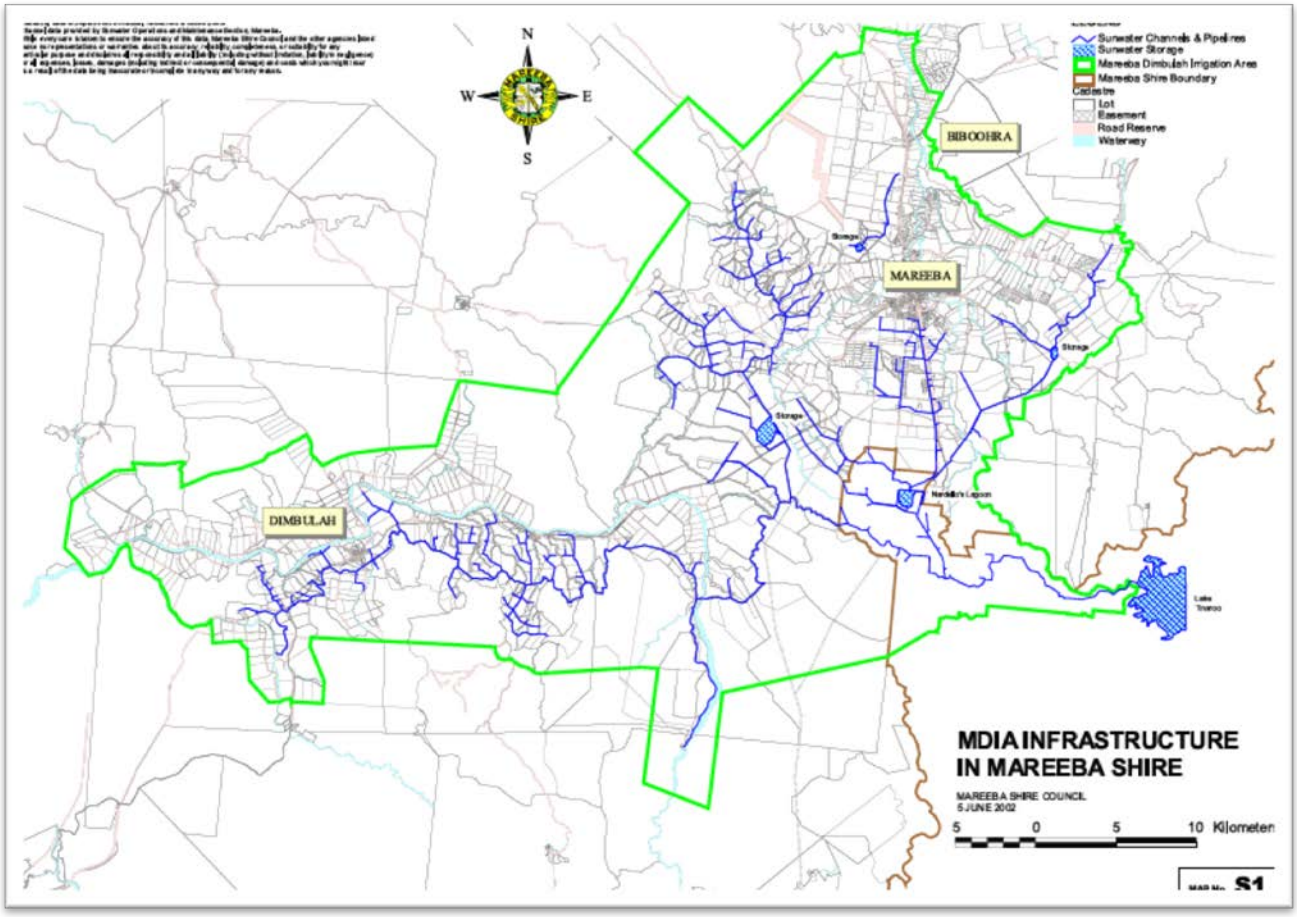


FIGURE 6: WATER INFRASTRUCTURE IN MAREEBA SHIRE

Source: Mareeba Shire Planning scheme maps (2008)

However the predicted expansion of the sugar industry will significantly increase water demands, and has initiated an assessment of additional sources of irrigation water. Therefore, the long standing Nullinga Dam proposal continues to be revisited (Hogan & Valance 1997). The Nullinga Dam has also been identified as potentially supplementing the future water storage needs of the Cairns/Tablelands town water supplies (Cummings 2008). Five million dollars was recently awarded to another feasibility assessment in the recent White paper for Northern Australian (Australian Government, 2015).

The proposed Nullinga Dam site is on the Walsh River, downstream of the existing Collins Weir, and upstream of the existing Bruce and Leafgold weirs. At full capacity, the proposed Nullinga impoundment would drown out the Collins Weir spillway by almost 4 metres. The river flow in this area is naturally intermittent, however this section of the Walsh River has been highly modified, and is now permanently supplemented by water from Tinaroo Dam. This water from the West Barron main channel enters the Walsh a short distance downstream of the proposed Nullina Dam site, and flows downstream past the end of the MDIA (Hogan & Valance 1997).

7.3 FREIGHT

Freight linkages and distance to market continue to be major obstacles to agricultural industry expansion in the Northern Tablelands. Two freight linkages which have been promoted by industry representatives are the Dimbulah Road to Cooktown Road portion of the Mareeba bypass and upgrades to the Kuranda range road.

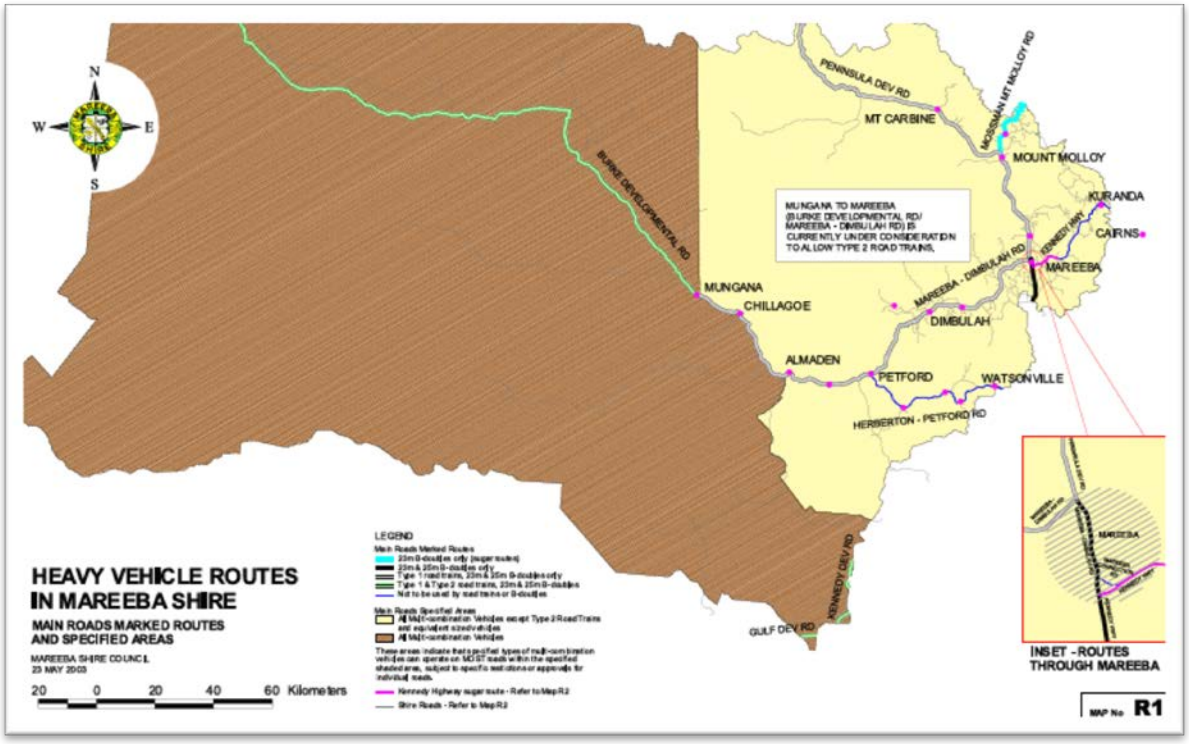


FIGURE 7 A) AND B): HEAVY VEHICLE ROUTES IN MAREEBA SHIRE

Source: Mareeba Shire Planning Scheme maps. (2008)

7.4 MINING

The Tablelands and ranges along the western and south-western margins of the region lie within a strongly mineralised geological area (Cummings; 2008).

Over the past few decades, mining activity has been relatively small scale and transient at Mungana (Red Dome – mainly copper), Mt Carbine in the Upper Mitchell (wolfram), and Dianne in the Palmer catchment (copper).

Longer-term mining activity includes limestone near Mt Molloy, limestone (Ootan), marble (Chillagoe), Solomon Mines copper sulphate (2nd Walsh crossing), perlite (Nychum Station area north west of Chillagoe), slate (Palmer), dolomite (Mt Surprise) and some very small tin and gold mines (Cummings 2008).

Within the vicinity of the Northern Tablelands, there are the following mining operations:

Upper Mitchell	• **Vital Minerals – sheelite mine north of Mt Carbine (advanced planning)** • **Republic Gold – gold mining in the Hodgkinson area** • **Republic Gold – wolfram mining, Mt Carbine area** • **Coal and methane gas – Mt Mulligan**
Walsh Catchment	• Queensland Ores – wolfram mining near Dimbulah (operating) • Kagara – copper base metal mining, Mungana area (operating) • Intermet – iron ore (magnetite) south of Almaden • NQ Minerals – Baal Gamon copper and tin near Irvinebank

Source: Cummings, 2008

There are various mining operations in proximity of the Northern Tablelands, some of which are located in the eastern part of the Grazing Lands region, however they are oriented towards Mareeba as a service and employment centre. Although the value of mining production fell to low levels in 2012-2013 after the closure of Kagara's operations, mining continues to attract activity and interest. Carbine Tungsten in Mt Carbine secured funding from Mitsubishi Corporation Japan in September 2014 to commence the first phase of its 12 million-metric-tonnes-per-annum Hard Rock Tungsten Project in 2015. Vital Metals (Palmer catchment) having completed a Definitive Feasibility Study and through agreement with Japan's JOGMEC group, is ready to commence project development in 2015 subject to finance at their Watershed development north of Mareeba. Almonty Industries is proposing to use improved processes to expand Wolfram camp operations and extend mine life to 10-plus years. Mungana Goldmines is promoting the development of the high grade King Vol zinc deposit west of Mungana to meet looming deficit in the global zinc market involving use of the former Kagara partially completed processing facilities at Mungana. Consolidated tin and Snow Peak mining are continuing to operate the former Kagara zinc and copper processing facilities at Mt Garnet, as well as the Baal Gammon mine in the Watsonville area, with employment back up to 130. Mantle mining continues to seek to develop the Mt Mulligan coal and gas project west of Mareeba, though this proposal is already being met with significant opposition from the community and Traditional Owners (Mareeba Chamber of Commerce, 2014).

7.5 Carbon trading opportunities for the Northern Tablelands

7.5.1 Soil carbon

Action on the Ground trials in the Mareeba-Dimbulah Irrigation Area

7.5.2 Avoided deforestation

Carbon credit generation through avoided deforestation can only be derived from land that still has native vegetation cover[1] and can be legally cleared[2]. Currently an approved methodology only applies where a permit to clear was issued before 1 July 2010. However, it is possible that a future methodology may be approved for land that can be cleared without a permit, as is the case on pastoral lands in Western Australia, North Territory and Queensland (see Beef industry case study).

Were this to occur, areas of the highest priority will be the areas currently storing the most carbon (and, hence, will be the most profitable). Carbon storage is greatest in areas of greatest biomass, which is related to productivity index, but also affected by climate, soil and vegetation type[266]. So the greatest potential for carbon storage is in the tall forests along Australia's eastern seaboard and in the far south-east and south west. Much less carbon is stored in the arid environments, although large amounts of carbon can accumulate in arid land vegetation in periods of high rainfall and be released during dry conditions[267]. The relationship between carbon, climate, soil and vegetation means that the highest carbon stocks in the Monsoonal North are in the Top End, North Kimberley and eastern parts of Northern Gulf (Figure), and, by extrapolation, in the highest rainfall areas of the Burdekin Dry Tropics.

