The Australian Wet Tropics Region

Biocarbon Sequestration and Abatement Project based on Regional Natural Resource Management

PROJECT DESIGN DOCUMENT
IN COMPLIANCE WITH THE CLIMATE, COMMUNITY AND BIODIVERSITY STANDARDS (CCB)

Version 2

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Cover photo: Endangered Green Ringtail-possum *Pseudochirops archeri* in threatened remnant of rainforest type 7.8.4 in the Atherton highlands, by Penny van Oosterzee.

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EXECUTIVE SUMMARY

The Wet Tropics Biocarbon Sequestration and Abatement Project (the Project) described in this Project Design Document (PDD) will develop voluntary emission reductions (VERs) based on integrated, regional natural resource management (NRM) activities of hundreds of landholders, extending back two decades, carried out under Far North Queensland's NRM body, Terrain NRM Ltd. Terrain's activities are largely incentive and education-based. Like most NRM bodies they must allocate limited funding and resources to maximise environmental outcomes. The NRM activities supported and encouraged at the landholder level are inevitably additional both socio-economically and technically.

These NRM activities are laid out in the latest iteration of the Regional Plan, "Sustaining the Wet Tropics: A Regional Plan for Natural Resource Management" (2004-2008), which has stream-lined mechanisms to continue the shift towards sustainable management of natural resources that includes reduced emissions and net sequestration of GHGs.

In 2007, Terrain NRM entered into the Degree Celsius Joint Venture with private enterprise company BIOCARBON Pty. Ltd. to aggregate and trade the regional Biocarbon pool. This PDD, the first major outcome of Degree Celsius, uses the Wet Tropics Regional Plan as its framework. These NRM activities not only reduce and remove GHGs but also contribute to sustainable land use practices, conserve biodiversity, and help build the resilience of the World Heritage Wet Tropics rainforests and the World Heritage Great Barrier Reef, two environments particularly threatened by climate change and requiring a regional mitigation approach to have any hope of surviving intact.

Payment for ecosystem services via this regional aggregation approach to carbon trading provides the first time that the NRM activities of hundreds of small holders in the region can be recognised and rewarded. We believe that the impact of this recognition has the potential to further incentivize interest in landholder NRM activities, which will maximise NRM synergies within the region, and catalyse the building of measurable resilience into this global biodiversity hotspot.

The project is using a range of methodologies to cover a range of GHG sequestration and abatement NRM activities covering the full scope of agriculture, forestry and land use (AFOLU) activities using definitions from the Voluntary Carbon Standard *Guidance for Agriculture, Forestry and Other Land Uses*, including avoided deforestation and degradation (REDD), farm forestry and selective logging (IFM), reforestation and revegetation (ARR), grazing land management and sustainable agriculture (ALM). The forest related methodologies, in particular, are well developed, and finance from the sale of these VERs will enable the implementation of landscape-scale sustainable agricultural management in the Wet Tropics which form part of the catchment of the Great Barrier Reef.

The regional approach presented here, with its aggregation of GHGs at a landscape scale, across a range of activities, also provides a robust approach to risk management, particularly with respect to permanence. This Project Design Document is intended to provide a qualified CCBA auditor with enough information to assess the project against CCB Standards and to determine if the project passes, and if so at what level. We are keen to achieve the Gold level, and are prepared to work assiduously to achieve this.

It is intended that this integrated regional NRM Biocarbon case will itself be a pilot for the NRM regions that flank the 2,300 km Great Barrier Reef, and define its catchments. A feature of global significance, the Reef's 3000-odd individual reefs have brilliance visible from space and an incomparable diversity of habitats, plants and animals. One of the main impacts on, and key element for, building the resilience of the Great Barrier Reef is water quality from these flanking catchments. Vulnerability assessments show that interaction between climate stressors and poor water quality are often synergistic, and seriously undermine the resilience of nearly every component of the Reef. Arguably it will be the integrated regional management of the Great Barrier Reef catchments that will determine how the Reef survives climate change now and into the future.

Importantly, the Wet Tropics Biocarbon Sequestration and Abatement Project tests an approach to AFOLU methodologies currently excluded from the Australian national emissions trading scheme. The Project attempts to showcase how important land uses, such as agriculture, are to be included in any national scheme. We believe an integrated, regional approach will provide a path forward, and that without such an approach the world may be waiting years for timely sustainable management solutions while features such as the Great Barrier Reef die.

The project will be undertaken by Degree Celsius, an ecosystem services joint venture between Terrain NRM Ltd and Biocarbon Pty Ltd.

NOTE: “Sustaining the Wet Tropics” series provides the foundation for the region’s NRM planning, and is the basis of this PDD. It can be found here:
http://www.terrain.org.au/index.php?option=com_content&task=view&id=38&Itemid=21

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1 ORIGINAL CONDITIONS AND BACKGROUND OF WET TROPICS REGION

1.1 Introduction

1.1.1 Regional Context

Australia is a developed country with a liberal democratic tradition backed by a constitution that generally reflects British and North American values including rule of law. Queensland is one of the six states of the country, and it has its own legislature and parliament. States in Australia are subject to both the national and their own constitutions, and the two levels of government cooperate in many areas. One important area is in the delivery of community-based natural resource management (NRM) through strategic investment at a regional scale where regional NRM bodies – those who demonstrably represent the majority of the community – develop regional NRM plans. These NRM plans form the basis of regional investment strategies to implement strategic action and investment in NRM activities. Though no laws specify the NRM activities laid out in the plans, which are mostly incentive and education based, Commonwealth and State governments accredit these regional plans jointly. Far North Queensland Natural Resource Management Ltd (FNQNRM Ltd), trading as Terrain NRM, is the Regional NRM body for Australia's Wet Tropics, and its history is further explained in the next section. This PDD is based on, and value-adds to, the Wet Tropics Regional Plan.

While natural resource management activities in the Wet Tropics have seen improvement, continued biodiversity loss, ongoing loss of soil, and poor quality water flowing into the Great Barrier Reef still occur. For example, Catterall and Harrison (2006) examined the rainforest restoration activities of the Wet Tropics as a result of NRM activities since around 1990. They found that much of the focus of rainforest restoration has been in very small landholdings. Compared to the 180,000 ha cleared, the total area reforested is small and, up to 2002, estimated to be in the order of 2500 ha, or about 1.5% of the Wet Tropics. Catterall and Harrison (2006) concluded that for land to be reforested at ecologically meaningful scales a greater focus on methods of reinstating forest over larger areas and a revolutionary change in funding was required. Until relatively recently NRM across Australia was problem-based, and responses were erratic rather than strategic, with little planning, evaluation and monitoring.

Terrain is considered one of the leaders in the development and implementation of strategic, integrated regional NRM. This PDD provides an avenue for securing immediate incentive payments to bolster the community-based Wet Tropics NRM plan, and ensure that it will not falter in its aims of protecting and enhancing the viability of its primary assets of biodiversity, climate, land and water, and the community.

The PDD aims to incorporate carbon sequestration and abatement within the integrated regional planning context. Regional planning systems have a high potential to contribute to sustainable economic development by integrating economic, social and environmental policies in a spatial context. Many of the issues of natural resource management such as water quality, biodiversity conservation, sustainable use of land, and carbon sequestration can be best measured and addressed technically, and administratively, at a regional scale. Regionalising NRM activities also allows for decentralisation of decisions closer to the community - at the property and local scales - facilitating more open participatory decision-making processes. Australia does not have formalised structures of statutory government which deal with NRM issues at the regional scale. Instead, there is a tendency for local, state and federal government agencies to focus on narrow sets of objectives and to operate within the confines of their own agendas. Building the capacity of local people and institutions to develop and implement improved natural resources management is central to sustainable resources management in Australia.

The Wet Tropics region of Far North Queensland, as defined here, is based on catchments of the Barron, Russell/Mulgrave, Johnstone, Tully/Murray and Herbert Rivers as well as Trinity Inlet (see **Map 1**). This is what we define here as the Project Region.

1.1.2 The Wet Tropics NRM Plan

Terrain NRM is the 2001 amalgamation of three main entities: the Wet Tropics NRM Board, a confederation of catchment and Landcare groups, and the North Queensland Afforestation Association. These organisations, in turn, have a history going back to the 1980's beginnings of the Landcare movement and, in the case of the North Queensland Afforestation Association, to the listing of the Wet Tropics World Heritage Area in 1988. At this time the Australian government introduced a Structural Adjustment Package (SAP) to compensate displaced or otherwise affected workers associated with the forestry industry. A significant component of the SAP was tree planting and community revegetation programs such as the Wet Tropics Tree Planting Scheme. Terrain is the Australian and State Government's primary mechanism to involve the community in the management of the Wet Tropics region's natural resources.

The development of Terrain's current Regional NRM Plan and Investment Strategy is explained in detail in the "Sustaining the Wet Tropics: a regional plan for Natural Resource Management 2004-2008" part of the Sustaining the Wet Tropics series found at http://www.terrain.org.au/index.php?option=com_content&task=view&id=38&Itemid=21.

In summary, the planning process involved six Community Working Groups focusing around key NRM assets of biodiversity, sustainable landuse, coasts, and rivers, a Community Capacity Building working group, and a Traditional Owner Advisory Committee. Membership of these groups was non-exclusive and involved community members with both technical and practical skills.

A Key Stakeholder Reference Group involving key representatives of government, community and industry, and a separate Working Group of Traditional Owner Elders who progressed negotiations with the Indigenous community, and made decisions on their behalf. A Science Panel provided high-level scientific support assuring best practice in decision-making, and preparation of the technical reports that underpin the Regional NRM plan. These reports include a Background Report, two Condition Reports, a report on Community Capacity and Capacity Building, and the Aboriginal Plan. Together, they comprise the "Sustaining the Wet Tropics" series.

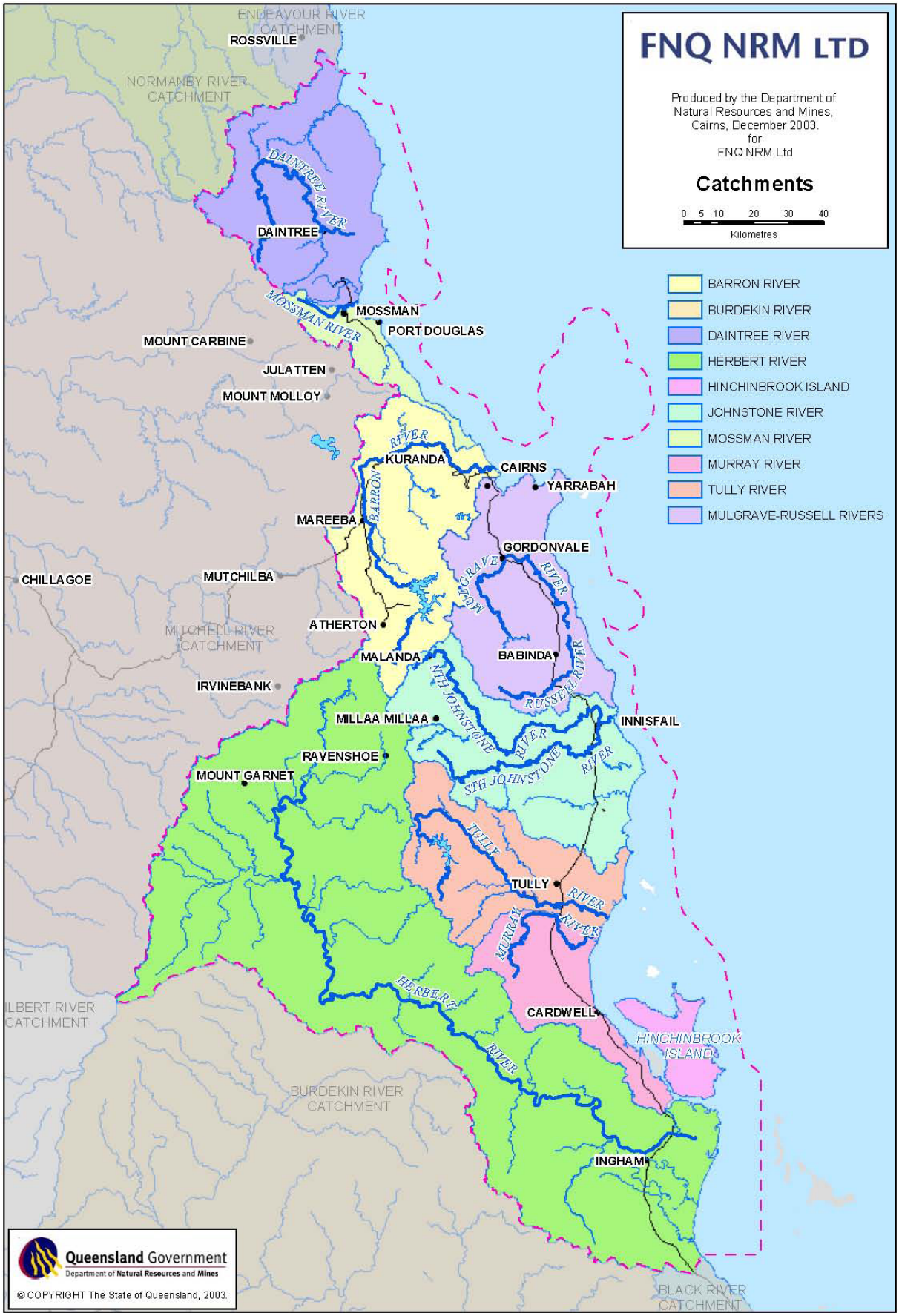
The Background Report (McDonald and Weston 2004) describes the background and context of the Plan, synthesizing over one hundred plans and strategies that had been prepared for the region. The two Conditions Reports deal with Biodiversity Conservation (Weston & Goosem, 2004) and Sustainable Use (Armour *et al.* 2004). Complementing the Condition Reports is a consultancy report on Community Capacity and Capacity Building Requirements in Relation to NRM in the Wet Tropics (Fenton 2004). Together with the Aboriginal Plan, all documents establish a continuing information base for developing sound environmental strategies and management, and for assessing the conservation of biodiversity and sustainable use of the natural resources in the Wet Tropics.

The Regional NRM plan (FNQ NRM Ltd., 2004) is based on these background and condition reports. The Regional Plan focuses on the integrated primary assets of biodiversity, climate, land and water, and social assets. Community and Aboriginal cultural and natural resource management, including indigenous ecological knowledge, are also treated as assets.

Targets and actions are at the core of the Regional Plan and are set out in terms of Aspirational Targets (Objectives) or statements about desired long-term condition of natural resources (over 50 years). Measures for achieving the targets are set in terms of resource conditions that are specific, time bound and measurable within a timeframe of 10-20 years; management action targets are short-term targets for actions that will contribute to the longer-term resource condition targets.

The Plan integrates statutory and non-statutory programs, and identifies targets and actions beyond regulation including sustainable management, restoration, rehabilitation, and off-reserve conservation. These actions often require community involvement and a more diverse set of actions, such as incentives or capacity building.

The Plan is dynamic, responsive to community needs and continuously improved as more information becomes available. A Regional Investment Strategy is developed annually to attract funding from government and corporations.



Map 1: The Project Region

1.1.3 Soil, Geology, Geomorphology, Climate

Soils, geology and geomorphology (landform) are summarised in the following **Table 1** and soils are show in **Map 2**. Generally, much of the landscape is of ancient origin with recent intrusion from volcanic activity. The ancient strata comprise sediments and volcanics that have been folded, faulted and metamorphosed to varying degrees, and widely intruded by granite and basic igneous rocks which are intensively mineralised. To the east, Palaeozoic and early Mesozoic deposits, dating back 500 million to 200 million years, resulted in thick sediments and volcanics that were folded and faulted, intruded by granite, and finally uplifted. Quaternary marine deposits, coastal dunes and alluvial plains and piedmont fans occur along the coast.

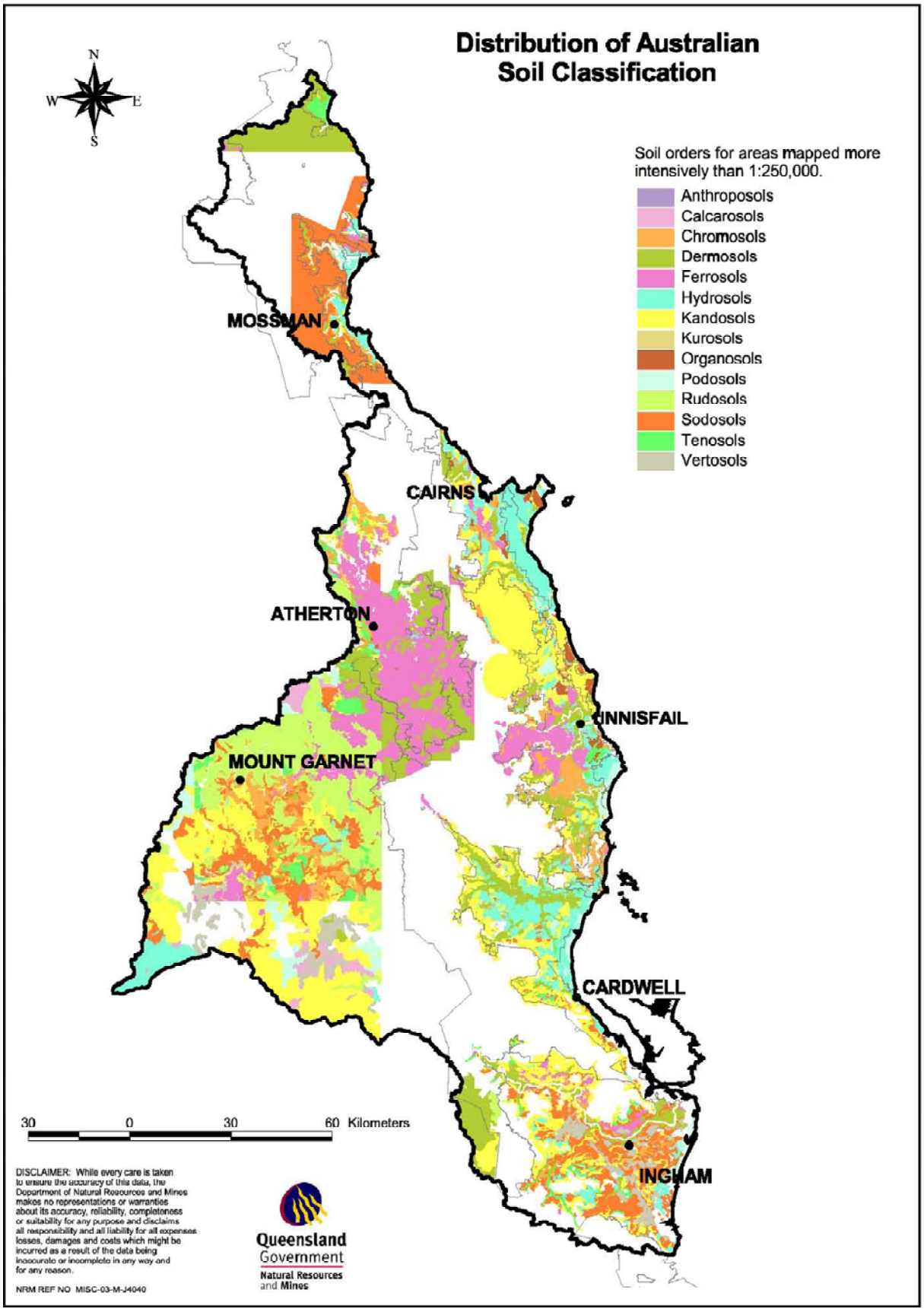
Soils types vary according to parent rock, geomorphic and climate processes. Dominant soil types include Kandosols (red, yellow and grey earths, red and brown hardpan soils); Dermosols (prairie soils, some red and yellow podzolic soils): Ferrosols; and Sodosols (solodic soils, solidized solontz, soloths and desert loams). Kandosols are most predominant in the region. They have physical properties favourable for plant growth but have low fertility and are prone to erosion. Dermosols occur mainly in the humid coastal area are quite fertile. Ferrosols are prized for agriculture particularly for sugar cane, dairying and horticulture; they exist in the high rainfall areas and are the red soils of the Atherton Tablelands. Sodosols are low in fertility with many being saline at depth.

Table 1: Subregions of the Project Area

Bioregion	Province	Percentage representation in Plan area	Geology	Landform	Soils	Vegetation
	Herbert	About 80%	Quaternary alluvium	Marine plains, salt pans, alluvial plains with relic stream channels, low stream levees and prior streams	Alluvia, gleyed podzolics, humic gleys, red earths, red podzolics, yellow earths.	Estuarine mangroves; open forests dominated by paperbark *Melaleuca quinquenervia*, pink bloodwood *Corymbia intermedia*; woodlands dominated by paperbark *Melaleuca viridiflora*, poplar gum *Eucalyptus platyphylla*, forest red gum *E. tereticornis.*
	Tully	100%	Quaternary alluvium	Marine plains, tidal flats, low beach ridges and swales, alluvial plains, channels, levees, lagoons	Siliceous sands, alluvia, gleyed podzolics, humic gleys, red earths, red podzolics, yellow earths.	Mesophyll rainforests; estuarine mangroves; coastal dune vegetation; paperbark *Melaleuca quinquenervia* forest; fan palm *Licuala ramsayi* and feather palm *Archontophoenix alexandrae* swamp; woodlands dominated by paperbark *M. viridiflora*, forest red gum *E. tereticornis*.
	Innisfail	100%	Quaternary alluvium	Low beach ridges and swales, alluvial plains, channels, levees, lagoons, low hills	Alluvia, gleyed podzolics, humic gleys, red earths, red podzolics, yellow earths.	Mesophyll rainforest ± *Acacia* spp., *Eucalyptus* spp; estuarine mangroves; coastal dune vegetation; paperbark *Melaleuca quinquenervia* forest; fan palm *Licuala ramsayi* and feather palm *Archontophoenix alexandrae* swamp; woodlands dominated by paperbark *M. viridiflora*, forest red gum *E. tereticornis*, carbeen *E. tessellaris*, pink bloodwood *Corymbia intermedia*.
	Atherton	90%	Pliocene-Holocene Atherton Basalts	Plains, low hills, scarps	Ferrosols	Complex and semi-deciduous mesophyll and notophyll rainforests; forest red gum *Eucalyptus tereticornis* tall open forests; woodlands

Bioregion	Province	Percentage representation in Plan area	Geology	Landform	Soils	Vegetation
						dominated by white stringybark *E. phaeotricha*, molloy red box *E. leptophleba*.
	Paluma-Seaview	About 50%	Lower Permian to Middle Carboniferous Granites Middle Palaeozoic metamorphics.	Ranges, high hills and mountains.	Lithosols, podzolics, red earths, solodics, xanthozems, yellow earths.	Notophyll rainforests with rose gum *Eucalyptus grandis*, turpentine *Syncarpia glomulifera* or hoop pine *Araucaria cunninghamii*; rose gum tall open forest; woodlands dominated by pink bloodwood *Corymbia intermedia*, white mahogany *E. acmenoides*, forest red gum *E. tereticornis*.
	6. Kirrama-Hinchinbrook	100%	Middle Carboniferous acid volcanics (Glen Gordon Volcanics) and Middle Carboniferous Tully Granite Complex.	Low hills, ranges, high hills and mountains.	Lithosols, podzolics, red earths, yellow earths.	Mesophyll, notophyll and microphyll forests ± turpentine *Syncarpia glomulifera*, kauri pine *Agathis robusta*; woodlands dominated by forest red gum *Eucalyptus tereticornis*, molloy red box *E leptophleba*, white mahogany *E. acmenoides*, pink bloodwood *Corymbia intermedia*, tall open forests dominated by rose gum *E. grandis*, red mahogany *E. resinifera*.
	Bellenden Ker-Lamb	100%	Lower Permian Mareeba, Tinaroo, and Bellenden Ker Granites.	High hills, high mountains.	Lithosols, podzols, yellow podzolics, yellow earths.	Complex-simple mesophyll, notophyll and microphyll rainforests ± *Acacia* spp., rose gum *Eucalyptus grandis*, turpentine *Syncarpia glomulifera*, cadaghi *E. torelliana*; tall open rose gum and red mahogany *E. resinifera* forests, woodlands dominated by gympie messmate *E. cloeziana*, pink bloodwood *Corymbia intermedia*, lemon-scented gum *C. citriodora*.
	Macalister	About 75%	Middle Palaeozoic metamorphics (Hodgkinson Formation) and Lower Permian Mareeba Granites.	Low hills and ranges	Humic gleys, red podzolics, xanthozems, yellow earths, yellow podzolics	Notophyll and mesophyll rainforests ± *Acacia* spp., kauri pine *Agathis robusta*; woodlands dominated by forest red gum *Eucalyptus tereticornis*, molloy red box *E. leptophleba*, pink bloodwood *Corymbia intermedia*, Melville Island bloodwood *C. nesophil*a.
	Daintree-Bloomfield	About 75%	Palaeozoic Finlayson Granites and metamorphics (Hodgkinson Formation).	Plains, low hills, ranges, high hills and mountains.	Lithosols, red earths, yellow earths, humic gleys, red podzolics, xanthozems, yellow earths, yellow podzolics.	Complex, simple and semi-deciduous mesophyll, notophyll and microphyll rainforests ± *Acacia* spp., *Eucalyptus* spp., kauri pine *Agathis robusta*; deciduous microphyll vine thickets; estuarine mangroves; fan palm swamps, tall open rose gum *E. grandis* and red mahogany *E. resinifera* forests, woodlands dominated

Bioregion	Province	Percentage representation in Plan area	Geology	Landform	Soils	Vegetation
						by paperbarks *Melaleuca* spp., forest red gum *E. tereticornis*, messmate E. tetrodonta, poplar gum *E. platyphylla*, red stringybark *E. pellita*, Melville Island bloodwood *C. nesophila*.
	Kidston	0.35%	Pre-Cambrian metamorphics, Pre-Cambrian and Palaeozoic granites, Carboniferous volcanics, areas of Mesozoic sandstones.	Undulating to hilly, with areas of rugged ranges.	Lithosols and podzolics, with areas of earths and clays.	*Eucalyptus crebra* woodlands and *E. shirleyi/Corymbia peltata* low woodlands. Small areas of *E. brownii* woodlands, and in the west, *E. microneura* low woodlands.
	Hodgkinson Basin	4.25	Silurian-Devonian sediments and basic volcanics, and Permian granites. Some Mesozoic sandstones.	Hilly, with areas of rugged ranges.	Lithosols and shallow loams.	Primarily *Eucalyptus cullenii* low woodlands. Areas of vine thicket.
	Undara-Toomba Basalts	2.4%	Tertiary and Quaternary basalts.	Plains, with occasional scarps and hillocks.	Krasnozems, cracking clays and lithosols.	*Eucalyptus crebra* woodlands and open forests, grasslands and vine thickets. Areas of *E. orgadophila* open woodlands.
	Herberton-Wairuna	60%	Tertiary and Quaternary deposits, with areas of Palaeozoic granites, acid volcanics and sediments, and Tertiary basalts.	Plains with areas of hills and rugged ranges.	Earths, lithosols and podzolics.	Mixed open forests including *Eucalyptus drepanophylla* and *Corymbia citriodora*; areas of *E. leptophleba* woodland.



Map 2: Soils of the Wet Tropics

Climate

Climate is a dominant driving force behind the exceptional biodiversity found in the Wet Tropics NRM region. The term 'wet' in the region's name distinguishes its mean annual rainfall of 1580 mm from the continental average of 472 mm. The rainfall is seasonal and dominated by major climatic events such as monsoons or cyclones, which occur during the wettest quarter of January to March with a mean rainfall of 1092 mm (refer **Figure 1**). The driest quarter is 116 mm and occurs from July to September.

Rainfall is variable within the NRM region (refer **Figure 1**). For instance Cairns has a total rainfall of 1992 mm on an average of 154 days whereas Babinda, only 60 km south, receives 4211 mm on an average of 157 days. Similarly, annual rainfall increases 40 mm per kilometre between Atherton and Millaa Millaa. The main factors causing this variance are proximity of mountains or the Coral Sea, and the angle of the coastline relative to the prevailing wind. Mareeba and Mt Garnet in the westerly part of the region receive 1000 mm and 772 mm respectively.

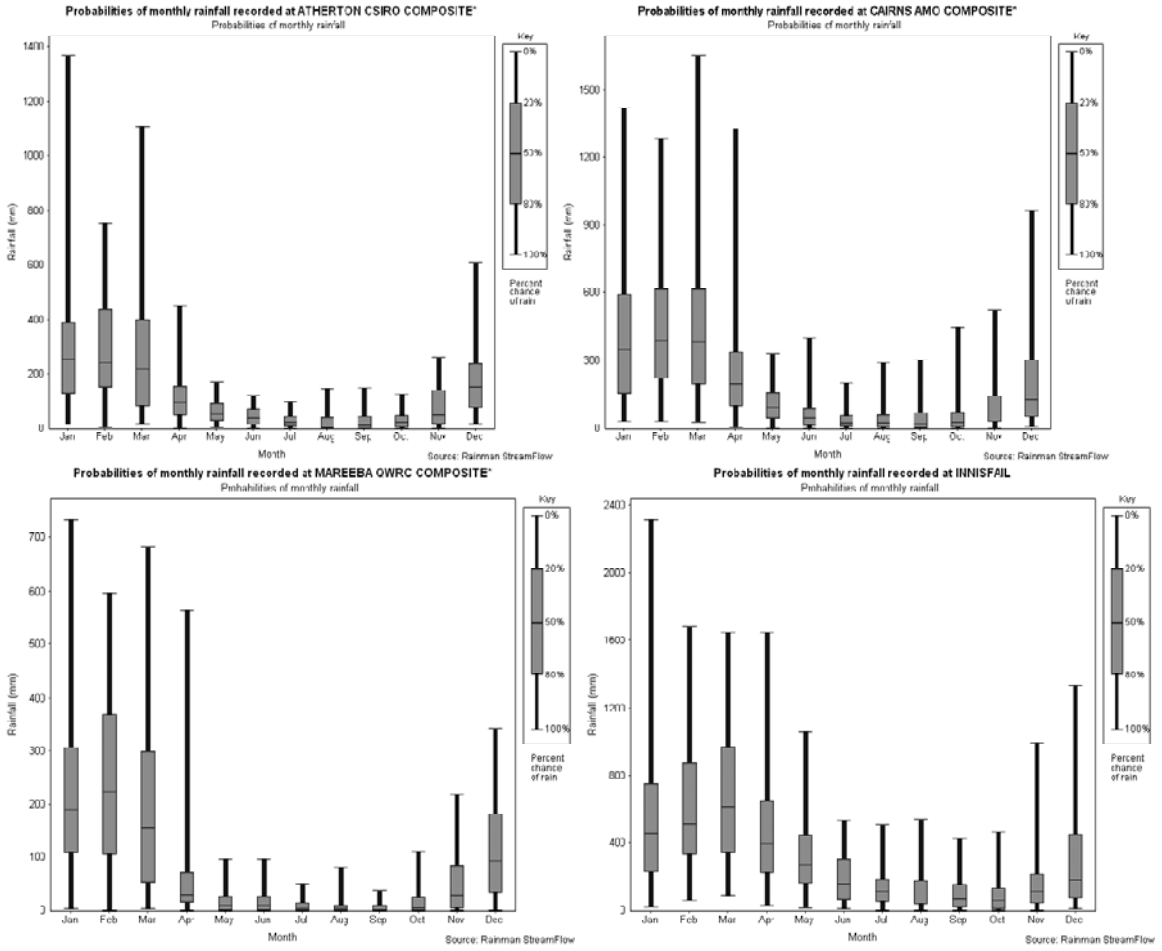


Figure 1: Rainfall in four major centres of the Wet Tropics region.

Cyclones occur commonly through the wet season months of November to April with an average of two cyclones crossing the Queensland coast each year.

Climate Change

There is no doubt that human activities are changing the composition of the atmosphere (refer **Fig 2**). Land and sea surface temperatures are projected to continue to warm and sea level is projected to continue to rise during the 21st century: coastal air temperatures in the region by 1.4 to 5°C by 2070 and sea temperatures by 1 to 3°C by 2100 (Marshall and Johnson 2007). It is highly likely that

extreme dry years will be more extreme due to higher temperatures and that intensity of individual rainfall events will increase so that rainfall and river flow regimes will become even more extreme than in the recent past (Lough 2007).

The Wet Tropics rainforests and the Great Barrier Reef are two of the most vulnerable of all Earth's ecosystems. Climate change in Far North Queensland's Wet Tropics has the potential to result in many extinctions as a result of the high levels of restricted endemism in the region. Recent bioclimatic modelling of the spatial distribution for the regionally endemic rainforest vertebrates suggests that predicted increasing temperature will result in significant reduction to complete loss of core environment of all regionally endemic vertebrates. Above an increase of 2^{o}C the extinction rates are likely to be severe and compounded by other climate related impacts (Williams *et al*. 2003, refer **Fig 3**).

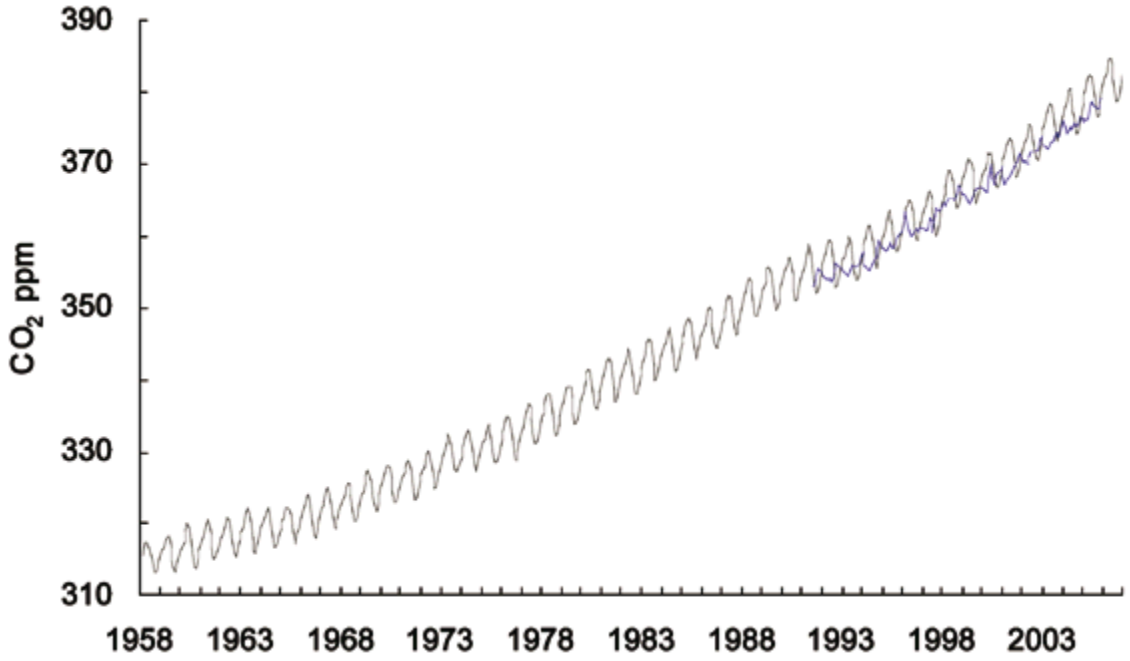


Figure 2: Monthly atmospheric concentrations of CO_2 for Mauna Loa, Hawaii (grey, 1958-2006) and Cape Ferguson, Queensland (blue 1991-2005) illustrating the steady increase in atmospheric CO_2 attributable to human activities, and showing that local trends in Queensland match global trends (from Lough 2007).

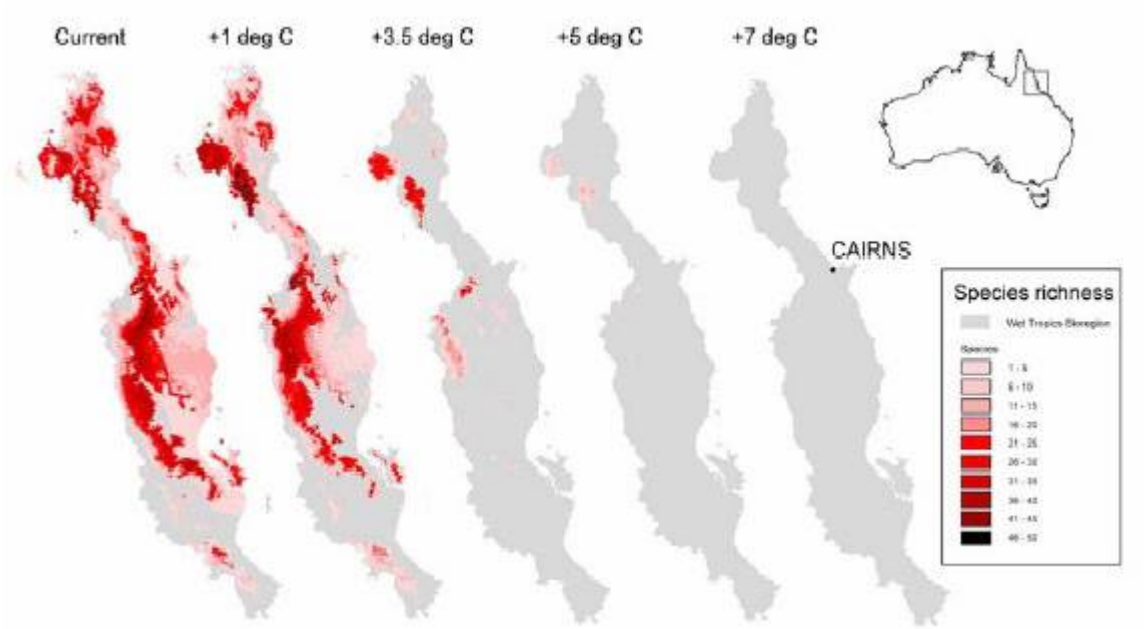
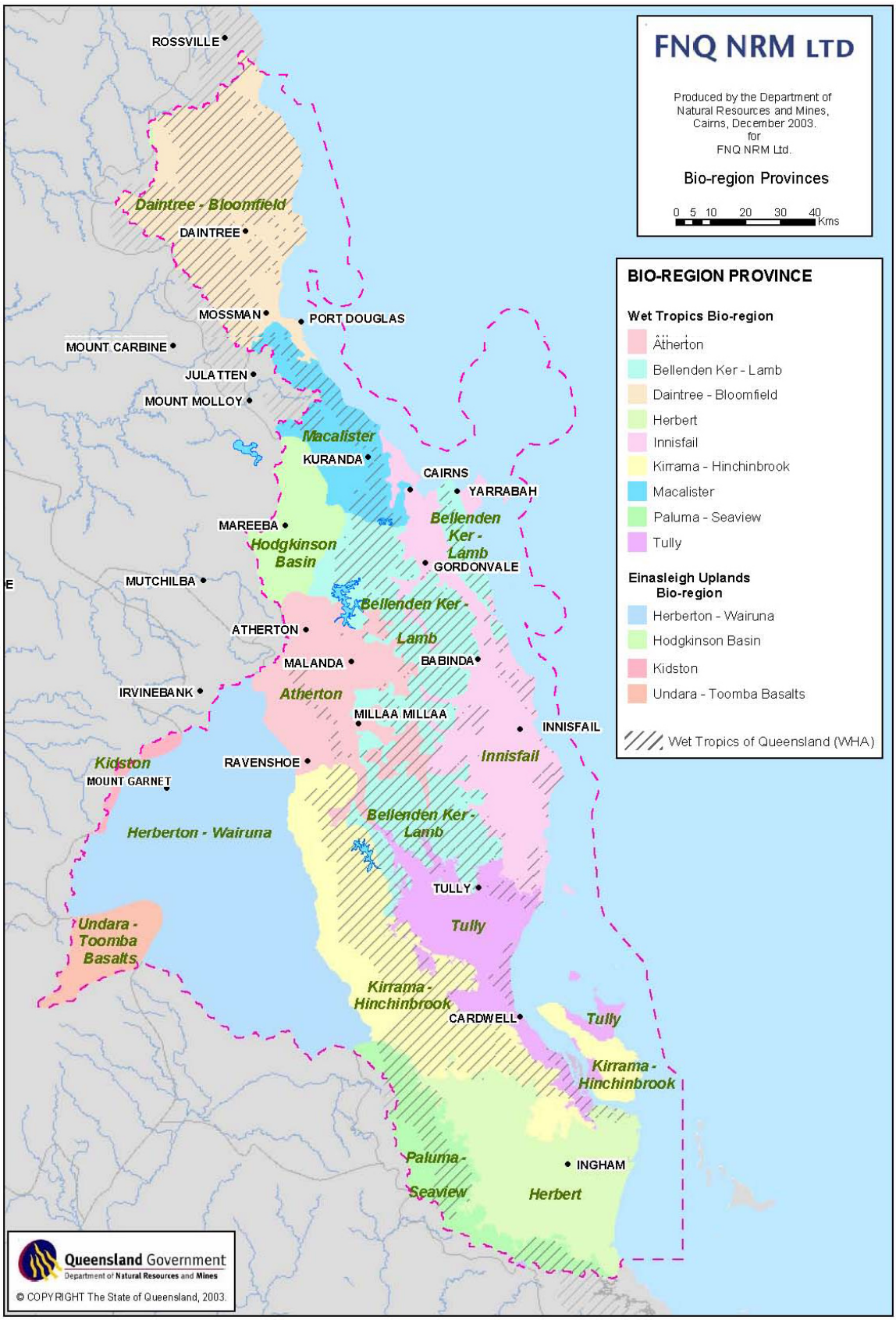


Figure 3: Geographical pattern of species richness of regionally endemic rainforest vertebrates at each temperature scenario (from Williams *et al*. 2003).