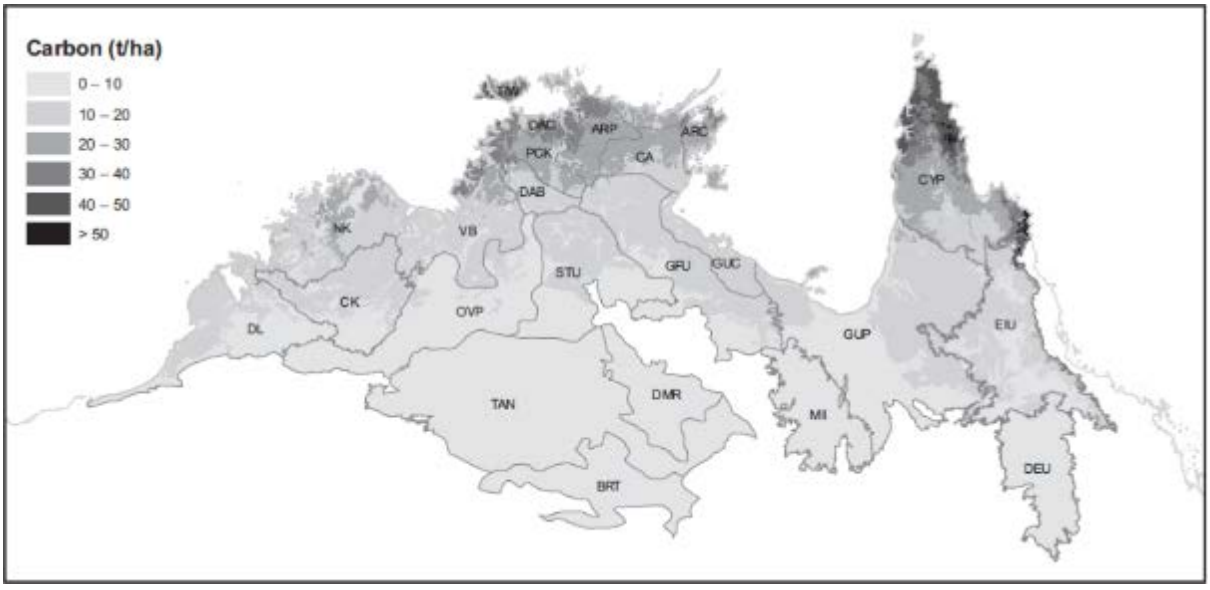


FIGURE 8. ESTIMATED ABOVE-GROUND TREE CARBON STOCKS IN NORTHERN AUSTRALIAN SAVANNAS

SOURCE: COOK ET AL. (2015) [268]

[1] With trees of at least 2m high providing at least 20% crown cover

[2] Emission reduction fund methodology: Avoided Deforestation 1.1

7.5.3 TREE PLANTING AND REGROWTH

Carbon credits can be generated by allowing native vegetation[3] to regrow on land that has been cleared[4] by undertaking environmental planting[5]. Cleared land can also be converted to forest through planting of non-native trees[6]. Carbon storage will be highest in the areas with the potential to produce the tallest forests. Therefore, cleared land in the same geographical areas that are a priority for avoided deforestation will also be of the highest priority for afforestation, reforestation and revegetation, and therefore the most profitable. The greatest potential for establishing forests from one of these methodologies in the Monsoonal North will be in the Burdekin catchment (Figure 9a), because this is where land clearing has been most extensive. However, re-establishing native vegetation in this area will have limited recognised biodiversity benefit, as few of the communities that would be re-established are currently considered threatened (Figure 9e, Figure 10).

[3] With the potential for trees of at least 2m high to provide crown cover of at least 20%
[4] Emission reduction fund methodology: Avoided clearing of native regrowth, Avoided deforestation 1.1
[5] Emission reduction fund methodologies: Reforestation and afforestation 2.0, Reforestation by environmental or mallee plantings - FullCAM
[6] Emission reduction fund methodologies: Reforestation and afforestation 2.0, Measurement based methods for new farm forestry plantations

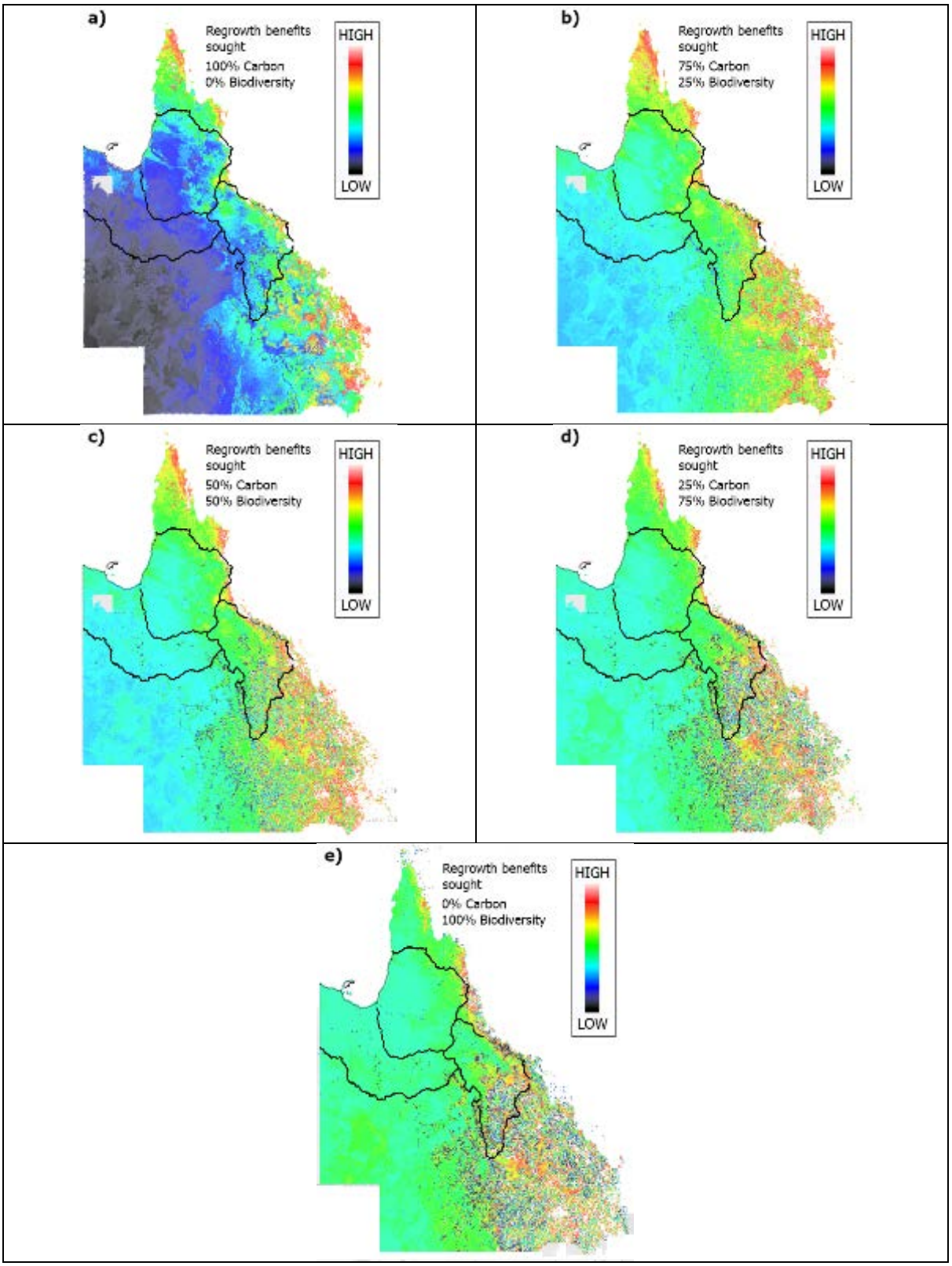


FIGURE 9. PRIORITY AREAS FOR REFORESTATION IN QUEENSLAND BASED ON VARYING COMBINATIONS OF CARBON AND BIODIVERSITY VALUES

SOURCE: ***HTTP://ENVIRONMENT.EHP.QLD.GOV.AU/REGROWTH-BENEFITS/***

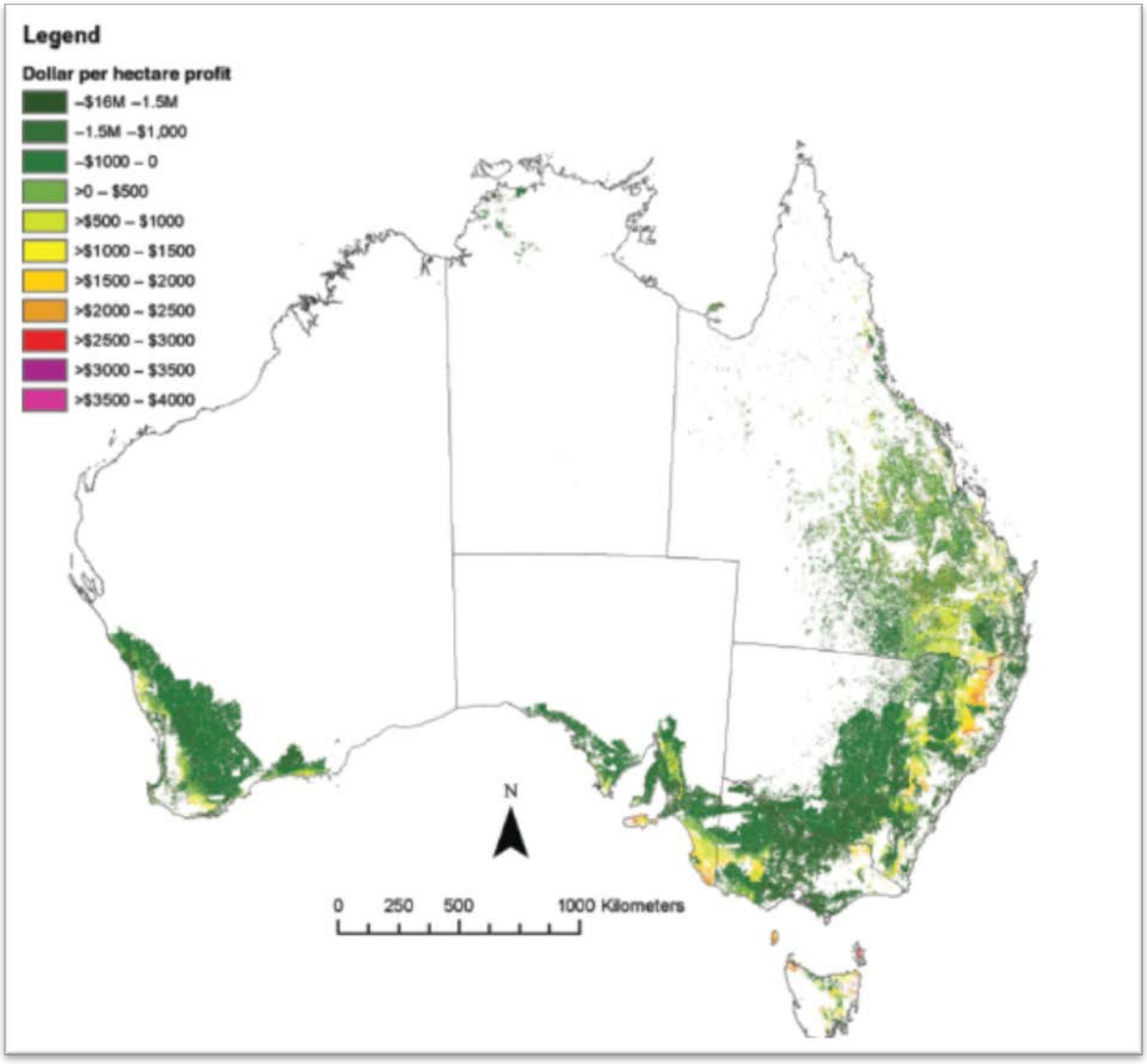


FIGURE 10. ESTIMATED PROFITABILITY OF REVEGETATION BASED ON COMBINED CARBON AND BIODIVERSITY VALUES

SOURCE: CARWARDINE ET AL. (2015)[269] PERMISSION REQUIRED

7.6 Land Assets

7.6.1 Tableland Soils

Soils of the Northern Tablelands are of low productivity, with the most agriculturally productive soils being the basaltic derived soils, however the nutrient status is generally low due to leaching which is induced by high rainfall (Malcolm et al. 1999). Detailed soil surveys have been undertaken throughout the Mareeba-Dimbulah Irrigation area. Soils in the Mareeba-Dimbulah Irrigation area were derived from four main sources: basaltic material (containing considerable amount of clay and silt with very little coarse sand), granitic material (containing more sand than silt or clay), metamorphic material (containing very little coarse sand) and minnow admixtures (soils of mixed origin or in markedly different adjacent soils) (McDonald 1976). Soil types vary markedly across the Tablelands. The soils in the Tableland region are suitable for a wide range of agricultural enterprises including tree crops, field crops and animal industries. Some examples of these include tree crops: mango, avocado, banana, limes and papaya; field crops: sugar cane, potato, peanut and maize; animal industries: beef and dairy cattle (Dickinson 2012). Due to the low productivity of soils for agriculture on the tablelands, organic inputs (such as biochar or compost) are used to improve crop productivity.