Even under optimistic climate change scenarios, the Great Barrier Reef is destined for significant change this century. The spatial extent of the GBR and its juxtaposition to land means that it is exposed to nearly every climate variable including increasing air and sea temperatures, ocean acidification, nutrient enrichment, altered light regimes, more extreme weather events and changes to ocean circulation and sea level rise. In addition the impacts of human activities on the marine environment undermine their resilience to climate change.

1.1.4 Regional Vegetation

Regional vegetation is described in McDonald and Weston (2004), Volume 1of the *Sustaining the Wet Tropics* series, from which this section, and the following section, is drawn. Regional ecosystems (RE) are used as the primary basis for planning the conservation of biodiversity in Queensland. Regional Ecosystems are defined within a bioregional framework where bioregions are complex areas of land and sea composed of a cluster of interacting ecosystems that are repeated in similar form throughout each bioregion. There are about 60 bioregions defined for Australia; 19 are recognised for Queensland, and two converge within the Wet Tropics NRM Region, namely the Wet Tropics and the Einasleigh Uplands (refer **Map 3**, below)



Map 3: Bioregion Provinces of the Project Area

The Wet Tropics bioregion is characterised by rugged mountain ranges cloaked with rainforests and vine thickets with eucalypt open forests. The low-lying coastal plain supports melaleuca and eucalypt communities. About a quarter of the region - the most accessible - has been cleared; inland for dairying and on the coastal plains for sugar cane and irrigated crops. Large areas are protected within the Wet Tropics World Heritage Area.

The Einasleigh Uplands are characterised by undulating to hilly land with some rugged ranges, dominated by eucalypt woodland and open woodland with significant patches of rainforest and vine thickets. The region is largely intact in terms of vegetation and is mainly used for cattle grazing with some localised horticulture and cropping.

The Wet Tropics NRM region also incorporates at least four marine and coastal regions encompassing all state and coastal islands and waters between the Bloomfield River and north of Crystal Creek, in other words, the northern boundary of Douglas Shire and southern boundary of Hinchinbrook Shire.

1.1.5 Carbon Stocks

1.1.5.1 Carbon Pollution Reduction Scheme

Of relevance to the PDD, and to how the Project deals with different carbon pools, is Australia's proposed Carbon Pollution Reduction Scheme (Australian Government, 2008). Legislation for the Scheme is still being developed and will need to pass through Parliament before the Scheme takes effect on the proposed date of 1 July 2010. The Scheme aims to put in place a cap and trade emissions trading mechanism covering around 75% of Australia's emissions and involve mandatory obligations for around 1000 entities. The sectoral coverage includes energy, transport, fugitive, industrial processes and waste. In general, direct Scheme obligations will apply to entities emitting greater than 25,000 tonnes of CO_2-e per year.

The approach to the Agriculture, Forestry and Other Land Use sector is complex and potentially results in a confusion of approaches leading to a level of uncertainty with implications for what carbon pools can and cannot be traded in the voluntary marketplace.

Forestry is covered by the scheme as an offset but on a voluntary opt-in basis. All reforestation is "covered" as part of Forestry because it is counted toward Australia's Kyoto accounts. Under the CPRS, it will, therefore, not be possible to trade reforestation in the international voluntary market. It may, however, be possible to trade reforestation internationally through the Joint Implementation (JI) mechanism as a Removal Unit. It is uncertain how small landholder reforestation efforts will fare under the CPRS since the definition of an "eligible forest entity" is yet to be defined: certain carbon property rights holders will be able to apply to become *accredited forest entities*, and Government consultations are still underway to determine the nature of these entities, and the accreditation required.

Deforestation, while included in Australia's international accounts will not, however, be covered under the CPRS. The National Carbon Offset Standard Discussion Paper (Australian Government, 2008) states that opportunity exists to register offset credits generated by approved methodologies for uncovered emission sources in the Australian Kyoto Protocol National Registry. Whether Australia will allow the deduction of VERs generated by similarly approved methodologies from the National Registry for trade on the international voluntary marketplace is uncertain.

Improved Forest Management in native forests, Agriculture and Regeneration "the removal of suppression activities (e.g. grazing) or the realization of the potential of existing vegetation" are not covered under the CPRS, and not counted toward Australia's international commitments. These pools are available for trade in the voluntary market.

All pools have been incorporated in **Table 7** below to provide an overall sum of carbon stocks.

1.1.5.2 National Carbon Accounting System

The information for this section is based on the National Carbon Accounting System (2008) http://www.greenhouse.gov.au/ncas which was initiated by the Australian government in response to the United Nations Framework Convention on Climate Change (UNFCCC) National Greenhouse Gas

Inventory (NGGI) reporting, and for Kyoto Protocol compliance monitoring. As part of these reporting and monitoring commitments Australia produced inventories of Land Use and Land Use Change and Forestry (LULUCF) annually from a 1990 baseline year. NCAS is based on resource inventories, field studies, modelling and an extensive remote-sensing program, and calculations of carbon emissions and sequestration use the National Carbon Accounting Toolbox (NCAT).

As well as addressing NGGI, the NCAT provides the capability to calculate emissions and removals of GHGs for Article 3.3 (of the Kyoto Protocol) activities of afforestation, reforestation, and deforestation, and Article 3.4 activities of forest management, cropland management, grazing land management and revegetation. Spatial modelling with the NCAT for carbon stock estimation provided a higher level of confidence than any of the biome average models typically applied to forest carbon stock assessment. In particular the NCAS Data Viewer contains a visual record of landscape and vegetation change in Australia since 1972 and can show data at a regional and point scale. The National Carbon Accounting Toolbox provides functions for carbon sequestration estimates from single stands to forest estates.

Figures reported for total land areas, total vegetated areas, cleared areas and vegetation categories were derived from several land use categorization indices. The Queensland Herbarium; as a division of the Queensland Environmental Protection Agency utilized the format of Sattler and Williams (1999) in developing Regional Ecosystem Mapping and an accompanying Regional Ecosystem Description Database (EPA 2008) for the state of Queensland. The framework has been incorporated into several planning initiatives including the development of guidelines for clearing on leasehold lands under the *Lands Act 1994* and more recently the *Vegetation Management Act 1999*. The RE mapping provides an important tool in both assessing the carbon composition of the project area and allocation of the zones into potential future land use categories. Vegetation is categorized into remnant and non-remnant/ disturbed categories; remnant vegetation is defined as that vegetation which is above 70% canopy height or 50% canopy cover of that stratum and is dominated by species characteristic of the vegetation type's undisturbed canopy. Figures for the rate of land clearing of the Terrain NRM region were derived from the Statewide Landcover and Trees Study (SLATS) Report (Natural Resources and Water, 2008). The SLATS report is based on satellite imagery designed to produce maps at 1:100 000 or coarser, and as such is unable to reliably map clearing of areas less than 1 ha.

For each of the sites within the project area, the RE mapping layer was applied to high-resolution aerial photography, enabling an accurate spatial assessment of the categories of vegetation. Supplementing the RE mapping with site historical data enabled categorization of the vegetation into environmental plantings and farm forestry (ARR), avoided deforestation (REDD) and reduced or avoided logging (IFM). Calculation of the carbon stocks in the project area was based on a pooled value of site specific NCAT models based on RE mapping, high resolution aerial photography and historical records. The NCAT modelling resulted in a set of Tier 3 values for the carbon pools of individual sites.

In order to improve the reliability of the values, site-specific validation of a sample of the sites has been undertaken (**Map 6**). A summary of the methods used in the field validation has been included in section ***2.1.1 Sequestration Methodology***, under the heading - Afforestation & Reforestation, Farm Forestry, Assisted Natural Regeneration, Avoided Deforestation, with an accompanying field manual in **Appendix 1**. We have excluded values for understory vegetation below 25 mm DBH, coarse woody debris, and herbaceous material as these components equate to less than 10% of the total on-site carbon stock. Inclusion of these components will be considered if subsequent research proves them either to: equate to more than 10% of the site carbon pool, or; the quantification of their volumes is robust and inexpensive enough to warrant it. The initial exclusion of these pools from the total carbon stock assessment represents the conservative nature of the assessment process. The result was the most accurate, transparent and practicable mode of calculation of total carbon stock for both the project sites and the region.

1.1.5.3 Forest Carbon stock values for the project area

Of the 2.22 M ha of land within the project region approximately 892,000 ha is remnant forest held on both freehold and leasehold lands outside of the world heritage area (**Map 7**). Mean values of the NCAT derived maximum biomass of the catchment areas equates to a calculated carbon pool of 132 Mt C on these lands. No quantifiable estimate has been made of the total standing carbon stock of the non-remnant woody vegetation on these same land categories. The SLATS (2008) notes that 88% of the Wet Tropics region was classed as woody in 2005, equating to 1.95 M ha. Pooling the values of the remnant vegetation on Freehold and Leasehold Land lands and incorporating a 100% woody vegetation coverage of World Heritage areas (712,000 ha) equates to 1.6 M ha (892000 + 712000) of vegetation protected by legislation. External to this is an area of 352,000 ha or 15.86% of the Wet Tropics NRM region that is classed as woody vegetation and may be rightfully cleared without permit. The average carbon stock of non-remnant vegetation sampled on landholders' properties (most planted <14 years ago) within this Project equates to 73.5 tC/ha; applying this average to 352,000 ha equates to a potential carbon pool of 25.8 M t C. The total pool is likely to be lower as SLATS relies on low-resolution imagery for analysis and includes immature stage vegetation which is classified as woody.

The SLATS (2008) reports that of the 2834 ha of land cleared in the project area for 2005/06, around 65.5% of it was classed as remnant vegetation, the highest proportion of remnant to non-remnant clearing since 1999/2000. The high proportion of remnant vegetation in the cleared areas is indicative of final broad scale clearing permits being activated prior to the end of broad scale clearing on 31 December 2006 as a result of the final implementation of The *Vegetation Management Act* (1999). Logging for commercial gain remains permissible in the freehold and leasehold areas of remnant native vegetation if the owner notifies of a Forest Practice and logs according to the *Code of Native Forest Practice* (refer *section 1.2.2.4 Improved Forest Management* below). The code stipulates that forest management is to ensure that the area has a high probability of being mapped as remnant within 20 years of a forestry practice being conducted. In the absence of an IPCC value for degraded forests we have estimated the degradation and removal by logging of 25% of standing carbon in remnant zones to be well within the guidelines of the code. This level of damage is consistent with the lower order of damage that is experienced in tropical forestry operations and represents a conservative estimate of the emissions reductions as a result of IFM. Of the landholders that have registered interest in the Project, there is a total of 476.8 ha of remnant vegetation currently eligible for inclusion under IFM. Prevention of commercial logging activities on these lands corresponds to the retention of 65,779 t CO_2-e (**Table 7**). Department of Natural Resource databases indicate that there are 126 Native Forest Practice Notifications. Our sample of 10 properties whose owners have notified of forest practices under the Code averages 48 ha of forest per property which can be logged. Multiplying this by 126 provides a broad estimate of 6000 ha that can be subject to logging.

We intend to utilize the 'Stock difference Method' (IPCC 2006) to make further assessments of the total carbon stock removal as the result of specific *Native Forest Code of Practice* operations in the Wet Tropics NRM region.

1.1.6 Socio-economic

A comprehensive analysis of population, economy and resource use was carried out in the development of the Wet Tropics Region NRM Plan (McDonald and Weston 2004), and most of the information in this section has been drawn from this, and related documents associated with the development and on-going update of this integrated Regional Plan.

Brief History

Traditional land management practices of rainforest Aboriginal people shaped the ecosystems of the Wet Tropics region for thousands of years. European colonisation had a devastating effect on Aboriginal people and ecosystems in the region. Despite this, Aboriginal culture today continues to survive and strongly assert its rights in the region. The European history of the region started with Edmund Kennedy who explored the area in 1848. By 1875 people arrived to work in the goldfields and as timber cutters. By 1881 timber cutters had extended their operations to the western margin of

the Atherton Tablelands. Cattle grazing was introduced to supply meat for miners and loggers and the growing coastal settlements, and rainforest was progressively cleared from the lowlands to make way for sugar cane. A government land scheme required settlers to clear the land within a specified time. As early as the 1930s there were criticisms of the extensive land clearing. After several more decades forests began to be protected from clearing by securing them for selective timber harvesting. The economy of the region remains dependent on primary production and tourism, the latter, which grew steadily since the 1950s.

Population and Economy

Today more than 216,000 people live in the Wet Tropics region, and depend directly or indirectly on natural resources. The population is expected to increase to 300,000 by 2020 (refer **Table 2**). The region supports a massive tourism industry, focused on the two World Heritage properties of the Great Barrier Reef and the Wet Tropics, and a thriving agricultural sector.

At the 2001 census, retail trade was the largest employer in the Wet Tropics NRM Region employing 15.5% of the workforce, followed by accommodation, cafes and restaurants with 9.3%, agriculture, forestry and fishing 9.3%, and health and community services 8.5%.

Tourism is the major source of revenue. Each year nearly three million visitors come to the region, generating revenue of $2 billion and making up 35-40% of employment. The main pressures of the tourism industry are concentrated on specific areas such as the coast between Cairns and Cape Tribulation, and on areas of the GBR directly accessible from Cairns, Port Douglas and Mission Beach.

Farming, in comparison, produces about $750 million worth of revenue from crops and livestock, and is discussed below under *Land Use and Land Tenure*.

Pressure on natural resources as a result of population growth will result in increased numbers and distribution of exotic invasive plants, animals and disease; demand for high quality water supplies; and pressure on the environment for recreational purposes. A further 8,700 ha is likely to be converted to urban uses over the next 20 years, focused on the Cairns region.

Table 2: Population projections for the Wet Tropics

Local Government Area	2006	2011	2016	2021	Annual Average Growth Rate (%)
Atherton	11,600	12,400	13,200	14,100	1.3
Cairns	140,300	155,900	171,600	187,600	2.0
Cardwell	11,600	12,800	14,100	15,400	2.0
Douglas	12,600	14,200	15,900	17,500	2.3
Eacham	6,600	6,800	7,000	7,200	0.6
Johnstone	21,600	22,500	23,300	24,100	0.8
Mareeba	20,000	20,800	21,500	22,100	0.7
Herberton	6,200	6,600	7,100	7,500	1.4
Hinchinbrook	15,700	15,700	15,700	15,600	0.0
Wet Tropics	246,000	267,600	289,300	311,100	1.6

1.1.7 Land use and Land Tenure

The major land uses of the Wet Tropics NRM region are shown on **Map 4**. Much of the accessible land is privately owned, while the more rugged parts of the region are mainly leasehold land, State forest or National Park. Most of the forest in these areas is contained and protected within the Wet Tropics World Heritage Area.

The region has a secure land tenure system and clearly defined property rights embedded in law.

Agriculture is the main land use with, in year 2001 figures, nearly 130,000 ha under cropping and about 47,000 ha under horticulture. Improved pasture for grazing accounted for about 65,000 ha. In the coastal areas the main crops are sugar cane and bananas. Extensive grazing is the main land use in the western part of the region. Forestry as an industry has declined in recent times, though rainforest vegetation covers about 95,000 ha of freehold land.

The main land use trends include, on the lowlands, decreasing sugar cane as a result of low export prices, and a concomitant increase in horticultural activities such as bananas, tropical fruits, livestock, private forestry and aquaculture. On the Atherton Tableland sugar cane is declining and tobacco has virtually disappeared. Instead, crops such as potatoes, bananas, maize, peanuts, mango, avocado, macadamias, longans and lychees are increasing.

Fertilizer and pesticide application was significant, and in 2001, the application of nitrogen in intensive agricultural areas averaged 2.3 kg/ha while phosphorus averaged 0.6 kg/ha. This equated to a total nitrogen application in the region of about 5000 tonnes per annum, and total phosphorus application of around 1400 tonnes per annum. The major pesticides in the Wet Tropics NRM Region are Atrazine, Diuron, 2-4D, Chlorpyrifos and MEMC, amounting to a total pesticide application of around 300,000 kg active ingredient per annum.

Agricultural expansion within the Wet Tropics NRM Region is placing increasing pressure on the region's natural environment, particularly in terms of its biodiversity and ecosystem processes. Downstream, agricultural land use activities are placing pressure on the survival of the Great Barrier Reef, mostly as a result of increased sediment and pollutant-related water decline. Vegetation clearing is also a continuing threat and about 2000 ha was cleared in 1999-2001, about half cleared for grazing. More recent figures from the State of Queensland (Natural Resources and Water, 2008) show that this figure has increased to over 2,800 ha per year with over half cleared for grazing, and over a third for forestry.

1.1.8 Key Government policies and legislation

Many laws and policies influence the way the land and sea is used. Australia is signatory to the *Convention Concerning the Protection of the World Cultural and Natural Heritage*, and the Great Barrier Reef and Wet Tropics are listed under the convention. An enabling environment for the integrated management of the Great Barrier Reef World Heritage Area is created by the a single independent agency, the Great Barrier Reef Marine Park Agency, with the *Great Barrier Reef Marine Park Act 1975*.

While a raft of laws, plans and systems regulate point sources of pollution to the Reef such as sewage; the same is not true of diffuse sources resulting from land management activities. The Reef Water Quality Protection Plan, components of which are implemented through the Wet Tropics Plan, focuses on diffuse sources of pollution arising through land use activities.

Australia ratified the International Convention on Biological Diversity in 1993. In 1996 the Commonwealth government released its National Strategy for the Conservation of Australia's Biological Diversity.

The Environment Protection and Biodiversity Conservation Act 1999 requires that any development proposal creating a significant impact upon an area with national environmental significance under Commonwealth authority be referred to the Commonwealth for approvals in addition to approvals required at a State level. 'Matters of national environmental significance' includes nationally threatened species and ecological communities, protected migratory species and the values of a declared World Heritage Area.

Environment Protection Act 1994 is a central component of Queensland's environmental legal system. The object of the Act is environmental protection within the context of ecologically sustainable development.

The Integrated Planning Act 1997 is Queensland's principal planning legislation. It coordinates and integrates planning at the local, regional and State levels; manages the process by which development occurs; and manages the effects of development on the environment.

Environment Protection (Water) Policy 1997, under the Environment Protection Act is to protect Queensland's water environment consistent with the principles of ecological sustainable development.

Nature Conservation Act 1992 allows for the Queensland Parks and Wildlife Service to carry out a number of activities including:

- Declare protected areas;
- Protect native wildlife and habitats;
- Regulate the use of protected wildlife; and
- Manage commercial tour operations.

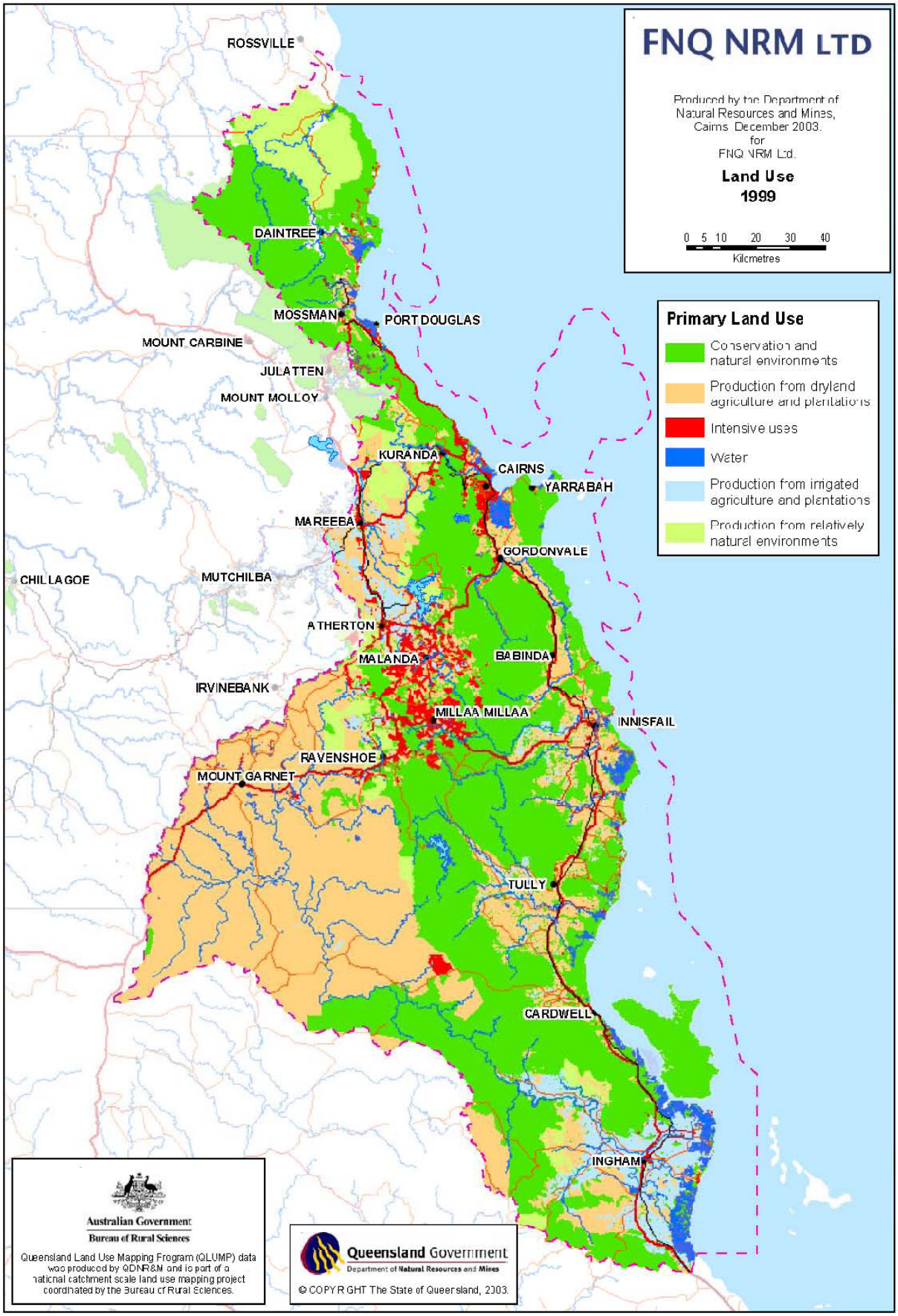
The *Vegetation Management Act* 1999 (and Vegetation Management Regulations 2000) make vegetation clearing on freehold land assessable under the *Integrated Planning Act* 1997 while the *Land Act* 1994 governs vegetation management on leasehold and other state land.

The Forestry Act 1959 regulates the use of forest products such as timber on all State land including State forests, leasehold land and unallocated state land.

The Water Act 2000 provides a framework for the planning, allocation and use of surface water and groundwater in Queensland.

A complete list of Acts and Regulations administered by the Queensland Department of Natural Resources can be found at http://www.nrw.qld.gov.au/about/policy/legislation.html.

A complete list of Acts and Regulations administered by the Queensland EPA can be found at http://www.epa.qld.gov.au/about_the_epa/legislation/.



Map 4: Primary land use in the Wet Tropics NRM region

1.1.9 Biodiversity

The information for this section was largely drawn from the Biodiversity Conservation volume of the Sustaining the Wet Tropics Regional Plan for NRM (Weston and Goosem 2004), which was collated from a synthesis of a large volume of research publications from a wide range of reputable sources. The Wet Tropics NRM Region is considered to be a biodiversity hotspot of global importance, containing two World Heritage Areas: the Wet Tropics of Queensland and the Great Barrier Reef. In places the rainforests of the Wet Tropics cascade down steep mountain ranges to meet the Reef.

One of the greatest barriers to biodiversity conservation is an acute lack of knowledge about biodiversity and the processes that maintain it. Information is richest on vertebrates and flowering plants and some taxa such as butterflies and dung beetles.

Significant recent additions to the protected area estate have been made, reflecting concern over the conservation status of the area but in the context of the size of the region, the area reserved is small.

Coastal and Marine

The coastal zone of the Wet Tropics region encompasses coastal islands and waters between the Bloomfield River, at the northern boundary of Douglas Shire, and north of Crystal Creek, at the southern boundary of Hinchinbrook Shire. The seaward boundary of the region includes areas of the Great Barrier Reef. The catchments of the Wet Tropics region are all catchments of the Reef, and water quality flowing from the Wet Tropics catchment will affect the resilience of the Reef as climate change progresses. It is therefore worthwhile providing a brief description of the biodiversity of the Reef, which follows.

The Great Barrier Reef is the largest coral system on Earth and has extraordinary species diversity including:

- Six of the world's seven species of marine turtles;
- 54% of the world's mangrove diversity;
- Greater than 1500 species of fish;
- 1500 species of sponges;
- 800 species of echinoderms;
- Over 5000 species of molluscs; and
- Over one third of third of the world's species of soft coral and sea-pens.

The World Heritage Values of the entire Great Barrier Reef are summarised as a Values Table found at http://www.environment.gov.au/heritage/worldheritage/sites/gbr/values.html.

Coastal flora and vegetation of the Wet Tropics region can broadly be broken down to include; tidal coastal wetlands; freshwater wetlands; continental islands; coral cays; seagrasses; and macroalgae.

Tidal Coastal Wetlands make up around 44,000 ha of the region, and are dominated by three community types namely Closed Rhizophora, Closed Mixed, and Closed Ceriops. Recent studies documenting changes to wetland habitats identified few large net losses, the major loss being in the Barron catchment due to the construction of Cairns International Airport. Areas of tidal coastal wetland has actually increased in some catchments due to mangrove colonisation at the mouth of rivers, and reasons for this include increase in tide levels and storm surges, and decrease of freshwater runoff as a result of agricultural drainage.

Freshwater wetlands slow the flow of water into coastal areas, trapping sediment and nutrients so that they settle out of the water column. Freshwater wetlands are capable of detoxifying pollutants and so provide a filtering and detoxifying service. Clearing in the catchments of the Barron, Russell-Mulgrave, Johnstone, Murray and Herbert Rivers has resulted in a loss of up to 70% of melaleuca wetlands and a significant proportion of sedgelands.

The vegetation of the continental islands, and coral cays, are surprisingly diverse and include more than 2211 plant species, about half-half rainforest species and open-forest species. These are distributed on the more than 550 continental islands of the Great Barrier Reef World Heritage Area, and comprise about a quarter of the total number of species for Queensland in only 0.1% of the area of the State.

Seagrass beds mainly occur in sheltered bays and estuaries. Seagrasses are food sources for threatened species such as green turtles and dugongs, and are nursery areas for juvenile commercial prawns, fish and crab species. The Wet Tropics region has rich seagrass assemblages with a total of 13 species being recorded between Cape Tribulation and Townsville.

Macroalgae of the Great Barrier Reef have high diversity and low endemism and display a variety of growth forms including turfs, encrusting calcareous algae and larger fleshy algae (seaweeds). The exact number of species is unknown but is possibly between 400 and 500 species.

The fauna of the Great Barrier Reef includes corals, fishes, marine reptiles, birds and marine mammals. The Reef is a global centre of coral diversity with over 70 hard coral genera and 350 individual species, matching the diversity of coral in Indonesian and Philippine waters. Monitoring studies of the coral cover barely a fraction of the reefs in the Reef system. The few long-term studies show that coral cover, growth and degradation vary considerably over time in the absence of direct human impact, and there is no clear evidence that there is major decline in coral status with increasing human influence, although a recent paper (De'ath *et. al,* 2009) suggests that calcification of reef building corals has declined significantly since 1990. The exact number of fish species is unknown with 1500 being taken as a reasonable estimate. Two severe coral bleaching events occurred in 1998 and 2002, which are attributed to climate change.

There are three major groups of marine reptiles namely crocodiles, marine turtles and sea snakes. *Crocodylus porosus* occurs in all coastal waterways. Crocodiles have been protected since 1974 and their numbers are increasing as a result. Six of the seven species of marine turtles are found in Wet Tropics coastal waters: the green, hawksbill, loggerhead, flatback, Olive Ridley and leatherback turtles. Globally, marine turtles are under threat. The hawksbill is listed as 'critically endangered' by the IUCN. Green, Olive Ridley, loggerhead and leatherback turtles are listed as 'endangered', and flatback turtles as 'vulnerable'. Seventeen species of sea snakes are recorded, none of which are endemic to the Reef, and there are no data to suggest that they are seriously threatened.

Birds of the Great Barrier Reef include shorebirds, land birds and seabirds. Seven internationally significant areas for shorebirds occur in the vicinity of the Reef, though none occurs along the Wet Tropics coast. One regionally significant site occurs at the Port of Cairns and Trinity Inlet, where at least 29 species of waders, which breed in Arctic Siberia and Alaska, stop on their migratory pathway. Land birds of the continental islands are similar to the fauna of comparable mainland habitats. A number of birds, however, breed on the continental islands and these include the pied imperial pigeon *Ducula bicolor*. The total seabird population of the Reef may exceed two million from 22 species.

The Great Barrier Reef is home to a significant proportion of the world's dugong population. Since 1986 there has been a serious decline in dugong numbers with some estimates suggesting that they are at about 3% of their 1960 numbers. Potential reasons include habitat loss, traditional hunting, and drowning in commercial fishing nets. Dugongs are designated 'vulnerable' by the IUCN. The Hinchinbrook Island area is recognised as an important site for the species. About 26 species of whales and dolphins have been recorded along the Reef, diversity typical of other coastal regions in the Indo-West Pacific. Most species are classified as 'insufficiently known', reflecting the paucity of knowledge of the group generally. Humpback whales, *Megaptera novaeangliae*, are, however, considered 'vulnerable'. They shelter in sheltered waters of the Reef, which are important calving areas. The population was brought to the brink of extinction by whaling between 1949 and 1962 when numbers reduced to about 200-500 animals. In 2002 there was an estimated 4000 animals in eastern Australia.

Terrestrial

Two terrestrial bioregions converge in the Wet Tropics plan: the Wet Tropics and the Einasleigh Uplands. These are further broken down into nine provinces as shown in **Map 3** above, of which four are wholly contained within the plan, namely Tully, Innisfail, Kirrama-Hinchinbrook and Bellenden Ker-Lamb. **Table 1** above provides a summary of these bioregions in the context of soils, geology and landforms. These bioregions are primary surrogates for planning for protection of biodiversity and for this purpose are further defined into regional ecosystems (RE).

Compared to Queensland bioregion averages, the Wet Tropics bioregion, with 105 regional ecosystems, has a high number of REs. The Einasleigh uplands, nearly seven times the size of the Wet Tropics, have by comparison 46 REs, though this bioregion is still poorly known. A disproportionately large percentage, over two-thirds, of the wet tropics REs have an 'endangered' or 'of concern' conservation status, compared to about half in the Einasleigh Uplands. The conservation status is largely determined by a comparison of remnant vegetation and Landsat images in terms of three classes: endangered (<10% of pre-European extent remains; of concern (10-30% remains); and not of concern (> 30% remains). Most 'endangered' and 'of concern' ecosystems occur on lowlands that have been cleared for agriculture. One of the REs, Mabi Forest, a complex notophyll rainforest on basalt uplands, has been added to the national list of critically endangered ecological communities under the EPBC Act. **Map 5** shows the Terrain NRM Region RE status.

Wetlands are also of considerable importance in the Wet Tropics. There are 850 wetlands in Australia considered to be nationally important, 181 of these are in Queensland, and 32 (including the Great Barrier Reef Marine Park) are located in the Terrain NRM region.

Of the riverine habitats of the Wet Tropics subregion, only two catchments, the Daintree-Bloomfield in the Wet Tropics and the Kidston in the Einasleigh Uplands were considered in good condition. Riparian ecosystems of the coastal floodplains and elevated tablelands of the Wet Tropics have been heavily cleared for flood mitigation, cropping, grazing and irrigation. This has led to extensive weed invasion in some areas including in the Herbert catchment. All other catchment were considered in fair condition and requiring significant intervention to assist recovery. One catchment, the Paluma-Seaview was considered degraded. The trend in all catchments was of declining condition.

Regional Species Diversity

The Wet Tropics accounts for less than 0.001% of the continent yet conserves an extraordinarily high level of Australia's biodiversity including over a quarter of the continent's vascular plant species, over a third of its mammals; over half its bats; 40% of its birds; 30% of frogs; and nearly 60% its butterflies.

The Wet Tropics bioregion possesses 26% of Australia's vascular plant diversity and 41% of all Queensland's vascular plant species in just over 1% of the State, making the region a biodiversity hot spot of global importance. The Wet Tropics has 12 of the 19 most primitive angiosperm families giving it the highest concentration of primitive plant species on earth. Many of these are from small, relict and virtually extinct families representing the last remnants of ancient assemblages that have survived the climatic vicissitudes of the past.

The Wet Tropics also has a disproportionate and diverse share of Australia's fauna including 259 rainforest dependent endemic vertebrates, more than any other area in Australia. Most of the endemics are confined to cooler, upland rainforests and are considered relicts from former widespread environments. At least 663 terrestrial vertebrate species have been recorded, representing 32% of Australia's terrestrial vertebrate fauna (refer **Table 3** below). In addition, the overlap zone between the rainforest and the dry sclerophyll forests to the west are rich in vertebrate species with at least 227 species in only 72,000 ha.

Table 3: Comparative Wet Tropics bioregion vertebrate diversity (from Table 34 in Weston and Goosem 2004)

Vertebrate Group	No of Wet Tropics Species	No. of Australian species	No. of Queensland species	% of Australian total	% of Queensland total	No of endemic species	Level of regional endemism
Mammals	110	315	226	35%	49%	13	12%
Birds	314	777	615	40%	51%	13	4%
Reptiles	151	770	442	20%	34%	27	21%
Frogs	58	205	120	28%	48%	24	40%
Freshwater fish	80	190	173	42%	46%	8	10%
Total	741	2255	1576	33%	47%	85	11%

Invertebrates in the Wet Tropics are very poorly known, though available statistics suggest the region is the richest comparable region in Australia including: 230 species of butterflies (58% of Australian species); 135 species of dung beetles (42% of all described Australian species); 42 species of barkbugs (46% of all Australian species); and 26 species of wetas or giant king crickets (50% of all described Australian species). The few surveys, which have examined insect fauna and aquatic invertebrate fauna, suggest that the region has extraordinary diversity and endemism including perhaps the highest aquatic invertebrate biodiversity in the world.

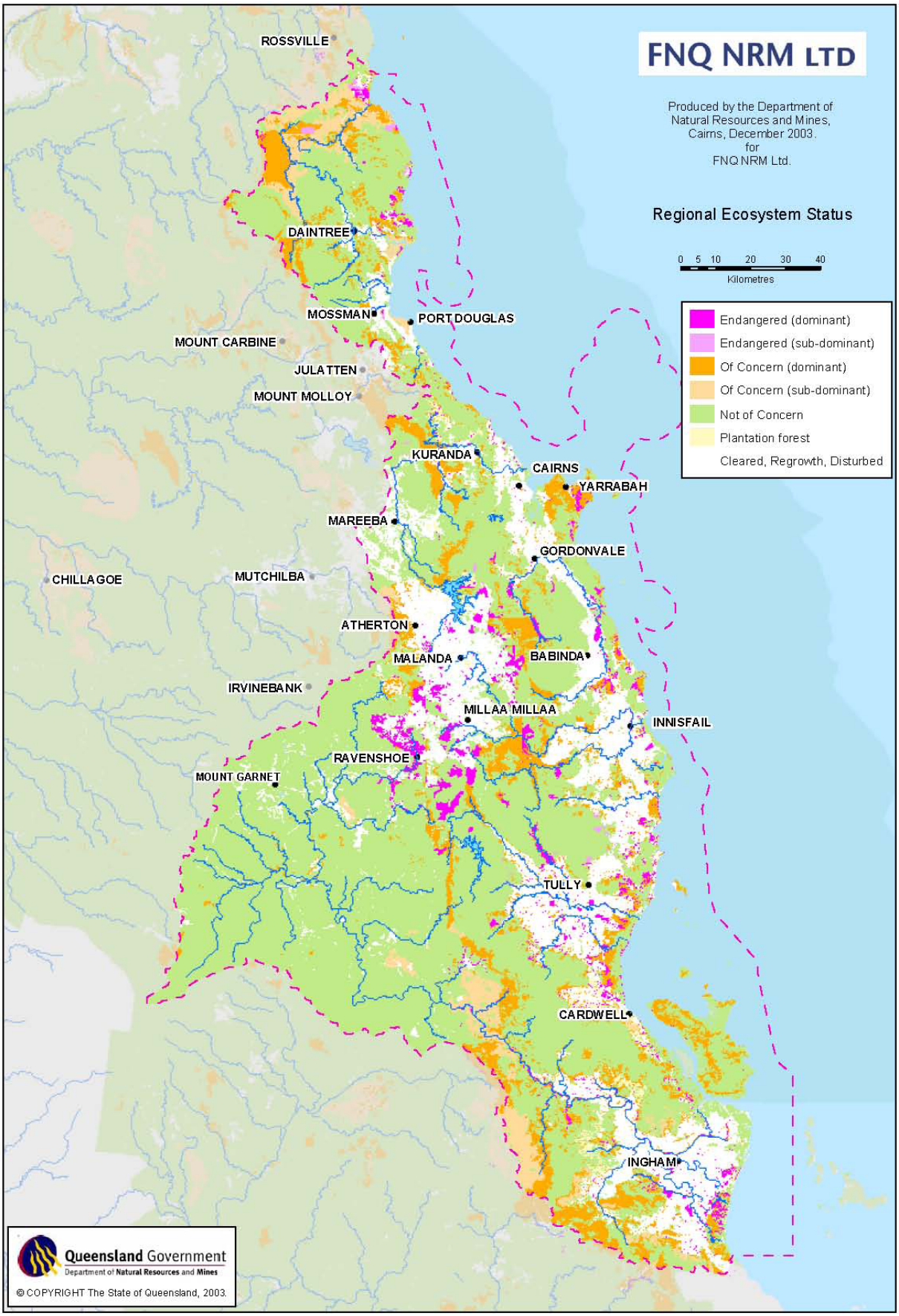
Threats to biodiversity

Vegetation clearing and climate change have been identified as the most significant threat to species and ecosystems in eastern Australia generally. Exotic weeds, feral animals, and changed fire regimes are additional key threats. In the Wet Tropics, broad scale tree clearing, followed by fragmentation, exotic weeds and changed fire regimes commonly threaten tropical and sub-tropical rainforest and eucalypt forests. Grazing is a major land use in the Wet Tropics region and clearing for pasture exceeds that for any other land use in the region. Many thousands of hectares are sown with introduced grass pastures and increasing areas of native pastures are being over sown with introduced legumes. Impacts from grazing animals are also a major threat to the wetlands of the Wet Tropics along with invasion by exotic ponded pasture. In the Einasleigh Uplands, ecosystems most under threat are those that occur on alluvial plains and associated drainage lines. The major threatening process here is grazing followed by exotic weeds.

Habitat loss in the Wet Tropics has been most severe in coastal lowlands, along major river valleys and on the basalt soils of the Atherton-Evelyn Tablelands. In these regions, species are patchily distributed, and incremental clearing can have the same effect as broad-scale land clearance. Vegetation clearing has been identified as a threatening process in all bioregional sub-regions represented in the Plan area. Alongside clearing, increased fragmentation of remnants is considered to be one of the principal factors threatening ecosystems in eastern Australia (NLWRA 2002, cited in Weston and Goosem 2004).

The Wet Tropics is particularly vulnerable to invasive species due to the fact that it has been isolated for millions of years by ocean barriers. Queensland has been invaded by at least 1,298 vascular plant taxa, 19 mammal, 11 bird, 2 reptile and 1 amphibian species. Pest management plans have been prepared for all local government areas within the Wet Tropics. There are some 84 weed species identified as part of this planning process including 15 recommended for eradication.

Major vertebrate pests are pig, cat, cane toad and dog. These species are ranked high because of their current ecological impacts and lack of feasible control options.



Map 5: Terrain NRM Region RE status

1.1.10 Endangered and Vulnerable Species

In Australia, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides the framework for protection of the environment including biodiversity. The Act describes lists of threatened species, ecological communities and threatening processes. The categories resemble those of the IUCN Red List. Detailed lists of rare and threatened Australian plants; rare and threatened animals of the Wet Tropics including coastal waters; wildlife of special significance are found in Appendix A, Appendix B, and Appendix C respectively of Volume 2A of the Wet Tropics Plan (Weston and Goosem 2004) which can be found at: http://www.terrain.org.au/index.php?option=com_content&task=view&id=38&Itemid=21.

Many species in the Wet Tropics are naturally rare due to small geographic range. Combined with low local abundance and patchy distribution, this increases the potential for extinction.

1.2 Baseline Projections

An analysis of projected land-use trends is necessary to predict likely on-site changes without implementation of a project. This "without-project" future land-use scenario enables comparison of the project's likely impacts with what would otherwise have occurred.

1.2.1 Most likely land-use scenario in absence of the project

Agricultural profit is the primary economic motivating factor in the region

The Wet Tropics Plan is based on a wide range of government, scientific and community inputs. One of the main formal outputs of the Plan is the Background to the Report (McDonald and Weston, 2004), which provides a background to, and context for, the Wet Tropics Plan. This section is drawn from this report.