7.6.2 Threats to land resources

Dry land salinity

Dry land salinity is an issue facing many regions of Australia. Major widespread anthropogenic changes to the salinity of rivers generally occur due to hydrological and/or hydrological and ecological alterations that result from irrigation; excessive clearing of deep-rooted vegetation, groundwater use, flow supplementation, river regulation, water extraction and/or drainage works (Butler & Burrows 2006).

In the Northern Gulf region, water tables that are more likely to rise and cause salinity problems are the Arriga Flats-Tabacum area, which is an area of irrigated sugar cane farming near the town of Dimbulah. The main catchments of current concern for development of salinity in the irrigated areas of the region are in the Cattle Creek and Two-Mile Creek sub-catchments in the Mareeba-Dimbulah Irrigation Area (MDIA) of the Upper Mitchell River. Irrigated farming in the Arriga flats section of the Cattle Creek sub-catchment (which has a total area of 16,700 ha) which represents roughly 20% the MDIA has experienced the effects of salt within the soil profile depressing crop growth in some low lying areas. Some rice crops were locally affected by soil salinity in the early 1980s (Nelson & Webb 2004).

A monitoring program by the Queensland Government has found a long term rising trend in 82% of bores in the Cattle Creek catchment (DNRM 2012).This area has experienced a significant increase in the estimated total area of very shallow (less than two metres) and shallow (two to three metre) water tables. Long-term monitoring shows areas affected to be 43, 140 and 786 hectares in 1998, 2004 and 2010 respectively (DNRM 2012).

No other occurrences of salinity have been recorded in the Northern Gulf, however the risk and occurrence of salinity is unknown (Nelson & Webb 2004). Shallow aquifers in river sands tend to have low salinity, such as those of the Gilbert River bed sands (Hill et al. 1999), whereas the aquifers in the coastal zone are very saline.

According to Nelson and Webb (2004) the most significant salinity related risks for the region include:

- rising water tables resulting from intensive irrigation;
- increasing seawater intrusion resulting from excessive groundwater use adjacent to coastal areas;
- deteriorating groundwater quality associated with water extraction from sub-artesian aquifers; and
- the impact of soil sodicity on future agricultural production.

A basin of saline groundwater has been identified in the Two Mile Creek area near Biboohra, MDIA (Nelson & Webb 2004, Jensen et al. 1996 in Nelson & Webb 2004). With pressure to expand irrigated cane cropping in this area, further groundwater observation bores were constructed and monitored (Jensen 1998 in (Nelson & Webb 2004). Groundwater levels were found to be reasonably high (-4m) in the central to southern part of this study area, resulting from continuous water logging from the discharge from the Mareeba sewerage treatment plant at the

nearby Two Mile Creek. The groundwater depth was found to be deeper (-8 to -14m) further to the north in the Biboohra section of the MDIA. Recent groundwater and soil observations in the southern part of this section have recorded water table depths of only -0.5 to -1.0 m from the surface (Nelson & Webb 2004).

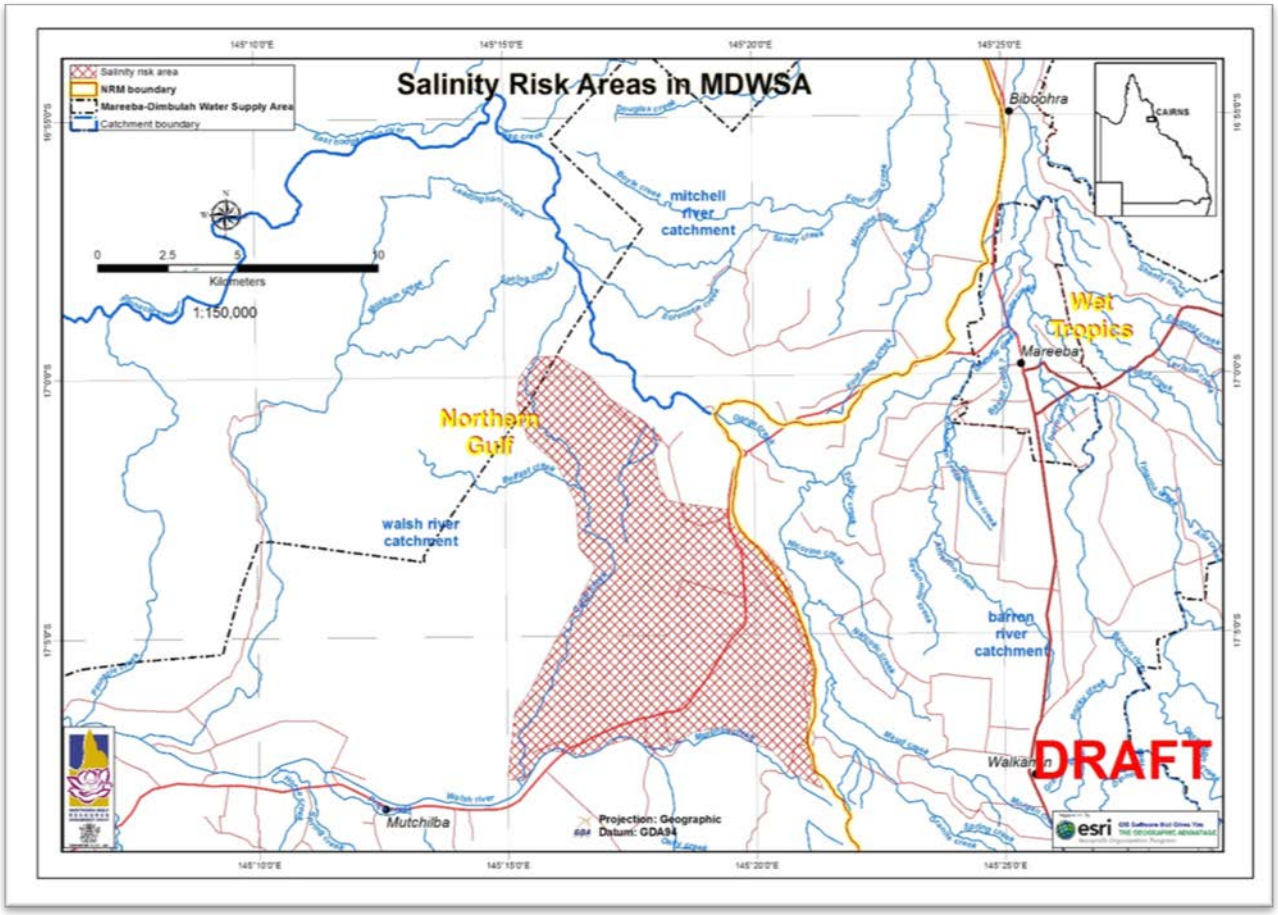


FIGURE 11: SALINITY RISK AREAS

Source: NGRMG, 2014.

In soils of the Einasleigh Common, the well-drained non-saline soils had low salt stores but the poorly drained soils had ground conductivity tests indicated high salt stores down to four to six meters of depth (Hill et al. 1999). Similar work by in the Biboohra area (MDIA) has also shown large salt stores under sodosols and sodic groups of vertosols, dermosols and chromosols (Webb et al. 2000). Therefore, in the absence of more information, it can be assumed that wherever these soils occur elsewhere in the region, they may hold considerable salt stores at depth.

KEY MESSAGES FROM THE NATIONAL DRY LAND SALINITY PROGRAM (**VAN BUEREN & PRICE 2004**)

- 'There is no quick fix — salinity can be managed by prevention, treating the cause, ameliorating the symptoms, living with it or a combination of these;
- Salinity management requires knowledge about soil, salt, water and vegetation integrated with knowledge about groundwater flow systems;
- Hazard assessment has confirmed that large areas of the tropics and sub-tropics have potential salinity problems if clearing occurs;
- Broad-scale land clearing with little or no regard for the salinity hazard is a recipe to repeat the problems of temperate Australia'.
- 'The opportunity exists for a major national, well-focused investment in preventive action in northern Australia'.

THE SALINITY OF CATTLE CREEK (**NELSON & WEBB 2004**)

'Changes in groundwater levels in the Cattle Creek area were first noticed in 1987 when the initial investigations commenced. Early observations identified that there was some cause for concern, with the complexity of sub-catchment geology and groundwater movement providing a challenge for scientists and decision makers (Lait 1992 in (Nelson & Webb 2004)'.

'Subsequent updates on the groundwater monitoring have been provided in 1996 (DNR staff), 2001 (NR&M) and 2004 (Bell). The 1996 study (DNR staff) classified the observation bores into five trends: consistently rising, minor seasonal variation, major season variation, locally affected and dry. The consistently rising bores in Cattle Creek sub-catchment are mainly in the Arriga Flats and were found to be rising at rates from 0.02m to 0.5m per year, in the period from 1987 to 1996. The depth to water table amongst this group of consistently rising bores ranged from -2.2m to -17.5m. The water in some bores was extremely saline at more than 20 dS/m (>12800 ppm). The 2001 update report concluded that groundwater levels in some monitoring bores in the Cattle Creek Catchment had continued to rise, with the Arriga Flats being the major area of concern. A general pattern has emerged that the rising trend accelerated in periods of wetter than average rainy seasons and that the groundwater did not retreat with drier years'.

'The area under irrigated agriculture doubled from 1,400 to 3,100 ha between 1992 and 1996 and has further increased to at least 5,400 ha by 2004/5. The total area under sugar cane increased from 3,862 ha in 1996 to 5,998 ha in 2001, but then decreased to 4,390 ha in 2004/05. In the period 1996-2000 there was an expansion in the use of overhead irrigation systems (centre pivot or linear move) for sugar cane to 860 ha, with the balance as furrow irrigation. Foodplain with dominantly clay soils, but which also has bands of sandier soils of higher permeability'.

'The total salt load to 20 m depth is moderate to high in the Arriga Flats section and reaches a maximum near the junction of Cattle Creek and Dingo Creek and the other at the junction of Chettle Road'.

CLIMATE CHANGE AND DRYLAND SALINITY

There are a number of links between possible changes in climate and dryland salinity. The predicted increase in the intensity of high rainfall events may cause an increase in dryland salinisation (John et al. 2005) in some parts of Northern Gulf. This may be offset by a reduction of annual rainfall, including droughts or longer dry seasons, which may result in less groundwater recharge and consequently less dryland salinity risk and water logging (John et al. 2005). Deep drainage tends to accelerate dryland salinity and at higher temperatures deep drainage may decrease up to 20%. Therefore, the threat to dryland salinity will be reduced if temperatures rise in response to climate change (John et al. 2005).

As per John et al. (2005) climate change may indirectly affect dryland salinity as summarised below:

- Changes in rainfall may affect the adaptation of using perennial plants to manage salinity.
- Climate change (rainfall, temperatures) will change the yields of different land uses and may therefore affect the relative attractiveness of land uses for salinity management.
- Climate change may alter production patterns internationally, driving changes in the relative prices of agricultural products, affecting the relative attractiveness of land uses for salinity management.
- Changes in yields and prices affect the overall profitability of farms, which affects the capacity of farmers to adopt some of the salinity management practices that have high up-front costs.
- If climate change policy leads to the establishment of markets for carbon credits, this would influence the adoption of woody perennials, which are recommended for salinity management in some cases.
- Adoption of woody perennials for purposes of salinity management would sequester carbon and contribute, at least a little, to mitigation of climate change.

NUTRIENT INPUTS

Nutrient inputs into agricultural soils can pose a threat to the environment and can lead to the pollution of water and in extreme cases can threaten soil fertility. Nutrients such as nitrogen and phosphorous are removed from agricultural soils by plant growth and need to be replaced. Mineral fertilisers when added to soils can in some cases build up nitrogen surpluses which are then at risk of running off into surface water or leach into groundwater. Phosphorous, added as phosphate, is not as soluble as nitrate and can easily be transported by sediment in runoff, ending up in rivers and streams (Pau Vall & Vidal 2015).

High concentrations of nitrogen and phosphorous in freshwater streams can result in eutrophication. This can cause proliferation of blue-green algae that produces toxins that are poisonous to fish and other vertebrates. The contamination of water can reduce its use for human consumption, stock water, recreation and agricultural irrigation. Excessive concentrations of nitrogen applied to soils can leach into the groundwater which when highly contaminated cannot be used as drinking water (Pau Vall & Vidal 2015).

Environmental impacts from excessive nitrogen loads can be minimised by applying fertilisers during suitable weather conditions and at the correct stage during crop growth in combination with using sustainable agricultural practices, such as crop rotation, planting cover crops, and ploughing in crop residues (Pau Vall & Vidal 2015).