The major drivers of the regional economy are tourism, agriculture and grazing. Agricultural profit is the primary motivator for land clearing in the Wet Tropics Region, resulting in immediate economic gain from increased production, and future economic gain from increased land values. From 1970-1990 a range of financial and institutional incentives such as cheap land and venture capital in the forms of loans or tax concessions enhanced this trend. These incentives were supported by research effort focused on providing quick financial returns.

In Queensland this resulted in large areas of "new" land being developed for grazing and cropping with increased commodity prices and new markets encouraging expansion and conversion from grazing to cropping with the inevitable increase in fertilizer and pesticide application. Between 1990 and 1999, the combined use of nitrogenous fertilizer for sugar cane and banana production is estimated to have increased by 55% in the Johnstone River catchment, and by 118% in the Tully-Murray River catchments. Nitrogen budgets for cropping lands consistently indicate that a significant proportion of Nitrogen, perhaps even half, is lost to the surrounding environment through gaseous transformations, surface runoff and leaching.

Most recent figures from fertilizer company, Incitec Pivot, show that nitrogen application for sugar cane in the Wet Tropics has remained more or less steady since 1999 and in 2007 was 145 kg/ha (Incitec Pivot, 2008). Incitec Pivot Fertilizers hold around 60-70% of the fertilizer market in the region (Sept 2008, unpublished data (Incitec Pivot, pers. comm.)) which means the rate of application is probably higher at about 200 kg/ha on sugarcane crops.

In the 1980s, increasing agricultural productivity remained the focus of rural research and development institutions. For example, research into soil deficiencies and ways to improve soil through the use of trace elements and fertilisers were a major driver for more land clearing and conversion to agricultural production. Closely associated with this drive was detailed experimentation with pasture cultivars which led to the development of location specific advice for farmers encouraging more intensive agricultural production.

Queensland in particular has an economy firmly embedded in primary production (refer **Fig 4**). It has the highest clearing rate in Australia. In 1995-1997, for example, clearing accounted for about 80% of all clearing in Australia. The latest figures for the Wet Tropics in the Statewide Landcover and Trees Study reveal that clearing rates for grazing and cropping have not reduced, and have remained steady over the past decade (Natural Resources and Water, 2008).

In summary, a range of factors, summarised in **Figure 4**, including financial and institutional incentives such as land development schemes, agricultural innovations such as new cattle breeds and pasture crop varieties, fluctuating market forces supporting different types of agriculture such as beef and sugar cane, and finally, land development pressure from urban development, all favour agricultural landuse.

Apart from regional NRM activities, there have been no viable incentives for sustainable landuse options that have measurable bio-sequestration or GHG abatement benefits.

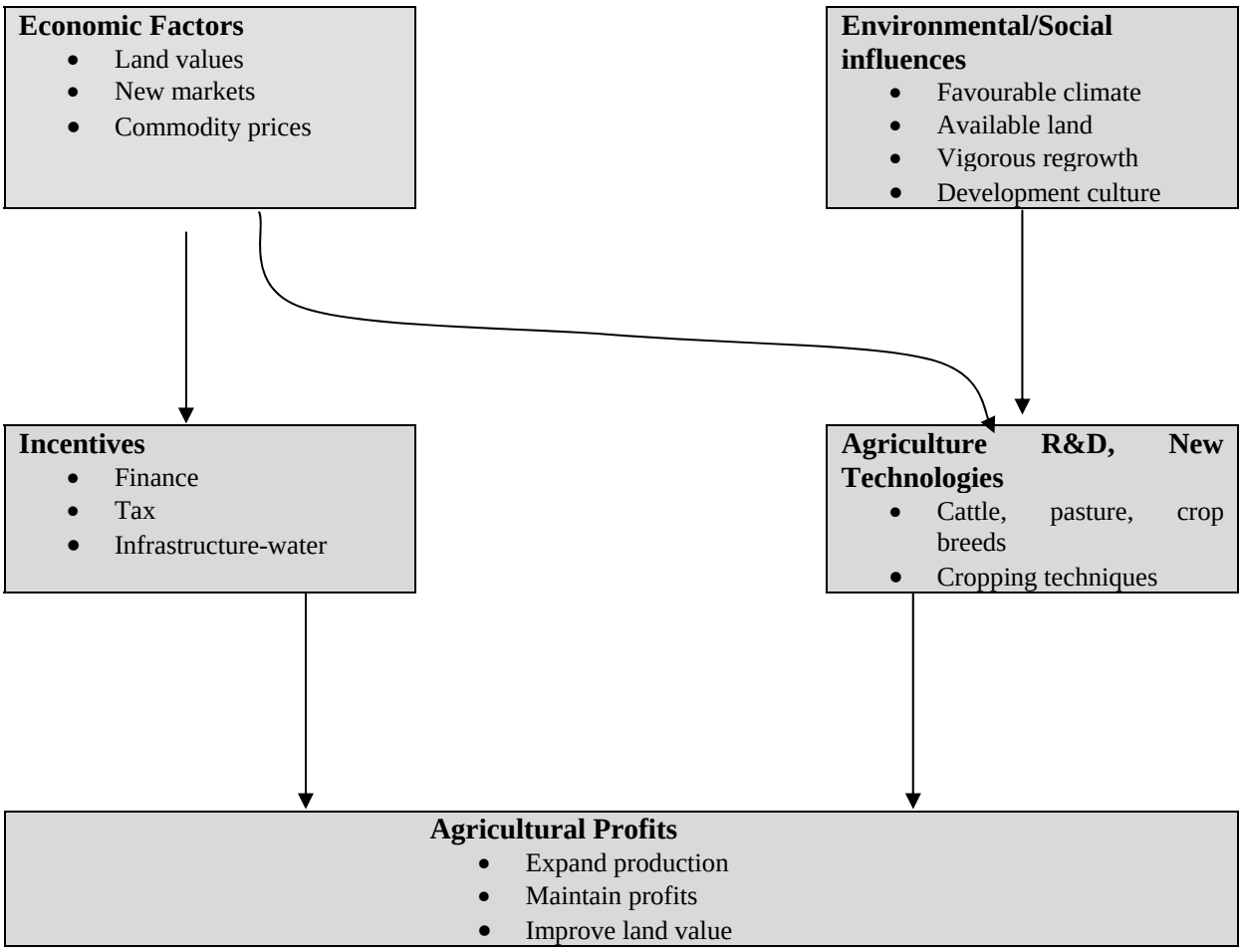


Figure 4: Incentives, which support agricultural land use (from McDonald and Weston 2004)

Cost Barrier

Reforestation and revegetation from a baseline of a grassy paddock is generally very costly. A recent analysis of the economic implications of reforestation in the region (Hunt 2008) points out that it is:

- Usually carried out on areas of about 1 ha on private land;
- Labour intensive with weak economies of scale;
- Done by voluntary organisations who contribute their labour; and
- Usually subsidised by government or corporate sector.

Labour opportunity costs include:

- Site preparation;
- Tree planting;
- Maintenance for 3 years after planting.

Additional costs include seedlings, weedicide applications necessary in the year of planting and for 3 year afterwards, and fencing for exclusion of cattle. In many cases there are also opportunity costs of replacing an existing landuse such as cattle.

Cost estimates of reforestation per hectare taking into account labour opportunity costs are in the vicinity of $30,000 per hectare. The small individual areas being revegetated, often below 2.0 ha can partly explain the high costs. Where reafforestation occurs in plots of 2-5 ha the cost reduces to $19,000/ha (Catterall and Harrison 2006). Clearly, larger scale projects will have the capacity to provide climate and biodiversity benefits at lower costs, but even at these lower rates costs will be still dependent on community goodwill, and adequate resourcing.

Socio-Economic Barrier

The Socio-Economic Indices for Areas, produced by the Australian Bureau of Statistics in 2001, provides a useful measure of describing relative socio-economic disadvantage relative to other areas in Australia. The index was based on family incomes, dwelling ownership, educational level and levels of employment. The results summarised below in **Table 4** show that Douglas and Cairns are comparatively above average, while Herberton is comparatively very disadvantaged and the remaining shires are comparatively disadvantaged. These results reveal a certain irony: they show the economic and social benefits that tourism brings to specific scenic areas, while on the other hand communities on the Tablelands and in the more agricultural areas, where costly natural resource management activities are particularly important, have experienced a downturn in areas such as agriculture and timber, resulting in depressed local economies and towns.

Table 4: Index of Relative socio-Economic Disadvantage for the Wet Tropics NRM Region.

	LGA value	Minimum	Median	Maximum
Regional total	986	586	993	1150
Herberton	896	780	897	979
Hinchinbrook	933	628	986	1150
Mareeba	954	753	973	1067
Johnstone	959	830	971	1052
Cardwell	967	850	959	1055
Atherton	979	902	969	1058
Eacham	980	859	990	1042
Cairns	1006	685	1014	1142
Douglas	1012	586	1013	1106
AUSTRALIA		924	981	1051

The influx of population into the region in recent decades has lead to increased social and cultural change that has included diversification, but also marginalisation, particularly in agricultural areas.

1.2.2 Future Carbon Stocks in the absence of the Project

The Wet Tropics region of Australia, with its spectacular scenery and biodiversity, is a desirable place to live. Increasing human activities threaten the values that draw people here. Over the past two decades dozens of plans and strategies have been developed for the region focused on various different aspects of natural resource management. While these plans have helped identify the major threats and actions that need to be taken, it is only relatively recently that the plans have been integrated into a single strategic integrated regional action plan, the Wet Tropics Plan. The Plan remains mostly incentive and education-based. Degree Celsius will provide the economic incentive for change through payment for ecosystem services via carbon pooling, and GHG abatement via agricultural land management. In the meantime agriculture, forestry and landuse activities will continue to follow the business-as-usual trajectory established above.

1.2.2.1 Reforestation

The enormous costs of revegetation activities detailed above ensure that reforestation and revegetation will remain at very low rates. Catterall and Harrison (2006) examined the rainforest restoration activities of the Wet Tropics as a result of NRM activities since around 1990. They found that much of the focus of rainforest restoration has been in very small landholdings. Compared to the 180,000 ha cleared, the total area reforested is small and, up to 2002, estimated to be in the order of 2500 ha, or about 1.5% of the Wet Tropics. Unfortunately, records of these plantings have been lost and, together with a lack of monitoring and maintenance, we anticipate that perhaps as little as 100 ha remain of these restoration activities.

Thiaki Creek

Recognising the cost-effectiveness of reforestation as a major impediment to carbon sequestration with biodiversity outcomes, Degree Celsius is involved, as the carbon broker, in a major Australian

research initiative titled "*Identifying cost-effective reforestation approaches for biodiversity conservation and carbon sequestration in the Australian wet tropics*" funded by the Australian Research Council. The Thiaki Creek baseline is pasture. The focus is on reforestation methods for converting pasture to rainforest using local native species. In the light of any clear scientific evidence of the contribution of rainforest restoration schemes to conservation and as viable economic alternatives to business-as-usual, the approach focuses on identifying reforestation methods that optimise trade-offs and synergies between biodiversity goals and potential economic returns from the ecosystem services market.

The study is unique in taking an experimental approach to identifying optimal reforestation methods under the real-world limitations and conditions faced by tropical farmers. The research project draws together a team of experts from relevant disciplines to address a conservation issue of urgent national and region significance. It creates opportunities for small land-owners and agri-business to participate in the development of reforestation protocols for land currently under grazing, and will encourage more extensive reforestation across the tropics.

The site of the project is Thiaki Creek, a large rain-forested property with 50 ha of grazed pasture cleared about 50 years ago. The property harbours all 13 endemic North Queensland bird species and has breeding populations of the *rare* Lumholtz Tree-kangaroo, Lemuroid Ringtail-possum, Herbert River Ringtail-possum and Green Ringtail-possum, and possibly the endangered Northern Quoll *Dasyurus hallucatus*. The project provides a unique opportunity to demonstrate how sound scientific principles, grounded in forest ecology, silviculture and biodiversity monitoring, can be combined within an active adaptive management framework to enhance opportunities for ecologically responsible tropical reforestation.

1.2.2.2 Revegetation

While it is possible to identify revegetation on a block by block basis, there are no available data for the region.

1.2.2.3 Deforestation

For deforestation the business-as-usual baseline can be defined by the Queensland Government's latest figures (2005-6) for the Statewide Landcover and Trees Study. These figures reveal that woody vegetation clearing rates in the Wet Tropics NRM region amounted to 2834 ha/yr. The last time clearing rates were this high was a decade earlier in 1995-97.

The information for clearing in the Wet Tropics can be found at www.nrw.qld.gov.au/slats.

1.2.2.4 Improved Forest Management

Under the *Vegetation Management Act*, 1999 "forest practice" includes felling and removing trees. A landholder who conducts a native forest practice on remnant vegetation on freehold land must do so according to the Code of Native Forest Practice, which came into effect on the 1st of December 2005. Landholders must give formal notice stating the location of the native forest practice via a Notice of Forest Practice form. Once the form is submitted operations can commence. With respect to Improved Forest Management, data indicate that there are 126 Native Forest Practice Notifications, covering approximately 6000 hectares of remnant vegetation (based on our average of 48 ha for IFM from a sample of 10 properties).

The required outcomes for the Code (State of Queensland, 2007) are listed below. It is to ensure that:

- Biodiversity and ecological processes are maintained;
- Wildlife habitat values are maintained;
- Streams, drainage lines and adjacent vegetation are protected;
- Soils are protected;
- No adverse effects on the environment will be caused by the disturbance of acid sulfate soils;
- Floristic composition and stand structure are maintained over time.

Landholders can achieve these outcomes without specifying how in practical terms. The Code acts as a guide. Disturbance and degradation is permitted as long there is a strong probability that composition and stand structure will return to a mappable remnant status after 20 years. To be classified as remnant a forest would have to be:

- 50% of the predominant canopy cover;
- 70% of the height of the predominant canopy;
- Composed of the same floristic species that would exist if the vegetation community were undisturbed.

The broad, non-prescriptive and voluntary nature of the Code provides a means for potential serious degradation, and the reduction of remnant forest to scraps, which our field observations confirm. Given the natural recuperative abilities of tropical forests, and the fact that even an environmental planting - from the baseline of a paddock - can become a mappable remnant within two or three decades, in reality it is possible to severely degrade a forest by following the Code.

1.2.2.5 Agricultural Land Management

Nitrous Oxide
There is evidence that nitrate-N concentration in river waters increases as water passes through intensive sugarcane growing areas. In the Johnstone R Catchment, for example, sugarcane occupies about 12% of the catchment but contributes around 50% of the nitrate exported. Rainforest, in contrast, occupies greater than 50% of the catchment but produces around only 10% of the nitrate load.

At Appendix 2 we have documented a method we propose to use for calculating the gains made by reducing fertilizer application and therefore nitrous oxides emissions from sugarcane farming in the Wet Tropics region.

In 2001, the estimated usage of nitrogen fertilizers contributed about 4970 tonnes of N (as N fertilizer) to the Wet Tropics region (21,611 km^2) and the rate of application of N fertilizers was calculated to be 2.3 kg/ha (McDonald & Weston 2004) on average for the region. Area under agriculture is around 2,399 km^2 (239882 ha), which is about 11% of the total regional area. This averages to around 20.7 kg/ha as applied to the intensive agricultural areas, including sugarcane. In 2004 there were about 182,355 hectares under sugarcane (McDonald & Weston 2004).

But the rate of application of N fertilizers to sugarcane in the Wet Tropics as estimated by Incitec Pivot Fertilizers (Sept 2008, unpublished data which is around 60-70% of the fertilizer sold in the region (Incitec Pivot, pers. comm.)), is about 200 kg/ha - much higher than the McDonald & Weston (2004) estimates (refer Appendix 2).

1.2.3 Local communities in a without-project scenario

In 2005 the Institute for Sustainable Regional Development (Central Queensland) produced a report (Rolfe *et al*. 2005), which examined the social and economic impacts of declining water quality, focusing on three catchments as case studies. One of these, the Douglas Shire, is in the Wet Tropics and comprises the fresh and estuarine waters of the Daintree, Mossman and Mowbray rivers and Saltwater and Mossman catchments. We use this study as an indicator of socio-economic impacts in a without-project scenario.

As a result of continuing decline in water quality (refer section 1.2.5 below), a number of adverse economic and social impacts over the short, medium and longer term are expected (Rolfe 2005) including the following in the Douglas Shire, which was the only Wet Tropics catchment examined:

- Recreational: reduced activity as fish numbers decline. Expenditure is $1.5 M in the Douglas Shire;

- Health impacts such as water quality deteriorate;
- Commercial fisheries decline. Currently $3.24M in the Douglas Shire;
- Annual water charges will increase. Currently $2.7M in the Douglas Shire;
- Agricultural production may decrease. Currently aquaculture in Far North Queensland is estimated to be $18.5 M, and agriculture in the Douglas Shire is $18.6M; and
- Impact on environmental values.

The social impacts of a business-as-usual case as reflected in the water quality case study may be substantial with potential major impacts on tourism, the key industry in the Wet Tropics. Potential negative impacts would flow through to reduced incomes, expenditure and employment in the Shire. Rolfe *et al*. (2005) point out the limitations of their study having been only a desktop. They point out, however, that the estimates they used were conservative and probably understated.

1.2.4 Biodiversity in a without-project scenario

The most extensive rainforests in Australia are in the Wet Tropics. They are characterised by closed canopy, broadleaved trees. There is a high diversity of genera and species and heterogeneity is high and influenced by soil type, temperature, moisture, topography, elevation and latitude. About 20% of the Wet Tropics rainforest has been cleared, but this relatively low figure belies the fact that in some regions clearing has been extreme. For instance both upland rainforests of the Atherton Tablelands and the lowland floodplains have been extensively cleared, resulting in loss of biodiversity and land degradation, silting up of waterways and disruptions to catchment processes. The conservation of the remaining forests, mostly those left clinging to the mountain ranges, was the focus of intense environmental 'battles' during the last half of the twentieth century, culminating in World Heritage nominations. Since the late 1980s the rate of rainforest clearance has slowed and now most of the larger rainforest areas are within conservation reserves. Forests outside of reserves have been increasingly protected from clearing through regulations such as the *Queensland Vegetation Management Act 1999*, which regulates clearing on private land. Uncertainties, however, remain about the effectiveness of this Act.

Fragmentation

The condition of the areas not within the World Heritage Area and protected area estate are declining due to fragmentation and loss of remnants as a result of agricultural and urban expansion. There is strong evidence that the fragmented reserve system is insufficient to conserve biodiversity and that reforestation can reverse some of the environmental damage caused by clearing. Turner (1996) states that in nearly all cases of tropical rainforest fragmentation there has been a local loss of species through a variety of mechanisms including a reduction of population sizes, reduction of immigration rates, forest edge effects and immigration of exotic species. The relative importance of these mechanisms, however, remains obscure. Patchily distributed and specialized large animals are particularly susceptible to local extinction.

While the Einasleigh Uplands are considered 'intact' in terms of vegetation, the overall condition of the bioregion is steadily declining (Weston and Goosem 2004). Significant intervention is required to prevent further loss of biodiversity values of the area through grazing pressure, changes in fire regime and exotic weeds.

Williams *et al*. (2003) developed bioclimatic models of spatial distribution for 65 regionally endemic rainforest vertebrates and used these models to predict the effects of climate change on the fragmented wet tropical rainforests. They suggest that even a 1^{o}C increase will cause significant declines in range. At a 3.5^{o}C increase, all 65 species are predicted to undergo dramatic declines, with 30 species losing their core habitats. A business-as-usual scenario, resulting in temperature increases of 5^{o}C and over, will result in virtually all species losing their core environments.

Most of the Wet Tropics region is still managed for production-oriented outcomes. Much of this area is rich in biodiversity but the amount managed for conservation purposes or used in an ecologically sustainable way is still not known. While much of the more rugged parts of the region are under

leasehold, National Park, or Forestry Land, with regulatory controls in place, about a quarter, mostly the better agricultural land covering around 543,000 ha, is owned by private landholders under freehold tenure (McDonald & Weston 2004) with limited conservation controls in place. About 95,000 ha of this is still covered in rainforest (Annandale 2002, cited in Weston & Goosem 2004). Opportunities for acquisition of land for conservation are diminishing due to the small size of the remnants, urban development and costs of acquiring land, amounting to millions of dollars for relatively small blocks. There are a limited number of incentive schemes, including rate deferrals and rebates, and covenants, but these alone will not stop the attrition of natural areas or improve land use methods.

Without further incentives, remnant rainforest within highly cleared areas are likely to degrade and diminish in size. Further degradation of riparian forests will likely continue, resulting in deteriorating water quality with dire implications for the Great Barrier Reef. Catterall and Harrison (2006) explain that much of the activities of the community have involved control of degradation and threatening processes within existing remnant forest patches or the revegetation of formerly cleared land with a rainforest-like structure and species mix. In the latter case in particular, the impact at the local, landholder level is major since biodiversity of grasslands is low and that of reconstructed rainforests very high, particularly in this part of the world. A tool for monitoring revegetation projects for biodiversity in the landscape (Kanowski & Catterall 2006) has been developed and can be found at the following URL: http://www.rrrc.org.au/publications/biodiversity_monitoring.html. This Project has adapted this toolkit to collect data on biodiversity on individual landholdings.

Weed control, planting to fill gaps or increase a remnant's size, and planting to establish corridor linkages to other rainforests are all important activities which would not occur if not for the NRM movement in the Wet Tropics. These actions are often aimed specifically at restoring relationships between plants and animals such as pollination and seed dispersal, interactions that are important to the functioning of rainforest ecosystems.

1.2.5 Soil and water resources without project

Water Quality

Water quality in Queensland rivers and estuaries varies from pristine to poor quality. Because natural systems are complex it is difficult to make definitive linkages between human activities and decline in water quality. A guide, however, can be gained by considering the surrogates of suspended sediment, total nitrogen and total phosphorus (Rolfe *et al*. 2005).

Water flowing downstream deposits quantities of fine particles, nutrients and organic matter to estuarine and coastal waters. These play a critical role in the physical, chemical and biological processes of nearshore waters. Influences of human activity are reflected in changes in sediment yield per unit runoff. Generally, water quality in rivers entering the Great Barrier Reef has declined several-fold since 1850 because of sediments, nutrients and chemicals from cropping and grazing lands in relatively small catchments of the adjacent catchments (Productivity Commission 2003, cited in Weston and Goosem 2004). The main potential impacts are soil erosion from grazing, and nutrient runoff from cropping. Pollutant loads for the Wet Tropics basin are estimated to export under two million tonnes of sediment annually, including 14,256 tonnes of nitrogen and 2009 tonnes of phosphorus (refer **Table 5** below). The Wet Tropics catchment is one of the areas along the catchment areas of the Great Barrier Reef of most concern. Under current policy settings, water quality levels are expected to decline further.

Table 5: Estimates of annual sediment and nutrient exports from Wet Tropics Great Barrier Reef Basins (Brodie *et al.* 2003, cited in Weston and Goosem 2004)

Basin Name	**Pollutant (/yr)**		
	Sediment (000t)	**Nitrogen (TN t)**	**Phosphorous (TP t)**
Daintree	167	1170	175
Mossman	49	279	30
Barron	76	636	109

Basin Name	Pollutant (/yr)		
Russell-Mulgrave	283	2853	485
Johnstone	388	3781	548
Tully	191	2080	224
Murray	54	638	68
Herbert	682	2819	370
Total	**1890**	**14256**	**2009**

In 2005, the Institute for Sustainable Regional Development (Central Queensland) produced a report (Rolfe *et al*. 2005) that examined the social and economic impacts of declining water quality focusing on three catchments as case studies. One of these, the Douglas Shire, was in the Wet Tropics, which comprise the fresh and estuarine waters of the Daintree, Mossman and Mowbray rivers and Saltwater and Mossman catchments. The location of the monitoring sites can be found at the following web site:

http://www.epa.qld.gov.au/environmental_management/water/water_quality_monitoring/current_water_quality_in_queensland/

Sediment and nutrient modelling in the Douglas Shire catchments suggested that pre 1850 sediment and nutrient loads were 29% lower than 2004 loads.

Environmental values were identified in the catchment in consultation with the community. Catchment modelling of pollutant loads, as a predictive support tool was carried out using nitrogen, phosphorus and sediment as key indicators. Rolfe *et al.* (2005) state that there are a number of social impacts the might be expected from a continued deterioration in water quality in the Douglas Shire which we use here as indicative of the Wet Tropics generally.

The key impact would be a loss in tourism revenue, which has revenue at least 10 times that of agriculture, as negative publicity would send tourists elsewhere.

1.3 Project Design & Goals

This PDD provides an avenue for securing incentive payments to support landscape-scale community-based NRM activities. The PDD aims to incorporate carbon sequestration within an integrated regional planning context. Regional planning systems have a high potential to contribute to sustainable economic development by integrating economic, social and environmental policies in a spatial context. Many of the issues of natural resource management such as water quality, biodiversity conservation, sustainable use of land, and carbon sequestration can be best measured and addressed technically, and administratively, at a regional scale. Regionalising NRM activities also allows for decentralisation of decisions closer to the community at the property and local scales, facilitating more open participatory decision making processes.

Significantly, the PDD builds on the NRM activities of the region and while it provides a detailed approach and methodology for ARR, deforestation (REDD), and improved forest management (IFM), it also provides a plan for approaching activities associated with agricultural land management such as abatement of GHG through reduced fertilizer use, and sequestration via soil carbon through grazing land management. The PDD aims, in effect, to provide a modular framework: immediately incorporating carbon pools and land uses that have robust information and methodologies. Other pools and land uses will be incorporated when information and methodologies allow. For instance, the methodologies for calculating nitrous oxides emission reduction are known, but information gaps remain to be filled. Soil carbon response to grazing land management, however, requires both methodological development and information collection.

It is important to emphasize that the Project is not static. As approaches and methodologies become available for measuring the sequestration and abatement of GHGs through NRM activities they will be incorporated into the Project.

1.4 Scope of Project

The integrated Regional Plan for Natural Resource Management for the Wet Tropics is the framework for this PDD. The Plan is based around the primary assets of biodiversity, climate, land and water as well as the human or social asset of the community on which the future health of the environment is dependent. The Plan is based on three main principles: ecologically sustainable development; an agreed community vision; and recognition of Traditional Owner rights.

The Plan has a suite of agreed Aspirational targets, or goals, which define the scope. The overarching goal for Climate in the Plan is:

- Clean air and zero net greenhouse gas emissions in the Wet Tropics

The ability to achieve this will rely on other major goals of the Plan including the 'no net loss' for biodiversity. Because of the regional framework of this PDD, all of the goals are relevant. Those that the activities of this PDD will directly influence are italicised.

More specific goals are presented for biodiversity:

- *The extent, diversity and condition of native ecosystems and the services and functions they provide will be maintained and, where possible, rehabilitated;*
- *Viable populations of regionally significant species, including threatened plants and animals, will be maintained or recovered;*
- *The number of threatened ecological communities will decrease through increasing their extent and improving their quality to achieve a net gain;*
- Aboriginal knowledge of biodiversity will be conserved and revitalised;
- Production systems will be developed around land management practices that conserve biodiversity.

For land resources:

- The land resources of the Wet Tropics are in good shape and continue to underpin viable rural industries;
- *Sustainable production systems, which maintain the productive capacity of the land and prevent degradation and, as far as possible, maintain biodiversity and ecosystem services;*
- The use and management of land for agriculture, forestry, and residential and other purposes will be consistent with its capability, and will follow the principles of ecologically sustainable development recognizing ecological, economic, Aboriginal cultural and social issues.

For Water Resources:

- Water in the Wet Tropics rivers and streams will be managed on an holistic basis and will be used efficiently to support domestic, agricultural and industrial uses, allocated equitably between users and provide sufficient water for ecological processes and environmental values;
- The Aboriginal cultural values for water will be maintained, protected and recognised in planning, use and management activities;
- *To halt and reverse the decline in the quality of water entering the Reef within ten years.*

For Aboriginal Cultural and Natural Resource Management, and Community

- *The authority and custodial obligations and responsibilities that Traditional Owners have for country as defined under their traditional laws and customs, and their contemporary aspirations for land and sea management are recognised and reflected in NRM policy, planning and management processes;*
- *A community that is knowledgeable and informed of natural and cultural resource management issues and which actively participates in the sustainable management of natural and cultural resources in the region.*

1.4.1 Description of Project Activities

1.4.1.1 ARR, IFM, REDD

The Project uses methodologies, explained below at section **2.1.1**, for reforestation, assisted natural regeneration (ARR), reduced or avoided logging (IFM) and avoided deforestation (REDD), which will form the first part of the inventory.

In order to pool specific NRM activities into this PDD we have gone through a three-stage process that has involved

- A preliminary field testing with a sample of landholders;
- A formal call for expressions of interest through the media;
- Field visits to landholders.

To enable the field-testing component, we ran press releases, carbon forums, talks, development of Fact Sheets based on questions that landholders are asking about carbon pooling and abatement, and then face-to-face discussions with interested individual landholders. This targeted process resulted in a number of landholders who permitted Degree Celsius to carry out field-testing methodologies (refer Section 2.1.1) on their properties. From this fieldwork we developed a comprehensive survey methodology, which is found at **Appendix 1**.

The formal call for expressions of interest was carried out via newspaper advertisements and radio interviews.

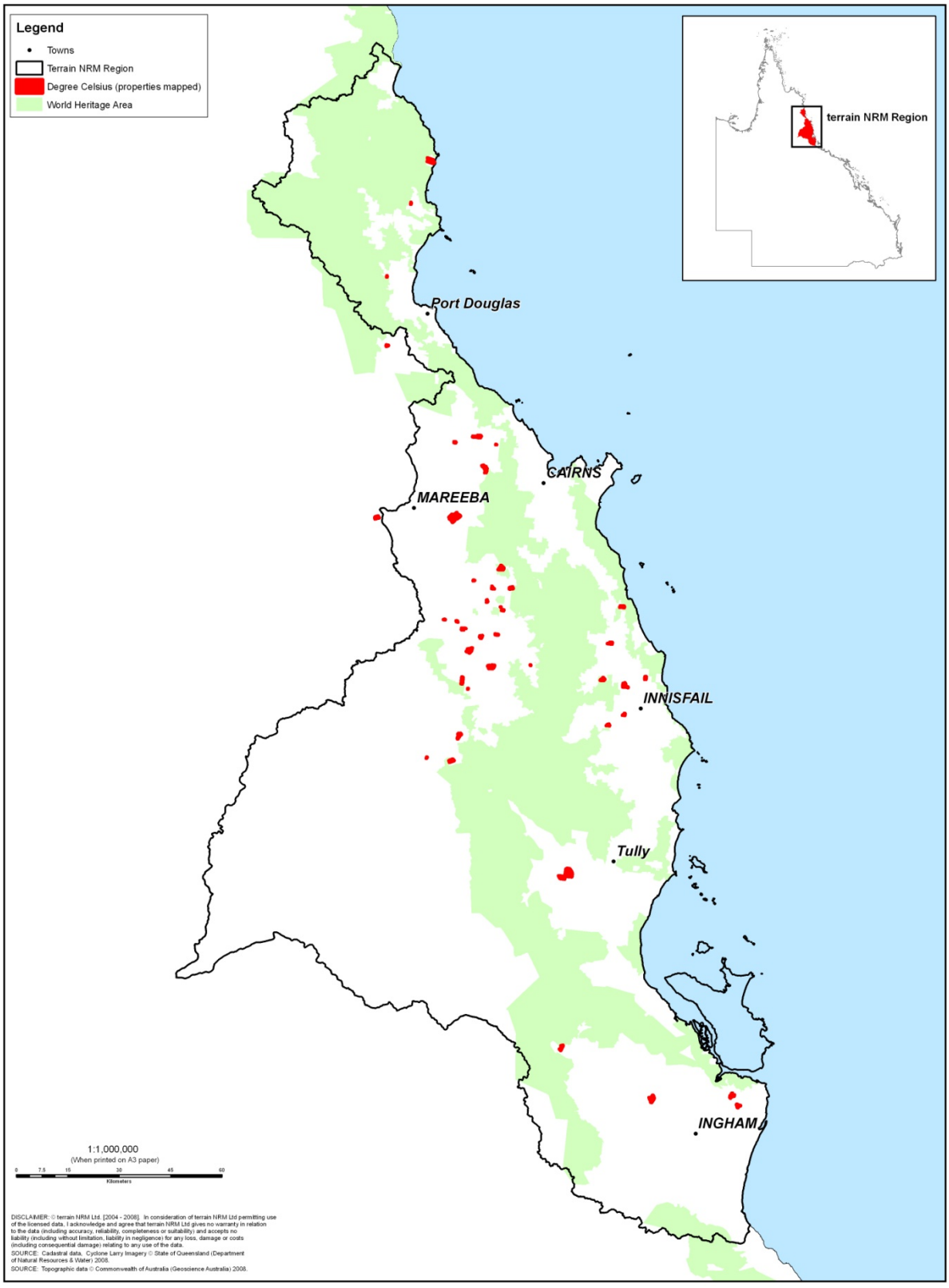
The formal call has resulted in a steady flow of interested landholders filling in Expression of Interest Forms. These landholders receive a package of material incorporating a general explanation of the Degree Celsius initiative and a Frequently Asked Questions sheet (refer **Appendix 3**). This is followed by a visit to answer questions and ascertain genuine interest before proceeding toward measurement.

On-going publicity and word-of-mouth continues to generate strong interest.

1.4.1.1.1 Project Location

Refer to **Map 1** for a representation of the Project region.

Locations of the properties, which have agreed in principle to aggregate their carbon with Degree Celsius, are shown in **Map 6**.



Map 6: Current and future Project property locations

1.4.1.1.2 Project Timeframe

The current Wet Tropics Regional Plan is for 2004-2008. The Plan is reviewed each four or five years, providing an opportunity to make sure targets and goals are still relevant and to assess how each plan has been tracking. The process is ongoing for the foreseeable future.

While permanence remains an issue within the AFOLU sector, there is a growing global consensus that all regions and sectors must be involved to capture the full potential for sequestration and abatement. The recent McKinsey and Company report (2009), for instance, makes it very clear that any significant shortfalls in any major sector, such as AFOLU, would result in an inability to capture the sequestration and abatement needed to avoid dangerous climate change. If AFOLU were not included, measures in other sectors would occur at a high cost. There is a growing consensus that to have a 50% chance of avoiding dangerous climate change we must include AFOLU without delay (Terrestrial Carbon Group, 2008). There is also a growing concern that our window of opportunity is only 30 years, and possibly as low as 10 years.

1.4.1.2 Agricultural Land Management

1.4.1.2.1 Nitrous Oxide abatement

Terrain has provided funding for the running of BSES (Bureau of Sugar Experiment Stations) *six-easy-steps* courses. The sugarcane industry in Queensland has been working for over a decade to improve management of soils used for sugarcane production. Positive environmental benefits have been one of the main focuses and outcomes of the improvements. Soil-specific management guidelines for catchments such as the Johnstone River catchment provide detailed recommendations for the analysis and assessment of on-farm soils so that the most appropriate management decisions can be made for crop and soil management (Schroeder et al. 2007).

These recommendations have been distilled into *six-easy-steps* for sugarcane growers which reflect the findings that analysis of nutrient requirements for sugarcane has been in need of improvement. Previous nutrient management recommendations have resulted in excessive addition of nutrients to soils, resulting in high levels of a range of elements (particularly P) in the soil, in runoff and in emissions to the atmosphere (Schroeder *et al.* 2008). The six easy steps are:

1. Knowing and understanding our soils;
2. Understanding and managing nutrient processes and losses;
3. Soil testing regularly;
4. Adopting soil-specific fertiliser recommendations;
5. Using leaf analysis as a check on the adequacy of fertiliser inputs;
6. Keeping good records/modifying nutrient inputs when and where necessary.

Adoption of these practices and recommendations would reduce the amount of N fertilizer added to sugarcane in the Wet Tropics region by around 20%, based on the fertilizer supply records.

According to BSES, adoption of these recommendations has been slow; few obtain soil analyses, and few keep good records of practices, cropping outcomes, fertilizers use and problems. Sugarcane farmers need incentives to adopt the practices. Rising costs of fertilizer are one incentive, but for them to adopt the more detailed nutrient management guidelines will require a higher level of incentive.

The Degree Celsius initiative will help provide this level of incentive by providing incentive payments for implementing the recommendation of the *six-easy-steps* course and thereby providing a baseline and ability to monitor outcomes. The methods we propose to use for calculating the gains made by reducing fertilizer application and therefore nitrous oxide (N_2O) emissions from sugarcane farming in the Wet Tropics region of Far North Queensland are detailed in Appendix 2, which also provides a detailed response of our approach to fertilizer use in the sugarcane areas.

1.4.1.2.2 Project Location

Map 4 shows the main land uses. Sugarcane is the main land-use on the coastal plains that are identified as production from dryland agriculture and production from irrigated agriculture (see **Appendix 7**).

1.4.1.2.3 Grazing Land Management and Soil Carbon

The Project will prepare a research methodology and proposal for funding to enable the Project to incorporate grazing into the aggregated inventory. **Appendix 7** shows the main areas of grazing in the Wet Tropics. The underlying assumption is that carbon sequestration increases with ground layer condition, with the greatest improvement being from heavily degraded land to well-grassed land. Carbon credits can only be claimed, however, where there is a measurable and 'additional' increase in carbon sequestration over baseline levels. For instance, a shift from low sequestration (or loss) under heavily grazed country to moderate to high sequestration under rehabilitated rangelands would only occur if the leaseholder were compensated with ecosystem services payments for soil carbon sink management. Currently, despite the clear message that it is unproductive and uneconomic to overstock, many land managers often want to intensify cattle production rather than reduce it. In this light, payment for carbon would act as an incentive not to overstock.

These incentive payments would value-add Grazing Land Management scheme which include training land managers to assess the condition of their pastures. The training allows for the categorization of condition into simple classes from good, A, to bad, D. The main purpose of assessing range condition is to ensure sustainability of grazing practices. In the GLM process, land managers self-assess pasture condition at a number of points on their properties. This project aims to link GLM and levels of soil carbon sequestration in the Far North Queensland region. Refer to *Section 2.1.1 Grazing Land management* for a more thorough treatment of our approach.

1.4.2 Risk Management

Identified risks for NRM have been extensively documented in the Regional Plan which itself is a framework for managing risk. Landholders themselves regularly raise risks issues, and Degree Celsius staff have documented the main ones. Degree Celsius has developed a FAQ sheet (see **Appendix 3**), which is based on questions asked frequently by landholders, which are based on assessments of risks they perceive from carbon pooling.

Assessment of the risks associated with the project is a critical part of understanding the inherent weaknesses and potential for the project to fail or not perform in accordance with expectations. Accordingly, we have undertaken a risk assessment in accordance with international standard *Risk Management* AS/NZS 4360:2004 guidelines, and subsequently according to the Voluntary Carbon Standard (2008) *Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination*. The full analysis can be found at **Appendix 4.** We have chosen to undertake both risk assessments because the AS 4360 approach provides a robust means to assess risks of projects. It is complementary to the VCS Tool, which allows the buffer of the carbon pool to be determined.

In summary, our risk analysis showed that the main risks are:

- Cyclone damage
- Flooding
- Low Project revenue from sales
- System Failure
- Legislative Policy and Legislative Changes
- Contractual breach
- Inadequate maintenance and management of inventory
- Poor monitoring
- External developments
- Fire
- Clearing
- Detrimental research findings
- Pathogens & disease

Most recently a report titled *Managing Australian Landscapes in a Changing Climate: A Climate Change primer for regional NRM bodies* (Campbell 2008) was released which assesses risks,

including those dot-pointed above, and regional approaches to them. This document can be found at http://www.climatechange.gov.au/impacts/publications/pubs/nrm.pdf.

1.4.3 Local Stakeholders

Stakeholder participation is the foundation stone of the regional natural resource management movement. The latest Wet Tropics Regional Plan 2004-2008 describes the extensive process of involving the community. This process is summarised below at Section 3.1.2. Also at Section 1.3.2, above, the process of inviting landholders who wish to be involved in regional Biocarbon pooling is outlined. The Degree Celsius website (www.degreecelsius.com.au) will provide an opportunity for the global community to invest in building the resilience of this global biodiversity hotspot.

1.4.4 Demonstrated Transparency

All project documentation will be available on the Degree Celsius website, and on the Terrain website (other than commercial-in-confidence material). The Degree Celsius website will be developed into a state-of-the-art delivery platform. The web-based platform will provide mapping and accounting resources, and algorithms to allow individuals, businesses and landholders to calculate their carbon footprint. It will provide a portal for landholders involved in regional aggregation. It will also enable corporations and individuals to track their offset investments through links with the web-based offset system to be developed for the Tourism Partnership Arrangement described in more detail in **Section 1.6** below.

Section **1.4.1** Description of Project Activities elaborates on arrangements with landholders who choose to be part of the Biocarbon pool.

1.5 Management Capacity

1.5.1 Team Experience

Terrain NRM
FNQ NRM Ltd, trading as Terrain NRM, is an independent not-for-profit company limited by government guarantee. Its history is discussed under Section 1.0. Briefly, Terrain was established in response to Commonwealth and Queensland government natural resource management policy to manage more strategically regional investment in natural resource management activities. Terrain builds on the successes of decades of community-based environmental work. Overseen by a nine-member board of Directors, the organization manages a core budget of $7.4M, as well as significant additional investments amounting to $9M over three years. Terrain represents a support base of 115 organisations through which several thousand North Queensland landholders are part of the natural resource management movement.