With global food demand projected to increase by 60% by 2050 and threats to the agricultural industry through climate change impacts, Australian agricultural enterprises will need to increase production per hectare to maintain a competitive export position. This increase in production will need to be cost effective without increased fertilizer

loads, therefore, minimising environmental damage. Therefore investment needs to be placed into developing climate resilient crops and pastures, and knowledge-intensive, sustainable farming systems. Maintaining land and vegetation in good condition can avoid 'tipping points' which lead to reduced agricultural production such as soil acidity (Eadie & Stone 2012).

Agricultural pests and diseases

Pests and diseases can be a serious threat to agricultural industries in the Northern Tablelands. The introduction or spread of pests and diseases onto agricultural properties can reduce production and cost time and money to resolve. There are a wide range of agricultural pests and diseases including invertebrates such as ants, mites and flies, bacterial plant pathogens, parasitic weeds, fungus and viruses. One of the most destructive disease is Panama disease tropical race 4 (Fusarium wilt) which threatens banana industries in the region. A case of Panama disease tropical race 4 was recently detected on Cavendish banana plants in the Tully valley. This disease is spread by the movement of infected plant material, infested soil and contaminated water. The disease enters the plant roots, blocking vascular tissue and eventually leading to plant death. There is currently no cure and the disease cannot be controlled by any known chemical, cultural or biological means (DAF 2015). There is a large biosecurity risk of this disease entering Banana plantations within the Northern Gulf Tablelands. A pest surveillance program has been developed for Panama disease tropical race 4, to assist Biosecurity Queensland to determine the distribution of this disease in Queensland and prevent the further spread of this disease.

There are currently pest quarantine areas developed for Queensland. Those relating to the Northern Tablelands includes the following pest and disease species: Asian sugarcane planthopper, banana freckle and Fire blight;, banana diseases including bacterial wilt of banana, bugtok disease, moko disease, black Sigatoka disease, mango leaf hopper, mango malformation disease, Mediterranean fruit fly, panama tropical race 4, potato pests golden nematode and potato cyst nematode, red imported fire ant. The Northern Tablelands also has restrictions on interstate market access due to the following: Cercospora leaf spot, Melon thrips, spiraling white fly (Queensland Government 2015).

The Department of Agriculture and Fisheries provides a detailed list of Agricultural pests and diseases, their impact and management on their website https://www.daf.qld.gov.au/plants/health-pests-diseases/

7.7 Flora Assets

The Northern Gulf region straddles four bioregions, each with distinctive climate and landforms: the Gulf Plains, Einasleigh Uplands, Wet Tropics and Cape York Peninsula. The Northern Tablelands region comprises areas of the Wet Tropics and Einasleigh Uplands bioregions, dominated by wet tropical rainforests and eucalypt woodlands (Tables 5a & Figure). The climate is tropical and characterised by hot wet summers and drier winter months. Annual rainfall varies considerably across the region, from the drier western areas, to high rainfall on the edge of the Wet Tropics, such as 1621 mm per annum at Julatten.

The Queensland herbarium has identified 14 Broad Vegetation Groups (BVG) within the Northern Gulf region (at 1:5 million scale). The BVG's comprise 499 separate regional ecosystems (RE's), 102 which are found in the Wet Tropics. In the Northern Gulf, the Wet Tropics bioregion comprises more threatened regional ecosystems than the Gulf Plains, Einasleigh Uplands and Cape York Peninsula combined with 31 of listed as 'endangered' and 42 as 'of concern' according to the EHP biodiversity status (Table 5). A comprehensive list of endangered Northern Gulf regional ecosystems and their threats can be found in Appendix 1.

TABLE 5. THE NUMBER OF REGIONAL ECOSYSTEMS FOR THE EINASLEIGH UPLANDS AND WET TROPICS BIOREGIONS, INCLUDING THE NUMBER WITH AN 'ENDANGERED' OR 'OF CONCERN' BIODIVERSITY STATUS.

Bioregion	Einasleigh Uplands	Wet Tropics
Number of RE's	176	102
Endangered	7	31
Of concern	63	42

The most distinctive vegetation communities found in the Northern Tablelands are:

- Eucalypt (*Eucalyptus* and *Corymbia* spp) woodlands with a grassy understory,
- Freshwater wetlands, both permanent and seasonal,
- Wet tropical rainforests and tall eucalypt forests in the high rainfall eastern region; and
- Riparian woodland and forest that occur along the more permanent watercourses.

The flora of the region is distinctly tropical. The eucalypt woodlands, which dominate the region, contain a variety of shrubs, such as wattles (*Acacia* spp.), currant bush (*Carissa lanceolata*). The ground layer is typically dominated by a range of native grasses including wire grasses (*Aristida* spp), blue grasses (*Bothriochloa ewartiana* and *Dichanthium sericeum*), black spear grass (*Heteropogon contortus*), kangaroo grass (*Themeda triandra*). A few eucalypt woodlands have a spinifex (*Triodia* spp.) grass layer. Introduced grasses include Indian bluegrass (*Bothriochloa pertusa*), buffel grass (*Cenchrus ciliaris*) and urochloa (*Urochloa mosambicensis*). Forbs include native legumes, *Desmodium* spp, *Glycine* spp, *Indigofera* spp. and introduced pasture legumes (e.g. stylos, *Stylosanthes* spp).

Figure 12. *The tall rose gum forests in the wet tropics.*

7.7.1 VEGETATION CONDITION AND CHANGE IN RECENT DECADES

Native vegetation is a critical element in biodiversity conservation and may be instrumental in facilitating vertebrate and invertebrate species adaptation to climate change. Assessment of the extent and condition of native vegetation is important in determining the health of landscapes for biodiversity.

Vegetation structure across the region has remained broadly stable over recent decades. However, significant rainforest thickening has occurred in the tall eucalypt forests of the Wet Tropics, in the far east of the region (Stanton et al. 2014). Thickening of native shrubs and saplings of trees (i.e. woody thickening) is also widely accepted to have occurred, however there is debate about the scale and degree of thickening in various locations (Fensham et al. 2007).

The composition of the grass layer of many woodlands has altered with the expansion of introduced grasses, including valued pasture species (e.g. buffel grass, *Cenchrus ciliaris)* and also less palatable species, e.g. grader (*Themeda quadrivalvis*) and rat's tail (*Sporobolus* spp) grasses. A decline in the diversity and abundance of some native grasses and forbs is linked to the increase in exotic plants (Jackson 2005; Kutt & Kemp 2012). In areas where vegetation has not been extensively cleared but is in poor condition (such as heavily grazed areas with little understory structure and low plant recruitment) biodiversity may be depleted (DEWHA 2009). The Landscape Health in Australia report (Morgan 2001) found that the Northern Gulf region was scored in the middle stress category. However, riparian vegetation (i.e. along rivers and significant creeks) were considered to be declining in condition.

7.7.2 Threatened ecological communities

Some of the REs across the region have an Endangered or Of Concern biodiversity status due to limited natural distribution. Other ecosystems are threatened by woody thickening, weed, fire and grazing management issues, or erosion impacts. These include RE 7.12.22 red mahogany (*Eucalyptus resinifera*), white mahogany (*Eucalyptus portuensis*) and turpentine (*Syncarpia glomulifera*) tall forests north of Herberton (threatened by low fire frequency and rainforest expansion); RE 2.3.9 Coolabah (*Eucalyptus microtheca*) and Bauhinia (*Lysiphyllum cunninghamii*).

There is one federally listed threatened ecological community (TEC) in the Northern Tablelands. This is the broad-leaf tea tree (*Melaleuca viridiflora*) woodlands of high rainfall coastal north Queensland. The endangered broad-leaf tea tree (*Melaleuca viridiflora*) woodlands of high rainfall coastal north Queensland primarily occur outside this region, in coastal areas of the Wet Tropics. However, there are probably a few small areas of tea tree woodlands that meet the criteria which extend into the Northern Tablelands region, to the east of Julatten and Mount Molloy. The EPBC (2012) lists the main threats to the long term condition of broad-leaf tea tree woodlands as including fragmentation from clearing, weeds, inappropriate grazing and fire regimes and illegal collection, particularly of orchids.

7.7.3 Threatened Flora

There are 95 plants known to occur within the region that have a Near Threatened, Vulnerable, Endangered (or presumed extinct) status under the Queensland Nature Conservation Act 1992 (Figure 13; Queensland Herbarium Herbrecs data, accessed February 2015; Appendix 2). Of these, 74 species are found on the Northern Tablelands. One species, *Acacia purpureopetalia*, has a Federal Environmental Protection and Biodiversity Conservation Act (2002) (EPBC) status of Critically Endangered. *A. purpureopetala* is a wattle shrub that grows in the Herberton - Irvinebank district and is considered by the lower status of Vulnerable under Queensland legislation. Three species have an EPBC Endangered status and ten have an EPBC Vulnerable status.

Of note are the few trees or large shrubs with a threatened status which are mainly restricted to the Wet Tropics. The majority of threatened flora across the region are grasses, forbs and shrubs, which can be particularly impacted by weeds, high grazing pressure and fire management.

Little ecological research has been undertaken on the majority of the 95 threatened species in the region. Therefore, there is little knowledge of specific threats and management requirements. Many of those with an EPBC status have some details on threats. These are typically relating to maintaining fire management appropriate to the species ecology, and limiting weed and clearing impacts. One species, the wetland forb *Eriocaulon carsonii*, grows amongst springs linked to the Great Artesian Basin. It is threatened by overuse of the water source as well as grazing and weed impacts.

Climate change has the potential to influence these threatened species through potential erratic rainfall and extreme weather events. These could impact on the survival of mature plants (e.g. droughts killing plants), or impact on germination or seeding events.

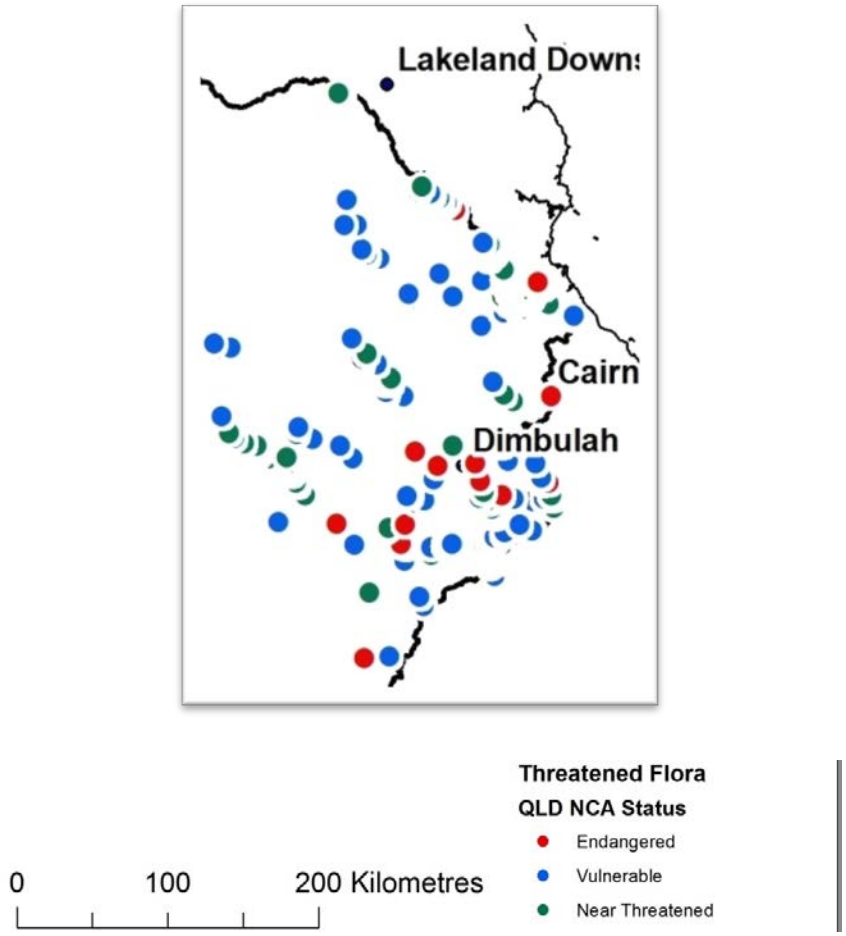


FIGURE 13. The known locations of threatened flora in the Northern Gulf. Data from the Queensland Herbarium (Herbrecs search February 2015)

7.8 THREATS TO FLORA

The principal threats to the flora across Northern Australian rangelands appear to be land degradation caused by inappropriate management, such as overgrazing (Lorimer 1998); and a reduction in landscape variability, especially in relation to pasture composition and mosaic fire management (Woinarski 1999). Although varying in specifics between ecosystems, there are many common issues including pest species, fire and grazing pressure and the management of canopy and ground layer habitats in general.

The common threats to the vegetation of the Northern Gulf region include inappropriate fire and grazing management, weed invasion, feral animals, artificial water extraction and timber harvesting.

7.8.1 WOODY THICKENING

The term "woody thickening" refers to an increase in the density of native shrubs, saplings and trees. There is considerable evidence that woody thickening has occurred within eucalypt forests, woodlands and grasslands across Northern Australia, including the Northern Gulf region, for at least the last few decades (Crowley et al. 2009;

Scanlan et al. 1996; Stanton et al. 2014). For example, over half (58%) of sites surveyed during land condition assessments showed evidence of woody thickening (Rolfe et al. 2004); while large areas of tall eucalypt forests in the Wet Tropics have been significantly altered through thickening of rainforest species (Stanton et al. 2014).

It is apparent that thickening has not been universal across all woodlands or locations, and the degree to which vegetation has thickened is subject to debate (e.g. Fensham *et al.* 2007; Fensham 2008. Severe droughts have had a balancing effect on woody structure of woodlands, as a consequence of extensive tree deaths (Fensham et al. 2009).

The most common vegetation types on the Northern Tablelands that have suffered from woody thickening are tall eucalypt forests in the Wet Tropics (Burrows et al. 2002; Crowley et al. 2009; Stanton et al. 2014). In the wet tropics woodland thickening occurs by rainforest species encroaching on neighbouring eucalypt forests. This may impact on biodiversity for example; rainforest expansion has significantly reduced the extent of grassy tall eucalypt forests (Stanton et al. 2014; Williams et al. 2012).

There is evidence that in dry tropical woodlands, woody thickening is influenced by a combination of factors including intensification of grazing, reduced fire frequency and/or intensity, and increases in atmospheric CO_2 (Fensham et al. 2009; Scholes & Archer 1997; Van Auken 2000). However the mechanisms driving woody thickening are complex and appear to differ between land types and among the woody species involved.

Reductions in frequent, moderately intense fires have been linked to woody thickening (Crowley et al. 2009; Stanton et al. 2014). This is because regular fires of sufficient intensity to scorch the shrub and sapling layer are thought to inhibit, or reduce woody thickening through several mechanisms (Hunt et al. 2014; Williams et al. 2012). Crown scorch reduces most shrubs and eucalypt saplings < 2m tall, to ground level coppice shoots from buds protected below to soil surface. Therefore, regular fires of this intensity can repeatedly prune the lower strata before it grows into large trees and shrubs, allowing grasses and herbs to maintain vigor. Regular fires are important for reducing the establishment of new woody seedlings. As germination events for savanna eucalypts is erratic and typically linked to high rainfall years (Williams 2009a), burning following good wet seasons is important for reducing the number of newly recruited woody seedlings.

The potential of increased numbers of severe droughts and perhaps more intense rainfall events will potentially impact on woody thickening. The germination of new woody plants most commonly occurs during high rainfall periods (Williams 2009a), and wet conditions will probably promote growth of existing saplings. Any increase in woody thickening due to high rainfall events can be managed using regular fire. Drought is known to cause the die back of canopy trees, which may balance woody thickening over a decadal scale (Fensham et al. 2009).

Where woody thickening is already dense over a large area, the success from burning may need to occur over stages, with initial fires producing the best results on the edges of thickets and subsequent fires burning more successfully further within the thicket. Where woody thickening is dense and extensive, fire intensity may need to be higher than in more open woodlands. The more intense fires implemented in the late dry season have a greater effect on woody thickening control than lower intensity early dry season fires (Cowley et al. 2014; Dyer et al. 2001). However greater preparation and management is required to contain late dry season fires and if limited rain falls after these fires, pastures may need considerable post-fire spelling to allow grass regeneration.

The aim of burning dense thickets is to scorch the tops of crowns of the thickening shrubs and saplings to produce some mortality and reduce others to ground level coppice shoots. This allows grasses and herbs to regenerate. Some species are more susceptible to being killed by crown scorching fires (e.g. rubbervine, *Cryptostegia grandiflora* and breadfruit, *Gardenia vilhelmii*) than others (e.g. tea tree, *Melaleuca* spp. and eucalypts (Dyer et al. 2001; Kernot & English 2008; Williams 2009b). All actions, whether burning, controlling weeds or promoting useful significant species, should include an element of assessment to ensure refinement of the program to its greatest potential. In regards to burning for woody thickening management, photo points and notes on observations of the reduction of woody thickening are important.

7.8.2 Weeds

FIGURE 14. GAMBA GRASS INVADED WOODLAND WITH EUCALYPTS KILLED BY ELEVATED FIRE INTENSITY

Introduced plant species can cause negative impacts on native flora through competition. Weeds may also limit human use of an area by reducing access, recreational use and economic gains. Economically, weeds may impact directly on production systems, for example through reducing productivity of grazing lands, yield losses, contamination of agricultural products or through material and labour costs for their control (Council 2007, NRMMC 2007). Dense weed invasion reduces floristic diversity and pasture quality. Weeds that remain in low densities with little biomass may provide little problem other than a reduction in the pristine nature of a habitat, whereas those that invade in high densities with a large biomass replace native plants and alter the resources available to fauna.

Weeds establish in new areas through the spread of seeds, or vegetative material, and opportunities for recruitment, usually through soil disturbance. Weed seed spread occurs through:

- Wind borne seeds;
- Water borne seeds in rivers and floods;
- Explosive seed pods;
- Animal transport including ants, wildlife (birds and mammals) and introduced herbivores;
- Graders and roadside machinery;
- Tractors, cars and farm implements;
- Transported materials, soils, sand, mulch and hay; and

- Deliberate introductions by gardeners and graziers.

Activities that increase soil disturbance and provide suitable environments for weeds to establish include:

- Inappropriately managed fire that changes vegetation composition, providing bare areas for weeds to invade;
- Clearing of ground for agriculture;
- Over-grazing that leaves bare ground or reduced grass cover;
- Selective grazing reducing desirable species giving weedy species a selective advantage;
- Soil disturbance by machinery or cattle; and
- Introduction of weed seeds to new areas by transport or machinery.

The most appropriate way to prioritise weed control actions is to consider the weed's current and potential extent and impact. This prioritisation needs to be done at a property and a regional scale. All land holders have responsibility for managing weeds on their property. Weeds that are a priority for a particular property may not be a priority at a regional extent due to a weeds distribution and the larger number of weeds that must be prioritised across the region.

Significant weed management actions at a property and regional scale involve:

- Weed seed hygiene to prevent new weeds from entering an area and exist weeds spreading;
- Keeping transport corridors clear of weeds to reduce their spread;
- Mapping the extent and abundance of weeds;
- Prioritising weed species and locations for control;
- Focusing control efforts on small outlier infestations and scattered plants and working back from the edges of larger infestations;
- Using the most appropriate control actions for the right weed, in the correct location, using safe methods. These control actions will typically involve a combination of the following, where appropriate: biocontrol where available, fire, mechanical and/or herbicide;
- Coordinated weed control amongst neighbours; and
- Assessment of the success of control actions and updated weed distribution information.

DECLARED WEEDS

Many of the significant weeds of the Northern Tablelands are declared under legislation, Queensland *Land Protection (Pest and Stock Route Management) Act* 2002. This act has the following three categories for declared weeds and feral animals.

TABLE 6: CATEGORIES FOR DECLARED WEEDS AND FERAL ANIMALS

Class	Definition	Known to occur within the region	Near to the region
Class 1 weeds	Biosecurity Queensland indicate that "a Class 1 pest is one that has the potential to become a very serious pest in Queensland in the future. All landholders are required by law to keep their land free of Class 1 pests. It is a serious offence to introduce, keep, release or sell Class 1 pests without a permit."	• Koster's curse (*Clidemia hirta*) • Siam Weed (*Chromolaena odorata*)	• Limnocharis or yellow burrhead (*Limnocharis flava*) • Miconia (*Miconia* spp.) • Mikania vine (*Mikania* spp.) • Fragrant thunbergia (*Thunbergia fragrans*) • Laurel clockvine (*Thunbergia laurifolia*)
Class 2 weeds	Biosecurity Queensland indicate that "a Class 2 pest is one that has already spread over substantial areas of Queensland, but its impact is so serious that we need to try and control it and avoid further spread onto properties that are still free of the pest. By law, all landholders must try to keep their land free of Class 2 pests and it is an offence to possess, sell or release these pests without a permit."	• Bellyache bush (*Jatropha gossypiifolia* and hybrids) • Chinee apple (*Ziziphus mauritiana*) • Gamba grass (*Andropogon gayanus*) • Giant sensitive plant (*Mimosa diplotricha* var. *diplotricha*) • Mesquite (*Prosopis pallida*) • Olive hymenachne (*Hymenachne amplexicaulis*) • Parkinsonia (*Parkinsonia aculeata*) • Parthenium (*Parthenium hysterophorus*) • Prickly acacia (*Vachellia nilotica*) • Rat's tail grasses (*Sporobolus fertilis*, *S. jacquemontii*, *S. natalensis* and *S. pyramidalis*) • Sicklepod (*Senna obtusifolia* and *S. tora*) • Rubber vine (*Cryptostegia grandiflora*) • Water hyacinth (*Eichhornia crassipes*)	• Cabomba (*Cabomba caroliniana*)
Class 3 weeds	Biosecurity Queensland indicate that "a Class 3 pest is one that is commonly established in parts of Queensland. Landholders are not required to control a Class 3	• Athel pine (*Tamarix aphylla*). Athel pine is also a Weed of National Significance.	• African tulip tree (*Spathodea campanulata*) • Cat's claw creeper

	declared pest plant on their land unless a pest control notice is issued by a local government because the pest is causing or has potential to cause an negative impact on an adjacent environmentally significant area. It is an offence to supply a Class 3 pest. A permit for specific purposes may be issued by Biosecurity Queensland. Class 3 weeds known from the region are:	• Broadleaved pepper tree (*Schinus terebinthifolius*) • Camphor laurel (*Cinnamomum camphora*) • Captain Cook tree or yellow oleander (*Cascabela thevetia* syn. *Thevetia peruviana*) • Lantana or common lantana (*Lantana camara*) • Madeira vine (*Anredera cordifolia*) • Singapore daisy (*Sphagneticola trilobata*; syn. *Wedelia trilobata*)	(*Macfadyena unguis-cati*) • Chinese celtis (*Celtis sinensis*) • Broad leaf privet or tree privet (*Ligustrum lucidum*) • Small leaf privet or Chinese privet (*L. sinense*)

Source: Department of Agriculture, Fisheries and Forestry, 2014

Environmental and pasture weeds

Many significant weeds have no legal requirements for control (i.e. are not declared Class 1, 2 or 3 under the Queensland Land Protection Act), but have a significant impact on the conservation values of a native ecosystem and can reduce pasture quality. These include exotic grasses, which outcompete with native grass layer species. The diversity of eucalypt woodlands is primarily found in the abundant grasses and herbs, and therefore large biomass exotic grasses, such as Gamba grass, buffel grass can dramatically reduce the diversity of native flora.

It should be noted that the mention of these weeds here does not suggest that they be actively controlled in every location. Some, such as Buffel grass, are widespread across Northern Australia and of some grazing value. Examples are:

- Buffel grass (*Cenchrus ciliaris*) also valued as a pasture species
- Leucaena (*Leucaena leucocephala*)
- Mimosa bush (*Vachellia farnesiana - was called Acacia farnesiana*)
- Neem (*Azadirachta indica*)
- Noogoora burr (*Xanthium occidentale*)

Weeds of concern to the Northern Gulf region

The Mareeba shire council (which the Northern Tablelands is wholly contained within) has their own weed management priorities which reflect problem weeds in their geographic area and land holder preferences, expressed through the Mareeba Shire pest and weed management plan (---). Rather than undertaking a duplicating process, this review has focused on determining the priority weeds and actions that will provide a strategic regional response. This involves providing support and assistance for the management of the highest priority weeds identified in various Council plans, while taking on the role of ensuring highly aggressive weeds not currently present in the region (or only present in isolated areas) do not take a hold in this region.

There are 12 weed species currently recognised as high priority within the tableland and three species considered to be a biosecurity risk of entering the tablelands (Table 7 below).

TABLE 7: WEEDS OF PRIORITY FOR THE NORTHERN TABLELANDS AREA IN THE NORTHERN GULF REGION.