Terrain NRM is widely regarded as the leading natural resource management body in Australia, getting people working together toward a shared vision for the future that is based on enhancing biodiversity, managing water and land resources sustainably, and incorporating indigenous land and cultural resources. Degree Celsius will allow the land managers of Far North Queensland to prioritise the sequestering of carbon as part of their natural resource management activities.

Dr Allan Dale is the CEO of FNQ NRM Ltd. Dr Dale has previously been responsible for natural resources policy in the Queensland Government. The Chairman of the Board of FNQ NRM Ltd is Mr Mike Berwick. Mr Berwick is the now-retired Mayor of Douglas Shire Council. He has been a ceaseless campaigner for environmental issues in the far north of Queensland. He has a national profile in natural resources management, and is an expert in governance.

BIOCARBON
The principals of BIOCARBON, an ethical for-profit business, are environmental scientists and business entrepreneurs, Penny van Oosterzee and Dr Noel Preece. Ms van Oosterzee is one of Australia's leading science writers, with two Eureka Prizes to her name, and a 20-year career in environmental services at the corporate level. Noel has 30 years of experience in natural resource management across the main biomes of Australia.

Penny van Oosterzee (the Manager of Degree Celsius), Allan Dale, Noel Preece and Mike Berwick are the Degree Celsius managing team.

1.5.2 Specific Relevant Management Capacity

The Directors of BIOCARBON have a track record of managing complex projects. Before forming BIOCARBON, both Penny van Oosterzee and Noel Preece owned environmental consulting firm EcOz, which they sold to national engineering firm VDM group in 2006. Ms van Oosterzee and Dr Preece established EcOz, which operates from Darwin, in 1990. EcOz has worked on over 200 projects in the Northern Territory and nation-wide, and in the last decade has led many of the approvals processes for major projects in the NT including the Bonaparte Gas Pipeline, Blacktip Gas Plant, Vopak Darwin Terminal, Darwin Biodiesel, Telstra Optical Fibre Cables though World Heritage Kakadu and Aboriginal-owned Arnhem Land, and many other projects. Ms van Oosterzee has substantial experience in managing and working on large, complex projects within time and budget constraints. A complex role that demonstrates her expertise in this area was her role as Project Manager for legislative approvals required for the proposed Asia Pacific Space Base on Christmas Island.

Both Dr Preece and Ms van Oosterzee have managed staff in many disciplines in a wide variety of situations, often in remote locations. They also have managed numerous contractors and sub-consultants and contractors including archaeologists and heritage consultants, air-noise consultants, geotechnical and hydrological consultants, marine and terrestrial ecologists, and economists amongst others. Their long experience with managing sub-consultants provides them with a unique ability to select the best expertise for the job while still providing seamless project management. Dr Preece and

Ms van Oosterzee have an excellent record of timely delivery and quality outcomes. They are skilled at undertaking consultation with Government on most of the regulatory and technical aspects of developments, and have undertaken community consultation and public representations on many high profile projects.

In addition, Ms van Oosterzee and Dr Preece have an excellent network of specialist scientific and technical colleagues and advisers.

Dr Dale is the CEO of Terrain NRM, and is responsible for the day-to-day management of this diverse organisation. He has previously had extensive experience in resource use policy and planning having been General Manager of Resource Policy in the Queensland Department of Natural Resources and Mines where he was responsible for building policy development of NRM across Queensland.

1.5.3 Specific Technical Skills

Ms van Oosterzee has researched, written and managed over 200 environmental and land management projects, involving a complex mix of environmental, social and cultural issues over the past two decades. She is highly skilled in diverse projects such as environmental impact assessments, and indigenous and other land management projects. Ms van Oosterzee holds a Master of Environmental Science, and a BSc, and is a highly awarded Australian Science writer, having published seven popular science books including two internationally in the USA and Japan. She is also an Adjunct Research Fellow with Charles Darwin University, and is recently retired from the NT Government's Research and Innovation Board.

Dr Preece's expertise is broad, with technical expertise, from hundreds of projects, in: fauna and vegetation investigations (MSc Zoology) (expert in vertebrate fauna of northern Australia); Fire management and planning; Environmental impact assessment; Lead Environmental auditor; Pipeline & linear development environmental impact assessment and planning; Soils and geomorphologic investigations and analysis; prehistory/archaeology (BSc in Earth Sciences/Geography); and ethno-ecology (PhD in Science). Dr Preece is also a lead environmental auditor and has conducted a number of environmental risk assessments for major projects in the Northern Territory in accordance with AS/NZS 4360. His PhD in Indigenous Ecological Knowledge gives him special insight into different land management knowledge systems.

Dr Dale has a PhD in land use planning, specifically with regard to planning for government-funded land-use development projects on Aboriginal lands and the associated failure of government policy. He is expert at holistic community-based planning and broader systems of land-use planning in rural Australia.

CVs are found at **Appendix 5**.

1.5.4 Financial Health

Terrain NRM Ltd, and BIOCARBON PTY LTD support the Project jointly. The Project is closely associated with the Wet Tropics Regional Plan, which has attracted up to $16 M of funding, as explained above. BIOCARBON has provided substantial investment into Degree Celsius to research, field survey, develop and write this PDD, totalling approximately $250,000 in cash and kind. The Degree Celsius JV has no current liabilities.

The Degree Celsius website www.degreecelsius.com.au was soft-launched in late May 2008 and, once the Project has been validated and VERs verified, it will provide opportunities for business and individuals to invest in regional NRM activities that involve biosequestration, and offset their activities. A state level Climate-Tourism partnership dovetails with the Degree Celsius initiative and this is described below. It occurs in this section because the significant marketing and promotional activities will provide financial spin-offs, which are currently incalculable but should be significant.

1.5.5 Management systems

The Project has implemented the necessary due diligence, quality systems and record keeping, which are constantly being reviewed and revised to ensure standards are maintained to the highest level.

1.6 Regional NRM, regional tourism assets and climate change

An exciting initiative has been developed between Degree Celsius, Tourism Queensland and Queensland Tourism Industry Council (QTIC). A Memorandum of Understanding between the parties links regional NRM activities that build resilience into the regional tourism assets against climate change. This PDD is pivotal to the Tourism initiative, since it sets the scene for all the NRM regions flanking the Great Barrier Reef. The initiative has the following principles regarding the development of a credible and verified Biocarbon offsetting system for the tourism industry:

1. The Queensland Biocarbon offset system focuses on building resilience into natural ecosystems, and requires a collaborative effort between the parties.

2. Regional NRM bodies in association with local landholders and carbon aggregators including Degree Celsius will systematically develop and deliver verified Biocarbon-sequestration offsets.

3. The Biocarbon offsets within regions will be linked to regional tourism assets.

4. Tourism Queensland and QTIC will undertake Marketing and promotion of the offset system.

5. Delivery of the offsets will focus on a web-based system, which includes emissions calculators, and choices for offsetting and investment based on regional assets.

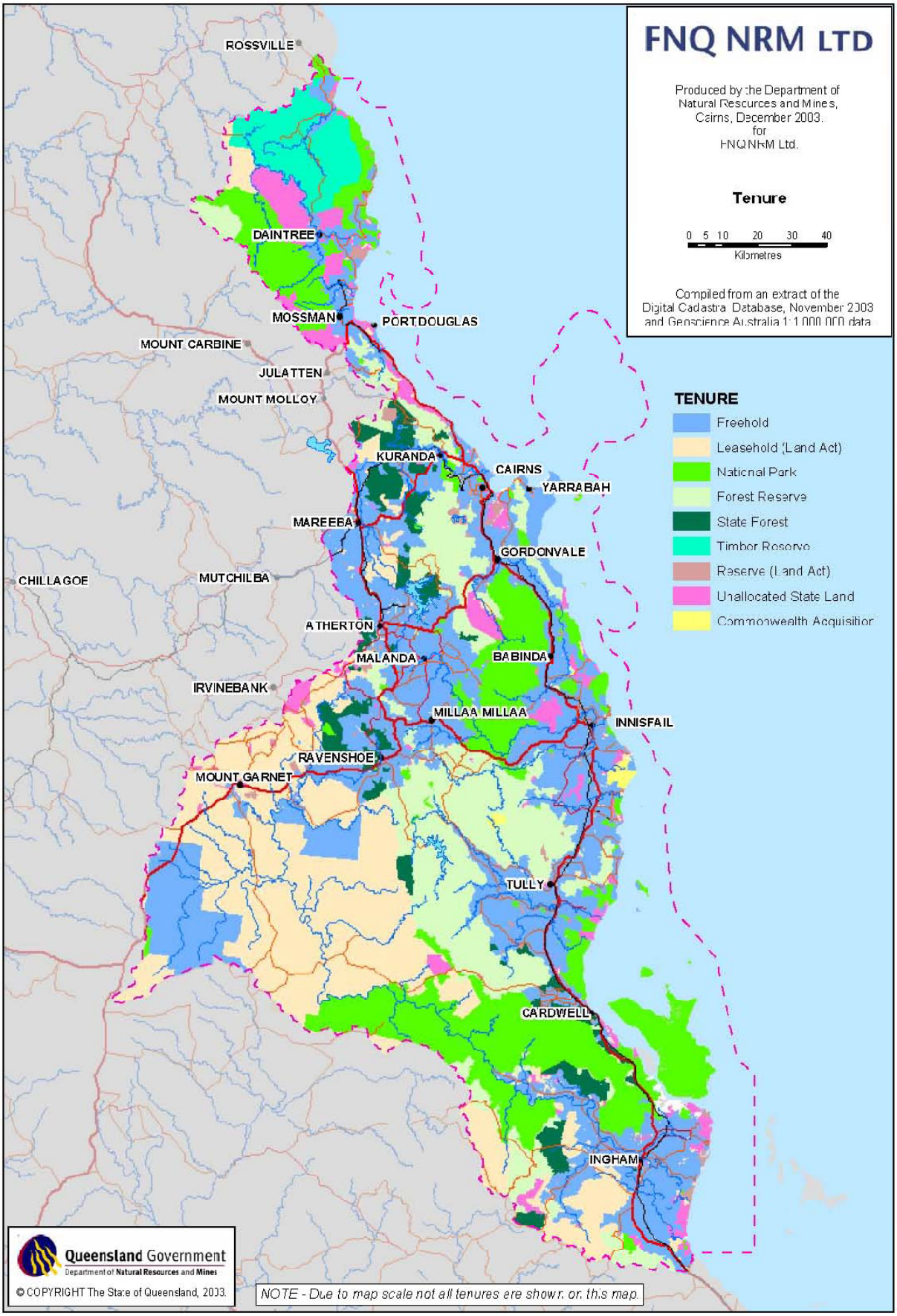
6. Deliverables include a fully-costed statement for offsetting Queensland's tourism industry carbon footprint based on a range of verified Biocarbon offset projects by around late 2009 with the system marketed and operationalised by around mid 2010, but with certain verified products coming on line earlier.

1.7 Land Tenure

All the land identified in the Project which forms the inventory is freehold land, held by individuals, companies or incorporated bodies.

1.7.1 Statement regarding uninvited encroachment

Map 7 shows land tenure in the region. It is illegal in Australia to encroach uninvited on private or leasehold land without the permission of the landholder or leaseholder. The concept of community property is not relevant here.



Map 7: Land Tenure in Project region

1.7.2 Statement regarding no relocation of people

There will be no relocation of people as a result of the Project.

1.7.3 In-migration

This is not relevant to the Project.

1.8 Legal Status

1.8.1 Define and confirm no laws broken

The legal framework for carbon trading for Queensland is described below in the next section. No laws will be broken in the approvals process.

1.8.2 Approval process

The project is based on a solid legal framework and appropriate contracts will be in place. There are two main options available.

Several options are available to producers growing trees or undertaking other land management practices. The two most obvious and common are as follows. The first is a contract between Degree Celsius and the producer. Under this scenario, the producer would revegetate the land, or undertake other described land management practices, which sequester carbon, for a contracted time period (in this case the default period is 30 years). In this case, the producer or landowner would plant and manage the 'product', being carbon.

A more likely alternative, and one currently being pursued by a number of landholders, is to enter into a formal agreement with Degree Celsius. In Queensland, carbon sequestration rights are recognised under the *Forestry Act 1959* (QLD) as a component of a "natural resource product". Under the *Forestry Act*, the owner of land may enter into an agreement with a third party about a natural resource product on the land. These agreements are called Natural Resource Product Agreements (NRPA) and can be registered on the land title, as a deemed *profit à prendre*, similar to a covenant. An NRPA may:

- vest all or part of the natural resource product in a third party;
- grant a third party the right to enter the land to:
    - establish, maintain or harvest the natural resource product; and
    - carry out works or activities for the natural resource product and grant the third party the right to deal with the natural resource product.

A contract based on a property management plan will be attached to the *profit à prendre*.

Once Degree Celsius has gained approval under the CCB Standards, it will look to sell the carbon credits (Verified Emission Reductions or VERs) to a number of buyers. To that end, Degree Celsius will develop a standard form template contract (a VER Agreement), based on Degree Celsius' requirements.

1.9 Adaptive Management for Sustainability

The Regional Plan for Natural Resource Management for the Wet Tropics is required to be dynamic and responsive to community and regional needs, and is continually improved as more information becomes available, feedback is obtained and on-ground change takes place.

1.9.1 Management and monitoring feedback

The Regional Plan is ultimately about protecting and restoring the natural and cultural assets, primarily land, water, biodiversity and climate. The primary human asset in this context is community capacity for long-term adaptive management of their natural resources. The Plan incorporates a community-based process to identify priority land management issues with a focus on soil and land

type, and to assist landowners and managers to improve their land management practices. This approach is set within an adaptive management framework to achieve continual improvement.

Key activities of this adaptive management framework are:

- Benchmarking current management practices;
- Identification of management practice across appropriate sectors;
- Negotiating the level of adoption to be reached;
- Providing technical advice and extension of best management practice/farming systems management/property management planning;
- Provide incentives for increasing adoption rates where public benefits accrue from management practices;
- Monitoring the effectiveness of management practices and continual improvement;
- Monitoring of management practice adoption rates.

Supporting this framework is on-going rigorous scientific research.

An example of this research is Catterall and Harrison (2006) who concluded in their study of afforestation and reforestation efforts in the Wet Tropics that much larger aggregated land areas will require reforestation than have been done to date to make an ecologically meaningful difference. Their study, itself a significant management and monitoring feedback into the NRM plan, suggested that the early revegetation works in the early and mid-1990s had fallen short of their goals of extensive revegetation and biodiversity conservation. The study suggested that to significantly increase rainforest cover would require a huge investment. They concluded a requirement for different methods of reinstating forests, and a revolutionary change in financial allocation. This PDD provides a path forward in implementing this recommendation.

One significant opportunity identified by Catterall and Harrison (2006) is assisted natural regrowth. Because of downturns in the economics of the dairy and sugar industries, many properties have regrown, often with introduced plant species, including environmental weeds. Available information suggests that some introduced species may support a promising level of rainforest-associated biodiversity, or an understorey that has seedlings of mature-phase rainforest trees. Conversely un-managed regrowth may be delayed or suppressed by aggressive vines and scramblers. Carefully targeted management actions may be able to influence the rate and pathway of succession. This PDD incorporates assisted natural revegetation ("revegetation" under AFOLU categories).

1.9.2 Decisions, actions and outcomes

The Wet Tropics Regional Plan is a comprehensive plan that specifically documents decisions, actions and outcomes, and insures that the information is fed back into the decision-making process. The regional NRM movement is extremely well buffered so that it is difficult for one person to take away and lose information. The Degree Celsius initiative itself already works within the framework of the Regional Plan processes, and necessarily works closely with on-ground field officers responsible for afforestation/reforestation, private farm forestry and sustainable landuse, and landholders. The information generated by Degree Celsius will be available for stakeholders on its website. Currently the website has available the information related to the Call Process outlined in Section 1.3.2.

1.9.3 In-built flexibility

Given the rapidity of climate change and its impacts it will be difficult to forecast the future simply through observation of past pathways and processes. The Regional Plan, however, is regularly reviewed, management targets assessed and the plan updated. The Plan is built on principles of adaptive management including that "cost-effective and flexible policy instructions should be adopted, such as improved valuation, pricing and incentive mechanisms" of which the Degree Celsius initiative is an example.

1.9.4 Sustainability of Project

The Degree Celsius initiative has been designed to be an important plank of the Regional Plan which has in-built and stream-lined mechanisms to continue the shift towards sustainable management of natural resources that involves reduced emissions and net sequestration of carbon. While this PDD uses the Regional Plan as its framework, both the Plan and the initiative will act synergistically. For instance important corporate objectives of the Regional Plan are to:

- Capitalise on the NRM opportunities for the Region;
- Establish an ecosystem services trading framework for the region; and
- Engage corporate partners and investors in the Terrain vision.

The Degree Celsius initiative is the Terrain Board's primary strategy for securing these objectives.

The Degree Celsius Joint Venture agreement (which we consider confidential) specifically includes the development of biodiversity and ecosystem services credits as one of its five main activities. This PDD is also itself a pilot for the regions flanking the Great Barrier Reef. Once financial support for biocarbon sequestration is secured, the Joint Venture partners will be working actively on water-quality credits and biodiversity credits to ensure the continued viability of both the Wet Tropics and the Great Barrier Reef.

1.10 Knowledge Dissemination

1.10.1 Lessons Learned

The information generated by Degree Celsius will be available for stakeholders on its website. Currently the website has available the information related to the Call Process outlined in Section 1.3.2.

The Regional Plan has in-built and streamlined mechanisms for knowledge dissemination, since that is one of the pivotal roles of the Regional Plan.

A recent review of afforestation and reforestation outcomes by Catterall and Harrison (2006) found that success in revegetation was limited by a lack of mechanisms for integrating scientific knowledge with government-sponsored community activities resulting in vaguely stated goals, lack of dissemination of reports to regional decision-makers or the community, and lack of quantitatively monitored reforestation projects. Centralised, stable, and publicly accessible record keeping is important to allow the fate of projects to be tracked over a time-span of decades. Even within Government agencies records are lost, sometimes due to restructuring (e.g. lost records relating to the 2500 ha of reforested land, refer section 1.2.2.1). This Project provides a mechanism for such record keeping.

The linked Thiaki Creek research initiative promulgated by the Directors of Biocarbon, and funded by the Australian Research Council is based on lessons learned from literature, research, and consultation with the community of Far North Queensland. These lessons revealed the lack of scientific rigour behind reforestation with biodiversity outcomes. The research project will test and provide statistically and ecologically rigorous results on the pre-existing and establishment phases of reforestation. It will also provide detailed cost assessments of reforestation. The research project is a joint proposal between leading scientists from the University of Queensland, Adelaide University and Charles Darwin Uni, with four Industry Partners including Terrain NRM, Greening Australia, Stanwell Corporation, and Biome5, the owners of the property where the research will take place.

1.10.2 Lessons disseminated

Terrain NRM (based on work commenced by the former Rainforest CRC) are working to avoid repeating the failings of previous reforestation projects outlined in section 1.8.1 by funding the development of a monitoring toolkit for rainforest restoration works (Kanowski & Catterall 2006). The

latest iteration of this toolkit can be found at the Reef and Rainforest URL: http://www.rrrc.org.au/publications/biodiversity_monitoring.html.

Disseminating information between government, scientists and landholders is a major role of Terrain NRM. Increasing the capacity of the community to manage for biodiversity conservation and sustainable management generally is incorporated in key Management Action Targets, and disseminating the results in key management actions is one of the key objectives. Extension and education programs form core activities for all activities of Terrain including:

- Disseminating information regarding key habitats;
- Field days and information sharing on critical pests to agriculture;
- Education programs for landholders of private farm forestry to encourage connectivity via forest corridors with other landholders;
- Support and training in the development and use of Best Management Practices for each major industry;
- Extension programs to improve land and water management for graziers and appropriate use of fertilizers;
- Information made available on the sources of funds for financing off-stream watering points, in paddock shade and shelter belts;
- Forums to facilitate the exchange of information on management options for riparian zones at the property and catchment scales;
- Guidelines developed and disseminated for sediment and nutrient loss management techniques;
- Extension staff including field staff available in main towns and within catchments;
- A small workforce for tree planting.

2 NET POSITIVE CLIMATE IMPACTS

2.1 Net change in carbon due to Project Activities

We hold a database of landholders who have responded to date to our formal call and provided signed expressions of interest forms. We are currently working through the processes described in this PDD. We hope to use part of the finance from the sale of VERs associated with the forest-related activities to test and implement the processes for all other activities.