Common name	Scientific name	Description	WONS	LPA Class
Gamba grass	*Andropogon gayanus*	Invasive tall grass, smothers other flora and fuels high intensity fires.	Y	2
Koster's Curse	*Clidemia hirta*	Rapidly spreading shrub		1
Olive Hymenachne	*Hymenachne amplexicaulis*	Very invasive and dense wetland grass	Y	2
Parthenium	*Parthenium hysterophorus*	Annual herb forming dense mats and causes allergic reactions	Y	2
Siam weed	*Chromolaena odorata*	Very invasive tall, dense shrub.		1
Water hyacinth *	*Eichhornia crassipes*	Very invasive wetland plants forming dense mats	Y	2
Bellyache bush	*Jatropa gossypiifolia*	Rapidly travelling down the Palmer and Walsh Rivers	Y	2
Grader grass	*Themeda quadrivalvis*	Highly invasive annual grass, especially of black soils and roadsides		
Leucaena	*Leucaena leucucephala*	Although planted for stock fodder but a highly aggressive smothering shrub.		
Neem tree	*Azadirachta indica*	Introduced tree that self-seeds. Currently forming thickets, soon to be a serious pest.		
Prickly acacia*	*Acacia nilotica*	An introduced legume particularly invasive in savannas and grasslands	Y	2
Rubber vine	*Chryptostegia grandiflora*	An aggressive vine, especially riparian areas. High priority in specific locations - e.g. Upper Gilbert	Y	2
Salvinia	*Salvinia molesta*	Water weed from aquariums covers water bodies	Y	2
Candy leaf	*Stevia ovata*	Tall perennial herb, white flowers. Known adjacent to the region, near Ravenshoe and Herberton		
Water lettuce*	*Pistia stratiotes*	Aggressive wetland plant, known from the adjacent coastal areas		2

*biosecurity risk for entering the Northern Gulf region

PRIORITIES FOR A STRATEGIC APPROACH TO WEED MANAGEMENT ACROSS THE REGION

The priorities discussed here relate to a regional strategic approach to weed management. These priorities do not encompass all priority weeds identified by the various councils across the region, but

focus on providing the best support at a regional level. The highest priority is given to highly damaging weeds with relatively limited regional distribution or species that are not currently present but have a high probably of being spread into the region. Key locations for some widely distributed weeds, such as rubbervine in the upper Gilbert River catchment, are also seen as priorities for Northern Gulf support.

This weed prioritisation process used a standard risk analysis, based on the combination of the impact of each weed, its legal status, its current and potential distribution and rate of spread. The weed distribution information was based on advice collated from consultation with local weed practitioners, well as maps from Queensland Herbarium data (Herbrecs) and Queensland Department of Agriculture, Fisheries and Forestry.

Following the risk and priority evaluation process, the weeds considered to have high and the highest priority in the tablelands area for input by the Northern Gulf, through landholder awareness, training and funding programs, are detailed below.

Weeds considered the highest priority:

- Gamba grass, *Andropogon gayanus*, a Class 2 weed, is considered one of highest priority weeds in the region because of the relatively limited regional distribution (currently restricted the Mareeba, Undara, and Peninsula road areas) and the extreme effects on ecosystems and pasture conditions.
- Koster's curse *Clidemia hirta*. This Class 1 weed can spread very rapidly and causing considerable pasture and environmental damage due to its ability to develop into dense smothering thickets. It is currently known, and being managed by the Mareeba Shire Council, in the Julatten area and creeks upstream from the Mitchell River.
- Olive Hymenachne, *Hymenachne amplexicaulis*. This Class 2 weed is known from near Mareeba and Mt Molloy areas, and also north of Normanton.
- Parthenium, *Parthenium hysterophorus*. This Class 2 weed is known from Mareeba and Tolga areas, and may be within the edge of the region. Ongoing vigilance is required because of the likelihood of repeated seed sources arriving in stock feed and on vehicles from outside the region.
- Siam weed, *Chromolaena odorata*. This is a Class 1 weed that has undergone considerable control effort in the Wet Tropics. It is known form the Irvinebank area.
- Water hyacinth, *Eichhornia crassipes*. This Class 2 weed is known from the Kowanyama area and also to the east of the region, north of Cairns.

Weeds considered a high priority:

- Bellyache bush, *Jatropha gossypiifolia*
- Giant rats tail grass, *Sporobolus fertilis* and *S. pyramidalis*
- Giant sensitive plant, *Mimosa diplotricha*
- Grader grass, *Themeda quadrivalvis*
- Leucaena, *Leucaena leucucephala*
- Mesquite, *Prosopis pallida*

- Neem, *Azadirachta indica*
- Physic nut, *Jatropha curcas*
- Prickly acacia, *Acacia nilotica*
- Rubbervine, *Cryptostegia grandiflora*; in specific locations only, e.g. upper reaches of Gilbert River.
- Salvinia, *Salvinia molesta*

Weeds not yet known in the region, but considered to be on the highest priority watch list for public awareness and immediate control:

- Chilean Needle grass, *Nassella neesiana*; currently present in the Toowoomba region, but is likely to grow in this region and the flow of vehicles between regions makes it possible it could establish in the Northern Gulf.
- Candy leaf, *Stevia ovata*, is a tall perennial herb, currently known from very recent collections near Herberton and Ravenshoe (i.e. adjacent to this region).
- Fire weed, *Senecio madagascariensis*; currently known in the Wondecla district.
- Fragrant thunbergia *Thunbergia fragrans*; currently known in the Wet Tropics.
- Laurel clockvine *Thunbergia laurifolia*; currently known in the Wet Tropics.
- Limnocharis or yellow burrhead *Limnocharis flava*; currently known in the Wet Tropics and Townsville district.
- Mexican feathertop, *Nasella tenuissima*; currently present in the Longreach region.
- Miconia, *Miconia* spp.; currently known in the Wet Tropics.
- Mikania vine *Mikania micrantha*; currently known in the Wet Tropics.
- Mimosa, *Mimosa pigra*; currently present in the Northern Territory and Prosperine.
- Pond apple, *Annona glabra*, is a shrub of wetlands, which is a problem in adjacent Wet Tropics areas.

Priority action summaries for critical weeds

Four weed species are considered a very high priority for the Northern Gulf region, all of which are found on the Northern Tablelands. Below is a summary of each of the weeds, areas where the species have been recorded and priority areas for control/containment.

Siam Weed (*Chromolaena odorata*) is a Class 1 declared weed. It has the large smothering habit of lantana, with a higher seed production and dispersal capability.

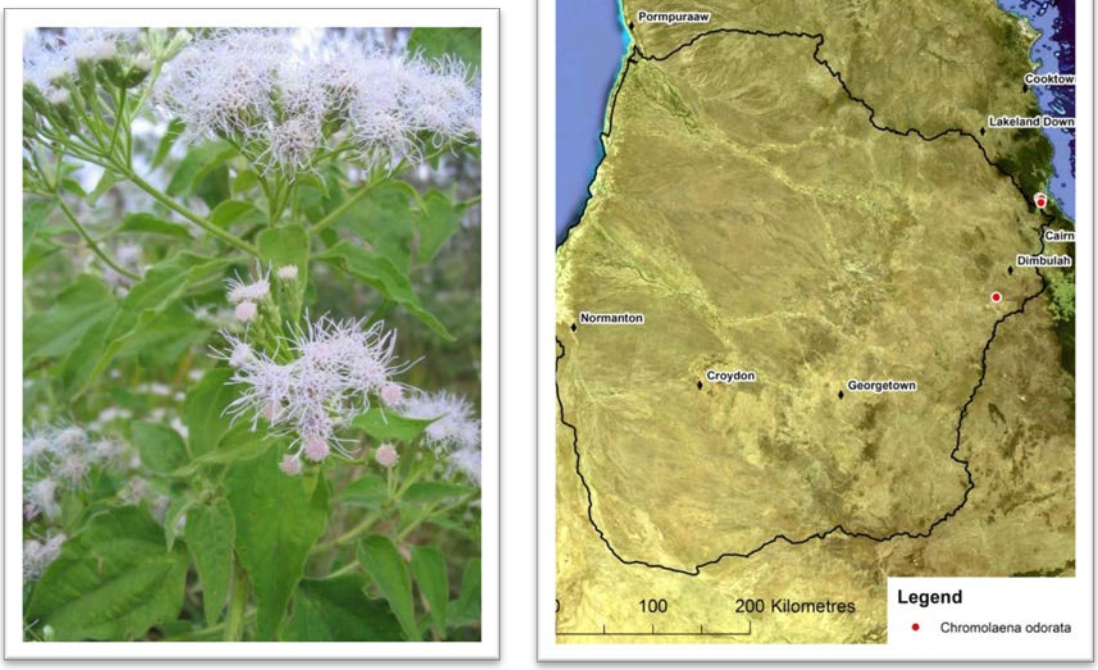


FIGURE 15. RED DOTS INDICATE THE LOCATIONS OF SIAM WEED (CHROMOLAENA ODORATA)SPECIMENS SUBMITTED TO THE QUEENSLAND HERBARIUM (SOURCE: QUEENSLAND HERBARIUM HERBRECS). THE NGRMG BOUNDARY IS INDICATED BY THE BLACK LINE.

Key locations for containment and / or control of Siam weed in the region:

1. Julatten district.
2. Irvinebank district.

Critical actions:

1. Focus land holder awareness information towards people in the key locations identified above.
2. Promote the values of vehicle and machinery wash down.
3. Support funding proposals for control of Siam weed.

Koster's Curse (*Clidemia hirta*) is a very invasive shrub which is a Class 1 declared weed.

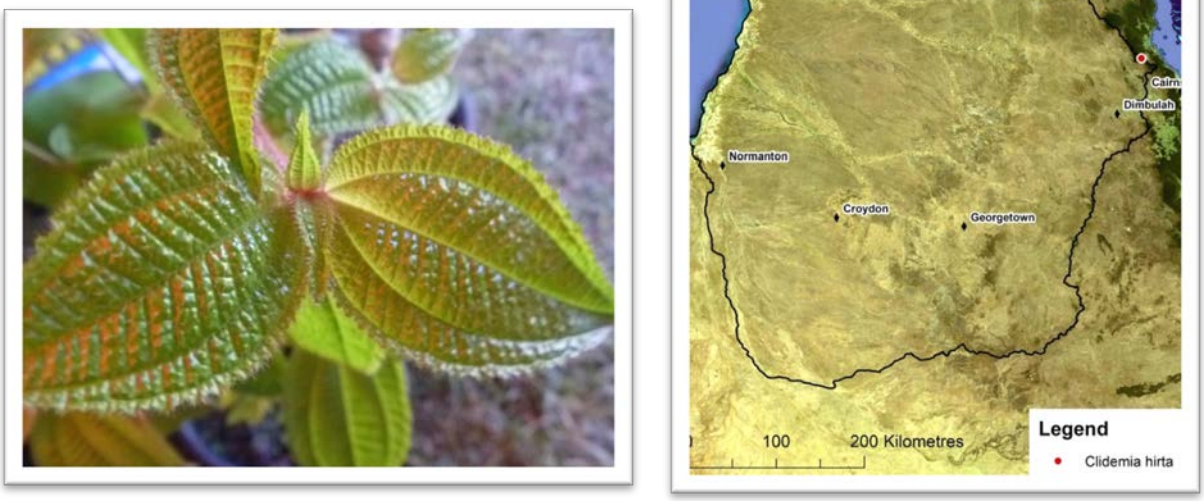


FIGURE 16.. RED DOTS INDICATE THE LOCATIONS OF KOSTER'S CURSE (CLIDEMIA HIRTA)SPECIMENS SUBMITTED TO THE QUEENSLAND HERBARIUM (SOURCE: QUEENSLAND HERBARIUM HERBRECS). THE NGRMG BOUNDARY IS INDICATED BY THE BLACK LINE.

Key locations for containment and/or control of Koster's Curse in the region:

1. The Julatten-Mt Molloy district is the only known locality in the region.

Critical actions:

1. Focus land holder awareness information towards people in the key locations identified above.
2. Promote the values of vehicle and machinery wash down. The Mt Surprise public wash down facility is a critical location to reducing the threat of spreading Gamba grass into the gulf by vehicles.
3. Support the Mareeba Council's active Koster's Curse control program.
4. Investigate in funding options for control of Koster's Curse.

Gamba grass, *Andropogon gayanus*. This Class 2 weed greatly increases fire intensity and smoothers out other flora, due to its high biomass. It is crucial to stop it spreading into the gulf region, and important to contain it in the Mareeba to Lakeland Downs corridor.

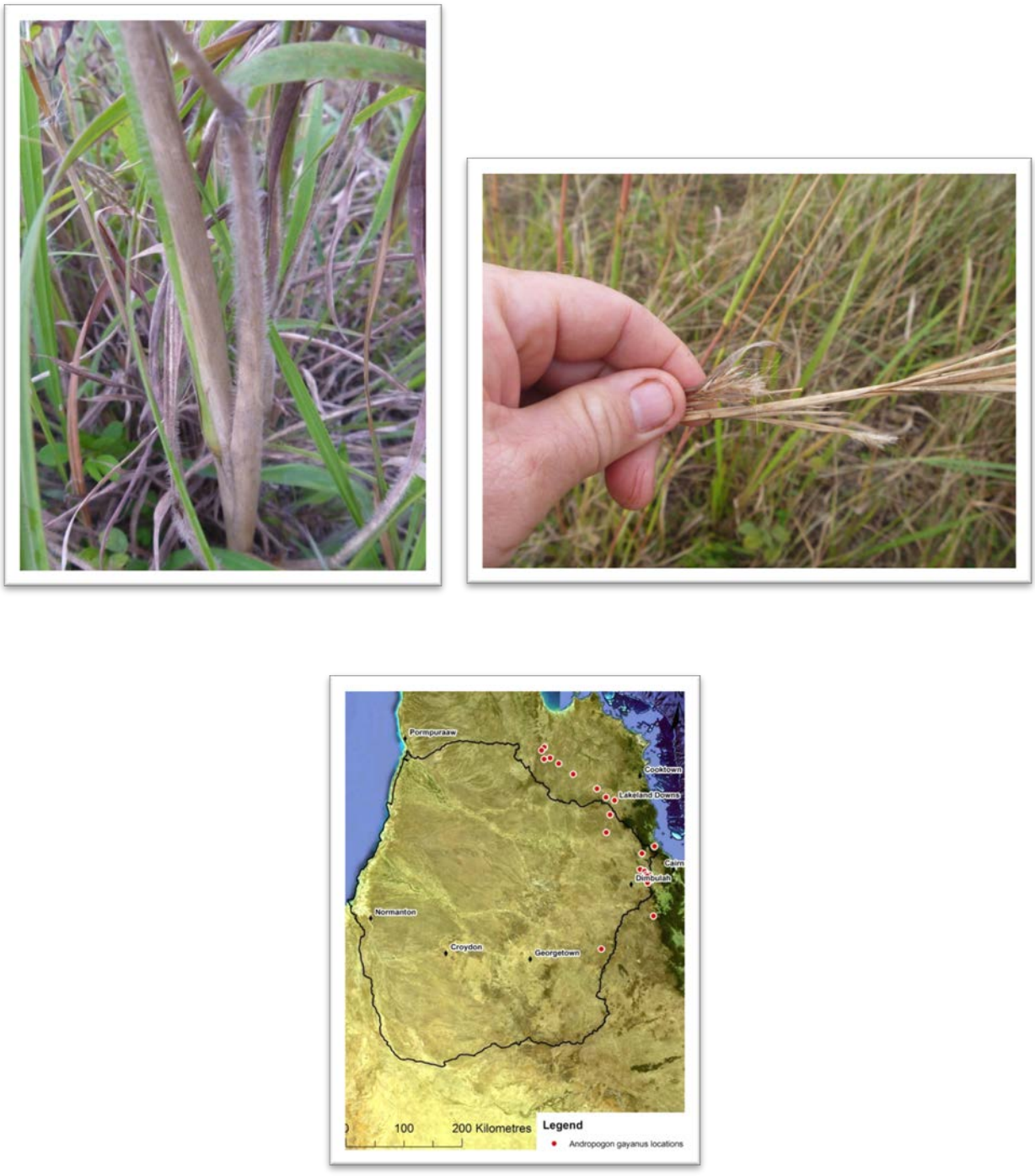


FIGURE 17. RED DOTS INDICATE THE LOCATIONS OF GAMBA GRASS (ANDROPOGON GAYANUS) SPECIMENS SUBMITTED TO THE QUEENSLAND HERBARIUM (SOURCE: QUEENSLAND HERBARIUM HERBRECS). THE NGRMG BOUNDARY IS INDICATED BY THE BLACK LINE.

Key locations for containment and / or control of Gamba grass:

1. Mulligan Highway between Mareeba and Lakeland Downs.
2. Walkamin-Mareeba district, especially near roads
3. The Mareeba wetlands.

Critical actions:

1. Focus land holder awareness information towards people in the key locations identified above.
2. Promote the values of vehicle and machinery wash down. The Mt Surprise public wash down facility is a critical location to reducing the threat of spreading Gamba grass into the gulf by vehicles.
3. Support finding proposals for control of gamba grass, especially in to the south and west of Mareeba, such as the Gulf and Burke Development roads, to reduce the risk of spread to the gulf district.

Olive Hymenachne (*Hymenachne amplexicaulis* cv. Olive) is a class 2 declared weed that smothers wetlands and is currently fairly limited in distribution across the region.

FIGURE 18. RED DOTS INDICATE THE LOCATIONS OF OLIVE HYMENACHNE (HYMENACHNE AMPLEXICAULIS CV. OLIVE) SPECIMENS SUBMITTED TO THE QUEENSLAND HERBARIUM (SOURCE: QUEENSLAND HERBARIUM HERBRECS). THE NGRMG BOUNDARY IS INDICATED BY THE BLACK LINE. THIS REGION IS STRATEGIC IN SPANNING THE NATIONAL OLIVE HYMENACHNE CONTAINMENT ZONE (MOST OF REGION) AND HIGH RISK PREVENTION ZONE (THE GULF SOUTH OF NORMANTON).

Key locations for containment and/or control of Olive Hymenachne:

1. Mt Molloy to Julatten district.
2. The Mareeba district.

Critical actions:

1. Focus land holder awareness information towards people in the key locations identified above.
2. Promote the values of boat, vehicle and machinery wash down.
3. Support finding proposals for control of Olive Hymenachne in the key locations, especially around Normanton, to reduce the risk of spread to the gulf district.

7.8.3 FIRE

FIGURE 19. LOW INTENSITY FIRE IMPLEMENTED BY A SPOT IGNITION TECHNIQUE

Fire is a crucial factor influencing the condition of Northern Gulf ecosystems (Figure 19). Most ecosystems in the region benefit from some fire in the landscape, whether they are eucalypt woodlands with fire-promoted plant regeneration, or fire-sensitive *Acacia* thickets that benefit from low intensity protection burns in adjacent ecosystems.

Summer wet seasons can produce abundant grass in the eucalypt woodlands and grasslands, with these grasses drying off (curing) during the subsequent dry season. The consistency of this cycle leads to frequent and extensive fires across Northern Australia (Gill et al. 2009). Grasses rapidly regenerate following fire, re-establishing fuel loads and creating the potential for fire intervals as low as one or two years in high rainfall tussock grass areas on Cape York Peninsula and around 5 years in semiarid spinifex areas (Felderhof & Gillieson 2006; Gill et al. 2000).

A high proportion of native plants of the eucalypt woodlands and grasslands across Northern Australia survive fire by re-sprouting, providing some stability in species composition (Cowley et al. 2014; Russell-Smith et al. 2012; Williams et al. 2003). This vegetative regrowth stems from buds located on the branches, trunks, roots or base of a plant. Given adequate soil moisture, regrowth can be rapid due to reserves stored in the stem and roots of plants.

The seed germination of many eucalypt woodland plants is triggered by fire as a result of several distinct cues. The heat of a fire can promote germination by breaking physical restraints in the seed coat of some plants, such as legumes (Clarke et al. 2000). Seed dormancy can also be broken chemically as a result of a fire, from smoke,

charcoal and increased nitrates in the soil (Williams et al. 2014). The short-term release from competition provided by the removal of the grass biomass after fire may also enhance seed germination.

Fire is also essential for the management of native fauna and their habitats, where the production of a fine scale patchwork of burnt areas can be used to maintain a continuous supply of grasses and herb seeds throughout the year, which is important for many granivorous birds, such as finches (Williams 2009b). In contrast, extensive areas that are completely burnt-out will have reduced food and shelter over large areas, increasing competition between animals and threats from predators.

Unmanaged wildfires in north Queensland can be more severe and extensive than planned burns (Williams et al. 2015). The way fires are ignited can have considerable impact on fire intensity, with spot ignitions less severe than fires ignited from a continuous fire line (Williams *et al*. 2015). Recent declines in small native mammals (< 2 kg) in the Northern Territory has been linked to extensive and less patchy fires (Lawes et al. 2015).

In a recent review of fire regimes across the region, Gobius et al. (2014) found that several areas had been receiving fire regimes that are broadly reflective of expert opinion for their local ecosystems. On the Northern Tablelands these areas include the Atherton and Herberton-Wairuna areas. Therefore refinement in fire programs will require an increase in the frequency of fire in some areas (mostly in the south of the region) and a reduction in fire frequency in some northern sections of the region.

Fires produce substantial emissions of greenhouse gases such as carbon dioxide, carbon monoxide, methane and various oxides of nitrogen. Fires in Australian savannas contribute to approximately 3% of the national greenhouse gas emissions, however on a regional NRM perspective the Northern Gulf region would contribute minimally to these emissions as prescribed burning is not used extensively across the region. The emission of greenhouse gases varies with fire regimes, with late dry season fires resulting in relatively high greenhouse gas emissions (Williams 2007).

Useful information can be found at <http://www.nprsr.qld.gov.au/managing/planned-burn-guidelines.html>.

7.9 Fauna Assets

The current Wildnet data has identified a rich and diverse array of vertebrate fauna inhabiting the Northern Gulf region. This includes 99 native mammal, 163 reptile, 56 amphibian and 446 bird species. Of these a total of 15 native mammal, 14 reptile, 23 amphibian and 69 bird species are wet tropics specific and found predominantly on the Northern Tablelands (Table 8).

***TABLE 8*: THE NUMBER OF SPECIES AND THEIR CONSERVATION STATUS (STATE AND FEDERAL LEGISLATION) IN THE NORTHERN TABLELANDS IN THE NORTHERN GULF REGION.**

Order	Total	Nature Conservation Act listing		
		Near threatened	Vulnerable	Endangered
Mammals	15	1	0	0
Reptiles	14	1	0	0
Amphibians	23	2	2	6
Birds	69	2	0	1

The Northern Gulf provides significant habitat for a number of species listed as threatened under the Australian Government legislation (E***nvironment Protection and Biodiversity Conservation Act 1999*** (the EPBC Act)). These include: the golden-shouldered parrot (Psephotus *chrysopterygius*); gouldian finch (*Erythrura gouldiae*); star finch (eastern subspecies) (*Neochmia ruficauda ruficauda*); red goshawk (Erythrotriorchis radiatus); northern quoll (Dasyurus hallucatus); and the yakka skink (Egernia rugosa). Suitable habitat for the water mouse (Xeromys myoides) also occurs in this region (DEWHA 2009), however there have been no sightings to date.

The Northern Gulf region is also home to a wide range of invertebrate species. Two main faunal groups, ants and termites, are abundant and diverse. A number of unique and endemic invertebrate species are found within cave systems throughout the region, many of which are undescribed (Clarke 2010). Studies have shown ant communities to be sensitive to disturbance and are widely used as bio-indicators in land monitoring and assessment programs (Andersen & Majer 2004).

7.9.1 Protected estate

National Parks and other protected areas

There are currently 25 protected areas within the Northern Gulf region, 13 of these are located on the Northern Tablelands. These are predominantly made up of National Parks and Resource Reserves.

Can we list??

7.9.2 Nature Refuges

There are currently twenty-four four gazetted Nature Refuges on properties in the Northern Gulf region, four of which are located on the Northern Tablelands. A Nature Refuge is an area of land voluntarily protected for conservation, while allowing compatible and sustainable land uses to continue. Most nature refuges occur in a natural condition, with a proportion being under sustainable natural resource management. The aim of many of the nature refuges in Northern Gulf is to undertake low-level non-industrial use of natural resources that are compatible with nature conservation. The Northern Gulf Resource Management Group Nature Refuge Program, funded by the

Australian Government's Biodiversity fund provides financial incentives for landholders managing nature refuges to undertake projects that formally protect significant conservation values on their land and enhance the resilience of the property. This funding can often provide mutually beneficial outcomes, for example: fencing stock off river frontages improves the ecological condition of the riparian area while also assists with stock management such as reducing costs of mustering cattle from river beds in the dry season.

7.9.3 Fauna surveys

Northern Gulf remains one of the least studied management areas for biodiversity in Australia. There are few publications in the scientific literature specific to the region, and numerous unpublished reports. Appendix XX identifies all known fauna surveys and summarises primary findings. Systematic terrestrial vertebrate fauna surveys have been conducted on only 33 properties across the Northern Gulf region, and only eight properties have had these surveys repeated. Only one location has been surveyed on the Northern Tablelands area within the Northern Gulf (Burnett 2001). Additional university studies (mostly species specific) have occurred based on information reported from landholders, however were unable to access these, and many appear to only occur as grey literature. Single species studies can be used to determine species responses to their environment and in some cases can be used to direct management activities; this can be particularly useful for threatened species and/or species that are determined to be indicators of good habitat health.

7.9.4 Wildlife connectivity

NW to insert generic statement about the value of wildlife connectivity???

The following maps were taken from the Tablelands Regional Council's draft planning scheme, prior to their de-amalgamation in 2013. They depict suitable areas to restore to link wildlife habitat throughout the districts of the Northern Tablelands.

SR to insert maps

Figure 20: map x

7.10 Threats to Fauna

7.10.1 Pest animals

Pest animals pose a significant threat to ecosystems across the Northern Tablelands. Pest species may prey upon and compete with native fauna; degrade habitat by assisting in the spread of invasive weed species; cause erosion through trampling, be hosts and vectors of diseases and pathogens, and compete with production animals through the grazing of native pastures.

The pest species which pose the most serious threats to biodiversity in the region are the feral pig (*Sus scrofa*) and the feral cat (*Felis catus*) (Centre 2007a, 2007b)(IACRC 2007a, 2007b). Both species are listed by the Queensland government as 'abundant and widespread' throughout the Northern Gulf region (IACRC 2007a, 2007b). The impacts of feral pigs and cats on biodiversity values have been listed as key threatening processes under the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999*. The cane toad (*Rhinella marina*) and the European rabbit (***Oryctolagus cuniculus)*** also occur throughout the Northern Tablelands.

Feral pigs

Feral pigs cause economic losses to production systems through direct losses to agricultural production, the continued cost of pig control and indirect losses from missed opportunity to create profits from alternative investments (McGaw

& Mitchell 1998). Feral pigs impact on agricultural productivity by reducing sugar cane and tropical fruit crop yields. The Atherton Tablelands is one of the most agriculturally diverse areas in Australia. Commercial species grown include Mango, Lychee, Macadamia, Banana, Sugar cane, Maize, Avocados, Coffee, Tea, Citrus, Pawpaw, Stone fruits, Pineapple, Peanut, Navy bean and a myriad of horticultural crops such as pumpkins, melons, potatoes and most vegetable crops. It has an extensive fodder and seed industry growing both legume and grass species. Feral pigs have been known to feed on all of the above crops at one time or another (Authority 2008, WTMA 2008). The species can cause degradation of native pasture and can facilitate the spread and establishment of weeds and woody vegetation (Bradshaw et al. 2007; Hone 1980). Feral pig damage is exacerbated along drainage lines, riparian areas and wetlands as the species congregate and feed in these areas (Hone 1988, 1995; Mitchell 1993). Digging behaviours in soft soils reduces regeneration of plants and causes degradation of soil biology, which may cause drastic changes to the composition of native vegetation communities (McGaw & Mitchell 1998).

Feral pigs also cause environmental damage through degradation of habitat and competition with native fauna for food resources. The species are omnivorous with a diet including: tubers, native seeds and fruits, earthworms, amphipods, beetles, frogs, lizards and the eggs of crocodiles and turtles (Consulting 2006; McIlroy 1990; Mitchell 1993; Pullar 1950; Roberts et al. 1996; Tisdell 1984) KSE 2006). They also prey on small nesting birds, eggs and some aquatic species, and have been implicated in the decline of the snake-necked turtle (Tisdell 1982). Feral pigs also have the potential to be vectors of zoonotic diseases such as Japanese encephalitis which was found in Torres Strait pig populations in 2004 (Department of Health and Ageing, 2004, *In* Bradshaw *et al.* 2007) and Cryptosporidium and *Echinococcus granulosus* (Jenkins 2006).

Pig control options include ground and aerial bait dispersal, trapping, fencing, ground hunting, fertility control and aerial culls by shooting from helicopters (Hone 2012; Mitchell 2011). In regions as remote and vast as the Northern Gulf, aerial culls are often considered to be the most viable option, but they are expensive. Feral pig control needs to be regularly repeated to maintain the reduction in pig numbers. Poisoning is 'the most appropriate technique for large scale feral pig population control' because it is economic, efficient and is accessible (Mitchell 2011). Poison baiting can affect non-target species such as goannas and birds of prey, but with careful selection and management of the baits and poisons used, non-target impacts can be reduced considerably (Mitchell 2011). A feral pig program must consider a range of management options, as pigs can become wary of baits, can become trap-shy, and wary of shooters. The critical points of feral pig control are to achieve at least 70% reduction in populations for at least several years in a row, within a catchment where ingress of replacement pigs in minimal. Therefore coordinated efforts between properties and across regions are essential to success. Monitoring of pigs by aerial and ground counts is necessary to ensure that populations are reduced, so that the efforts are not wasted. It is often best to undertake control when pigs are concentrated rather than dispersed, such as during the late dry season. Targeted baiting programs to reduce pigs at critical times (such as leading up to the turtle nesting season or during the dry season where wetlands may be more vulnerable to damage) can be highly effective in reducing pig damage. This improves success rates and reduces effort, thereby reducing costs (Hone 2012; Mitchell 2011). A side effect of feral pig control may be that predators which relied substantially on pigs for the diet, such as dingoes, may switch to other prey, such as cattle, kangaroos and wallabies and smaller mammals. Monitoring of populations of these larger predators should be included in the feral pig monitoring program.

FERAL CATS

Feral cats prey on native birds, frogs, reptiles and small mammals. The success of the feral cat can be largely attributed to the lack of native meso-predators and the efficacy of the species hunting behaviour (Kutt 2012). The group of species most impacted by feral cat predation throughout northern Australia are critical weight-range mammals (35g to 5.5kg) with gut content analysis indicating that cats in northern Queensland have a strong dietary preference for small mammals (Dickman 1996; Kutt 2012). In particular, four of the five species of native mammal considered to be declining in Northern Australia, (the northern quoll, ***Dasyurus hallucatus***; northern brown bandicoot, *Isoodon macrourus*; common brushtail possum, *Trichosurus vulpecula* and pale field-rat, *Rattus tunneyi*) are found in the Northern Tablelands and of these, most overlap the medium to high selectivity size for the feral cat diet recorded in North Queensland (Kutt 2012). Cats can also act as hosts and vectors of a number of wildlife diseases, notably toxoplasmosis.

Control options for feral cats include fencing (the only feasible option for complete removal from protected areas), shooting, poisoning using lethal baits and trapping (Department of Agriculture 2013, DAFF 2013). Currently there are no viable options for controlling feral cats over large areas. Baits specifically developed to target cats (Eradicat® and Curiosity®) have shown to be effective; however these may also poison non-target species (Hetherington et al. 2007; Johnston et al. 2011). More research is required to further develop these baits for safe application across Australia.

EVIDENCE OF CAUSAL LINKAGES BETWEEN FERAL CATS AND SMALL MAMMAL DECLINE (DICKMAN 1996)

The range of species consumed by feral cats varies depending on the environment and prey availability. Birds and reptiles are the predominant prey item consumed on islands in arid areas respectively. Across the dry tropical savannas, mammals below 200g in weight have been found to be a preferred prey item. The predation of small mammals has implicated cats as one of the factors causing the decline of small to medium sized mammals across Northern Australia. Historical records show that all mammal species that disappeared from the Australian mainland by the 1850's weighed 200g or less, this timing is consistent with the introduction of the cat. The loss of these animals pre-dates the introduction of the rabbit and fox, as well as broad-scale changes to the landscape. Habitats of many now-extinct species were open plains, grasslands and woodlands, which provided limited shelter from visually hunting predators. Several of these species would have had behaviours which made them conspicuous to cats, including hopping, ground foraging and nesting.

FERAL CAT DIET- A STUDY IN CHARTERS TOWERS AREA (KUTT 2012)

A total of 169 cat stomachs were examined, containing 974 items, representing 106 unique prey types. The prey items consisted of invertebrates (10 genera/ families), amphibians (9 species), reptiles (43 species), birds (21 species) and mammals (23 species).Of the 974 prey items identified, 8% were invertebrates, 9% amphibians, 41% reptiles, 20% birds and 22% mammals. This study demonstrates that feral cats consume a large amount of prey per cat (approximately 200 g per cat, per night) and that mammals are the dominant prey item by mass in the 100-3500 g range (other prey species have few species within this size class), although reptiles and birds within 10g-100g weight range are a major component of the diet. The size and amount of native fauna in the cat diets of this study are of particular concern for northern Australia and suggest that predation by introduced carnivores such as feral cats is possibly a significant cause of mammal extinctions in the small size range.

CANE TOADS

The Cane toad is a serious threat to biodiversity as it poisons, preys upon and competes with native species. Although the cane toad has not caused the extinction of any native Australian fauna (Bradshaw et al. 2007), evidence shows that they have caused major declines and local extinctions of some goanna species (Taylor & Edwards 2005). Evidence also suggests that a wide range of species are impacted by cane toads including mammals (dingo, *Canis lupus dingo*; northern quoll, Dasyurus hallucatus), birds (kookaburra, *Dacelo* spp.;little and black bitterns, Ixobrychus minutus, I. flavicollis), reptiles (red-bellied black snake, *Pseudechis porphyriacus;* mulga snake, *Pseudechis australis;* green tree snake, *Dendrelaphis punctulata;* dragons and goannas) and frogs. There are, however, very few studies that present any data on population consequences of mortality from poisoning (Taylor & Edwards 2005). Control options for cane toads include exclusion fencing, live trapping and direct killing through bounty hunting (Taylor & Edwards 2005). Currently there appears to be no financially viable option for controlling cane toads over large areas.

SPECIES ADAPTATIONS TO CANE TOADS (O'DONNELL ET AL. 2010; TAYLOR & EDWARDS 2005; WOINARSKI

ET AL. 2008)

All stages of the cane toad's life cycle (eggs, tadpoles, toadlets and adult toads) are poisonous. If ingested, the poison can cause rapid heartbeat, excessive salivation, convulsions and paralysis and, in severe cases, death. Some species such as the keelback (*Tropidonophis mairii*) appear to have a high level of resistance to cane toad poison (Phillips *et al.* 2003), other species avoid ingestion of poisonous parts (e.g. ravens and crows (*Corvus spp.*) (Covacevich & Archer 1975) or reject eggs or tadpoles if they are caught (e.g. barramundi (*Lates calcarifer*) (Crossland 1997). Although the cane toad has been implicated in the decline and change in distribution of the northern quoll, studies have now found the species coexisting with cane toads across Queensland (Woinarski et al. 2008). It is not known if the quolls' persistence is due to some quolls having developed avoidance behaviours.

Researchers from the University of Sydney have successfully trained northern quolls to avoid eating cane toads by feeding the animals a dead toad containing a nausea-inducing chemical (thiabendazole) (O'Donnell et al. 2010). Results from this study show that toad-smart quolls were less likely to attack toads, and females were less likely to attack than were males. These results show that conditioned taste aversion is possible in this species and may have assisted the northern quoll to persist in the presence of cane toads (O'Donnell et al. 2010).

DINGOES AND FERAL DOGS

Dingoes and feral dogs may impact on native fauna through predation and by competition with native predators. Although dingoes in some areas have shown a preference for mammals in their diets (Dickman 1996), their impacts on mammal communities are considered to be less than feral cats (Bradshaw et al. 2007). There is evidence of a high degree of hybridisation of native dingoes and feral dogs in some areas (Crowther et al. 2014). Dingoes and hybrid animals are considered to have some beneficial impacts on native wildlife, by restricting populations of feral cats and foxes (Dickman 1996) however, the story is not clear and is subject of considerable debate recently (eg. (Allen et al. 2014; Letnic et al. 2012; Ritchie 2011). The risk of predation of livestock has resulted in wide scale control of feral dogs using toxic baits and shooting by property managers. The reduction in feral dog numbers is considered to be one of the key reasons why cat populations have become widespread and subsequently caused a loss of small native fauna (Brook & Kutt 2011; Fitzsimons et al. 2010).

MANAGING FERAL SPECIES

Population control is often used to reduce the environmental damage caused by feral animals as eradication is not considered to be a viable option for most feral species in Australia. Controlling populations through culling is generally not a long-term solution, as populations recover quickly, particularly for species with high fecundity. Other methods such as exclusion fencing or targeted control programs with direct management objectives may be more effective in protecting highly vulnerable environmental assets or rare or threatened fauna communities.

POISONING FOR FERAL DOGS, PIGS OR FERAL CATS REQUIRES A PERMIT

If using fresh meat baits containing 1080 an APVMA Permit (PER14015 effective until 30 June 2016) is required. 1080 baits can only be obtained from authorised persons from local government or Biosecurity Queensland (you can obtain the details of authorised persons from your local council).

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