2.1.1 Sequestration Methodology

Regional carbon sequestration NRM activities include ARR (reforestation, private farm forestry and assisted natural regeneration), IFM (reduced or no logging), avoided deforestation (REDD), grazing land management and sustainable agriculture (ALM). These are equivalent to the *key categories* for sources/sinks, which need to be identified in accordance with the key category analysis for AFOLU (Volume 4 Chapter 1 and Chapter 4; IPCC 2006). Changes in carbon sequestration due to Project Activities can be measured, calculated or estimated, depending on the status of historical research data at the international (Tier 1), national/regional (Tier 2) and local/specific (Tier 3) levels in accordance with IPCC 2006. Using the decision tree approach of IPCC 2006 (Figs 1.2 & 1.3), the six key categories have been analysed with respect to the level of information available on each. Specific steps in the decision tree for each key category are:

- Category identification – present/absent
- Is category a *key category?*
- *Repeat for each gas - CO_2, CH_4, N_2O*
- Is each subcategory significant? (biomass, dead organic matter, soil carbon, etc – i.e.>25% of removals; see Fig 1.2)
- Are country-specific data available? (Tier 1/Tier 2/3)
- Are advanced methods and detailed data available? (Tier 2/Tier3)

This Project assumes that all six categories identified are *key categories* as they are the basis of the Project. If the subcategories are not significant, IPCC 2006 recommends using country-specific emission factors if advanced methods and country-specific detailed data are not available.

The results of this analysis are provided in **Table 6** below.

Table 6: Tier levels for Land use categories and C pools for Wet Tropics Region (derived from Table 1.2 of IPCC 2006 Vol4Ch1

	C pool & non-CO2 gases					
Key category	*Above-ground Biomass*	*Below-ground biomass*	*Dead organic matter*	*Soil carbon*	*Non-CO_2 from biomass burning*	*Non-CO_2 from crops, grazing, etc*
Afforestation and Reforestation	Tier 2 - Tier 3[a]	(<25%) Tier 2	(<25%) Tier 2	Tier 2[b]	NA	NA
Farm forestry	Tier 2 - Tier3[a]	(<25%) Tier 2	(<25%) Tier 2	Tier 2[b]	Tier 2	NA
Assisted natural regeneration	Tier 2 - Tier3[a]	(<25%) Tier 2	(<25%) Tier 2	Tier 2[b]	Tier 2	NA
Avoided deforestation	Tier 2 - Tier3[a]	(<25%) Tier 2	Tier 2	Tier 2	Tier 2	NA
Grazing land management	Tier 2	Tier 2 – Tier 3	NA	Tier 2	Tier 2	Tier 1/Tier 2
Sustainable agriculture	Tier 2	NA	NA	Tier 2	Tier 2	Tier 1/Tier2

a. Tier 3 measured for samples to test for variance from Tier 2 estimates
b. Subject to Thiaki Research project with UQ, CDU, UAdel. 2008-13

Reforestation, Farm Forestry, Assisted Natural Regeneration, Avoided Deforestation, Improved Forest Management

For these categories (excluding Grazing Land Management and Sustainable Agriculture), most C pools and non-CO_2 pools can be estimated from the National Carbon Accounting Toolbox (NCAT) produced by the Australian Greenhouse Office which addressed the reporting capability for the United Nations Framework Convention on Climate Change National Greenhouse Gas Inventories and Kyoto Protocol baselines.

Considering the large area, diverse landscapes and diversity of patches which have been aggregated in this Project, the NCAT values, which are Tier 2 values, are considered adequate for accounting for the Carbon and non-CO_2 gases, but in order to improve the reliability of the Tier 2 values, site-specific validation of a sample of the sites has been undertaken. The methods that have been used for this validation are based on standard forest mensuration and monitoring methods used in the region and elsewhere (e.g. Burrows *et al.* 2000, 2002; and Back *et al*. 1997, 1999). A description of the methods is summarised below, and a field manual used by the Project team members is provided in **Appendix 1**. The site validation has been applied to sites with trees only. Further work will be required and is proposed for the sustainable agriculture and grazing land management categories, subject to sufficient funding being derived from the Project, and a brief approach to both these categories is provided below following this section.

Plots were established on a number of plantations in the Project area. Each small plantation or forest remnant was assessed using remote sensing, stratified to identify vegetation type boundaries, and then inspected on the ground. Where sufficient area existed, two or more plots were established. Permanent markers were established at each end of each plot so that monitoring and validation may be conducted. The plots were assessed using transects which are based on the TRAPS savanna monitoring approach following Burrows *et al.* 2000, 2002, and Back *et al*. 1997. TRAPS was modified to allow nesting in accordance with LULUCF guidelines (Pearson *et al.* 2005) to account for stem size classes, and biodiversity indices from Kanowski & Catterall (2007) were used for biodiversity values rating.

Nested transects 50 m long, and 3, 6, and 10 m wide for stems 2.5-<10cm, 10-20cm and >20cm diameter at breast height (DBH) respectively were established, resulting in surveyed areas of 150 m^2, 300 m^2; and 500 m^2. Measurements included DBH of each tree in relevant transects, and data were entered in Excel spreadsheets and analysed using established algorithms published in NCAT. Calculations are based on Snowdon *et al.* (2000). The formula is:

$$ln\ (\text{biomass}) = \text{constant} + \text{slope}\ (ln\ (\text{DBH}))$$

where the constant for rainforests is -1.8967, and the slope is 2.3698.

Biomass (above-ground biomass = AGB) is calculated by obtaining the exponent of the *ln*(biomass) and is measured in kg. IPCC 2006 National Guidance for Greenhouse Gas Inventories assumes a default value of Carbon as 0.47 of AGB for tropical and sub-tropical forests. CO_2-equivalent is calculated as 3.67 times the value of Carbon in the plant biomass (see Snowdon *et al*. 2000). Slope was also corrected for in the areal calculations. Twenty one sites have been established on properties which form part of the inventory. Results of the surveys are provided in **Appendix 6**.

Default values for rainforest tree wood density obtained from Snowdon *et al.* (2000) were used for this PDD. Values of species-specific wood density are available from NCAT, and it is the intention of the Project that species identifications for each plantation will be obtained over the next 5 years. The Snowdon *et al.* (2000) default values are considered to be conservative.

The estimates on each plantation were derived using NCAT, and the results provided in **Table 7**. The total area of the aggregated properties under the first tranche inventory is 730 hectares, and the total calculated CO_2-equivalent from all properties is 143,360 tonnes.

Table 7: NCAT Calculated C and CO_2-e sequestration for Tranche 1 Inventory

	Total area (ha)				NCAT C mass trees (above & below ground) (tC/ha) 2008				Total C (above & below ground) (tC/ha)				
	REDD	ARR		IFM	REDD	ARR		IFM (25% total C)	REDD	ARR		IFM	
Property ID	**Avoided (non-rem)**	**CRRP/ Forestry**	**Enviro Planting**	**Imprd frst mgmnt**	**Avoided**	**CRRP/ Forestry**	**Enviro Planting**	**Imprd frst mgmnt**	**Avoided**	**CRRP/ Forestry**	**Enviro Planting**	**Imprd frst mgmnt**	**Total C (NCAT)**
DCT1_001	0.0	0.0	2.13	0.0	0.0	0.0	80.5	0.0	0	0	171.7	0	171.7
DCT1_002	0.0	0.0	1.71	0.0	0.0	0.0	73.5	0.0	0	0	125.6	0	125.6
DCT1_003	0.7	0.0	0.00	0.0	235.4	0.0	0.0	0.0	164.8	0	0	0	164.8
DCT1_004	0.0	0.0	0.00	108.2	0.0	0.0	0.0	37.6	0	0	0	4069.4	4069.4
DCT1_005	0.0	0.0	0.00	20.0	0.0	0.0	0.0	12.1	0	0	0	242.6	242.6
DCT1_006	0.0	0.0	10.17	0.0	0.0	0.0	44.1	0.0	0	0	448.8	0	448.8
DCT1_007	2.1	5.3	0.31	0.0	75.8	55.3	45.5	0.0	162.6	291.2	14.1	0	467.9
DCT1_008	0.7	0.0	0.00	0.0	235.4	0.0	0.0	0.0	164.8	0	0	0	164.8
DCT1_009	1.4	0.0	0.00	0.0	235.4	0.0	0.0	0.0	329.5	0	0	0	329.5
DCT1_010	0.0	0.0	4.30	0.0	0.0	0.0	25.7	0.0	0	0	110.6	0	110.6
DCT1_011	1.0	1.6	2.68	0.0	127.1	86.6	86.6	0.0	127.1	134.3	231.9	0	493.3
DCT1_012	37.1	0.0	0.00	101.3	77.1	0.0	0.0	38.2	2864.7	0	0	3871.8	6736.5
DCT1_013	5.4	0.6	0.00	0.0	86.9	78.9	0.0	0.0	469.0	50.9	0	0	519.9
DCT1_014	1.8	4.8	0.00	0.0	122.6	47.0	0.0	0.0	220.5	225.7	0	0	446.2
DCT1_015	0.0	0.0	1.30	0.0	0.0	0.0	51.5	0.0	0	0	67.0	0	67.0
DCT1_016	71.1	0.0	0.00	5.9	91.0	0.0	0.0	43.8	6470.7	0	0	258.9	6729.6
DCT1_017	7.7	1.7	0.40	7.8	142.8	87.9	97.7	61.5	1099.9	146.7	39.1	482.3	1768.0
DCT1_018	0.0	0.0	1.70	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0.0
DCT1_019	4.6	0.0	0.00	0.0	128.4	0.0	0.0	0.0	587.2	0	0	0	587.2
DCT1_020	0.0	1.1	2.78	11.9	0.0	59.8	66.0	35.4	0	67.0	183.3	423.2	673.5
DCT1_021	6.3	0.0	0.00	48.2	65.7	0.0	0.0	31.4	414.4	0	0	1513.2	1927.6
DCT1_022	0.7	0.0	0.00	0.0	235.4	0.0	0.0	0.0	164.8	0	0	0	164.8
DCT1_023	0.0	5.4	0.00	0.0	0.0	43.3	0.0	0.0	0	231.9	0	0	231.9
DCT1_024	11.2	6.1	0.00	113.3	85.9	67.0	0.0	41.3	962.2	405.8	0	4680.9	6048.9

	Total area (ha)				NCAT C mass trees (above & below ground) (tC/ha) 2008				Total C (above & below ground) (tC/ha)				
	REDD	ARR		IFM	REDD	ARR		IFM (25% total C)	REDD	ARR		IFM	
Property ID	**Avoided (non-rem)**	**CRRP/ Forestry**	**Enviro Planting**	**Imprd frst mgmnt**	**Avoided**	**CRRP/ Forestry**	**Enviro Planting**	**Imprd frst mgmnt**	**Avoided**	**CRRP/ Forestry**	**Enviro Planting**	**Imprd frst mgmnt**	**Total C (NCAT)**
DCT1_025	3.9	0.0	2.82	0.0	68.3	0.0	83.9	0.0	264.2	0	236.6	0	500.7
DCT1_026	4.2	0.0	0.00	0.0	99.6	0.0	0.0	0.0	418.3	0	0	0	418.3
DCT1_027	0.7	0.0	0.00	0.0	235.4	0.0	0.0	0.0	164.8	0	0	0	164.8
DCT1_028	0.7	0.0	0.00	0.0	235.4	0.0	0.0	0.0	164.8	0	0	0	164.8
DCT1_029	0.7	0.0	0.00	0.0	235.4	0.0	0.0	0.0	164.8	0	0	0	164.8
DCT1_030	0.0	0.0	0.93	0.0	0.0	0.0	4.0	0.0	0	0	3.7	0	3.7
DCT1_031	16.8	1.5	0.00	16.2	76.0	72.8	0.0	35.8	1276.6	107.7	0	578.8	1963.2
DCT1_032	1.6	0.0	0.00	0.0	75.0	0.0	0.0	0.0	120.0	0	0	0	120.0
DCT1_033	0.0	0.6	0.43	0.0	0.0	50.9	50.9	0.0	0	30.0	21.9	0	51.9
DCT1_034	0.0	0.0	5.00	0.0	0.0	0.0	56.3	0.0	0	0	281.6	0	281.6
DCT1_035	3.9	0.0	1.77	43.8	83.9	0.0	43.8	41.1	329.4	0	77.6	1802.3	2209.4
DCT1_036	0.7	0.0	0.00	0.0	235.4	0.0	0.0	0.0	164.8	0	0	0	164.8
DCT1_037	0.7	0.0	0.00	0.0	235.4	0.0	0.0	0.0	164.8	0	0	0	164.8
	185.8	28.5	38.4	476.8				**Total C (t)**	17434.5	1691.3	2013.4	17923.5	39062.7
								Total CO2e (t)	63985	6207	7389	65779	143360

2.2 Wet Tropics Soil Carbon Trends under Grazing & ALM

2.2.1 Grazing Land Management

Carbon is distributed and redistributed among five major carbon pools, one of which is the soil. International experts are increasingly recognizing that soil carbon sequestration plays an important role in management of global climates. A lack of data has resulted in the exclusion of carbon in regulatory markets. Current voluntary range management carbon sequestration schemes in the USA allocate carbon credits on the basis of agreed improvement in management. The lowest offset rate awarded for applying sustainable management practices to previously degraded land is 0.16 tons CO_2/acre/year (0.37 tonnes/ha/year). For applying sustainable management practices to non-degraded land the rate is 0.12 tons CO_2/acre/year (0.27 tonnes/ha/year). At these rates, a non-degraded property of 1000 sq km (100,000 ha) that agrees to adopt sustainable management practices could obtain approximately 27,000 tonnes/ha/year. At a value of between $2 and $12 a tonne, this lower estimate would amount to between $54,000 and $323,000 per year. These soil carbon sequestration rates may not apply to Far North Queensland, so it is important to determine the applicable rate. However, even if the rates are considerably lower, adoption of sustainable land management practices would mean a significant injection of funds into pastoral enterprises, even matching funds received from grazing.

We have undertaken a brief literature review to provide context on this important area.

The effects of different types of grazing land management on the rate of loss and sequestration of soil carbon have, to some extent, been studied in rangeland grazing ecosystems around the world. The effects appear to differ from area to area and from management treatment to treatment, and show sometimes contradictory results, ranging from observed increases in soil C to no change to declines. For instance, long-term studies in central Utah in the USA using grazing exclusion areas 90 years old compared with grazed areas have shown that long-term grazing significantly reduced maximum biomass in all years compared with plots within grazing exclosures (Gill 2007). In the same study, livestock grazing had no statistically significant impacts on total soil C or particulate organic matter, although grazing increased active soil C and decreased soil moisture. Grazing significantly increased the proportion of total soil C pools that were potentially mineralizable in the laboratory, with soils from grazed plots evolving 4.6% of total soil C in one year while ungrazed plots lost 3.3% of total soil C (Gill 2007).

By contrast, long-term grazing trials in mixed-grass prairie in Wyoming USA showed significant differences between grazing exclosures, light grazing and heavy grazing intensities (Ingram *et al.* 2008). Over a decade, there was little difference in soil organic carbon (SOC) in the grazing exclosures and the light grazing, whereas there was a 30% decline in SOC in the heavy grazing trials. The loss was attributed to plant community changes from cool season (C3) grasses to warm-season (C4) grasses, resulting in organic C accumulating near the surface, making it more vulnerable to loss. In these studies, it was found that soil total nitrogen (TN) increased in the exclosure and light grazing treatments, but declined in the heavy grazing treatment. Differences in plant community composition and subsequent changes in SOC and TN may have contributed to microbial biomass, respiration, and N-mineralization rates generally being greatest in light grazing and least in the heavy grazing treatment.

Microbial community structure differed among treatments. The heavy grazing rate during a drought period altered plant community and microbial composition which subsequently impacted biogeochemical C and N cycles (Ingram *et al.* 2008), which are both critical in the carbon sequestration process. These findings are consistent with studies in Hawai'i, where it was shown that soil C declined in areas in Hawai'i converted from dry tropical rainforest to grazing across a range of grazing intensities (Elmore & Asner 2006). Also, in Ethiopia, soil C decreased when land was converted from forest to grazing to cropping, and showed an increase after 10 years when grazing was stopped (Girmay *et al.* 2008). Girmay *et al.* found that there is a large potential of increasing SOC pool with adoption of land restorative measures, but that data available in published literature are scarce.

In Minnesota USA studies of soil C and N accumulation mechanisms showed that the presence of C4 grasses and legumes increased soil C accumulation by 193% and 522% respectively (Fornara & Tilman 2008). While this study did not investigate the effects of grazing, they showed that high-diversity mixes of perennial grassland plant species stored 5 to 6 times more soil C and N, on average than did monoculture plots of the same species. This has implications for the nature of grazing pressure and the effects on the proportions of perennial to ephemeral grasses. Rangeland condition has a very strong influence on soil organic carbon, with studies in Australian rangelands showing a 42% lower percentage of carbon in soil plots dominated by annual grasses when compared with mainly perennial grasses. Adoption of grazing management strategies which increase perennial grass component could sequester significant volumes of organic carbon in the top 10cm of soil (Ash *et al.* 1995). Declining condition classes from A to B result in the loss of 30%, and from B to C classes resulted in the loss of 20% of soil carbon, that is from 2.1% to 1.5% to 1.2% of soil carbon under tropical tallgrass pasture, and reversing condition classes could reverse this trend. The study also suggested that rehabilitating degraded land could sequester significant amounts of soil carbon (Ash *et al.* 1995). Stocking rates modelled for rangeland grazing systems in the Australian rangelands have shown that changes in stocking rates may change the rate of loss of soil carbon substantially, with moderate levels of grazing at a safe carrying capacity showing substantially reduced losses. This was strongly correlated to dry conditions, where high long-term grazing intensity substantially increased losses (Hill *et al.* 2006).

In the Minnesota study (Fornara & Tilman 2008), higher soil C and N accrual resulted both from increased C and N inputs through higher root biomass and from greater root biomass accumulation to 60 cm soil depth resulting from the presence of highly complementary functional groups such as C4 grasses and legumes. They suggested that the joint presence of C4 grass and legume species is a key cause of greater soil C and N accumulation in both higher and lower diversity plant assemblages. This is because legumes have unique access to N, and C4 grasses take up and use N efficiently, increasing below-ground biomass and thus soil C and N inputs (Fornara & Tilman 2008). They demonstrated that plant functional complementarity is a key reason that higher plant diversity leads to greater soil C and N accumulation on agriculturally degraded soils. They also suggested that the combination of key C4 grass-legume species may greatly increase ecosystem services such as soil C accumulation and biomass production in both high- and low-diversity N-limited grassland systems (Fornara & Tilman 2008).

In studies in semi-arid steppe in Wyoming USA, there was found to be a lack of significant difference in SOC between grazed soil and soil not grazed for more than 40 years (Shrestha & Stahl 2008). The grazing study sites were considered to have low to very low stocking rates, which, considering the effects of light grazing on SOC, is consistent with the findings of Ingram and others (Ingram *et al*. 2008), also in Wyoming but in different environments.

Other studies cited showed different responses to grazing, with some showing decreases, and some showing increases, which may be due to differences in climate, soil and/or vegetation types, and grazing history (Shrestha & Stahl 2008). Well-managed grazing improves nutrient cycling in grassland ecosystems, stimulating aboveground production as well as root respiration and exudation rates. C:N ratios showed similar results, and were similar in three of the study sites regardless of grazing or non-grazing treatments, while one exclosure had slightly greater C:N ratio in the ungrazed soil (Shrestha & Stahl 2008). In contrast to SOC and C:N ratios, microbial biomass carbon (MBC) showed significant differences between grazed and ungrazed sites, with ungrazed sites showing significantly higher MBC in two of four sites (Shrestha & Stahl 2008).

A study in Argentinean grasslands showed that the differences between grazed and areas not grazed for 16 years were marginal for the very fine and fine root components of the below-ground biomass, which is one of the most important influences on soil ecosystem processes, and one of the main routes for soil carbon sequestration (Pucheta *et al.* 2004). The grazed lands were estimated to have a higher (1241 gm^{-2} yr^{-1}) below-ground net plant production (BNPP) when compared with non-grazed lands (723 gm^{-2} yr^{-1}). The authors estimated that very fine root productivity was almost twice as high at the grazed site as at the ungrazed one, despite both sites having similar total live biomass, and root

turnover rate was twofold at the grazed site (Pucheta *et al.* 2004). Root turnover rates varied significantly also, with 95% of roots being turned over in grazed sites, compared with 56% in the ungrazed site. Root turnover rate is a critical component of carbon sequestration (Pucheta *et al.* 2004). A review of literature worldwide suggested that if tropical savannas were to be protected from fire and grazing, most of them would accumulate substantial carbon and the sink would be larger. Savannas are under anthropogenic pressure, but this has been much less publicized than deforestation in the rain forest biome (Grace *et al.* 2006).

The review would suggest that conservative grazing, in contrast to heavy grazing, may either reduce the loss of soil carbon, or even increase the soil carbon in some circumstances, such as by diversifying the grass component, and increasing the C4 or perennial grass and legume component. Given the paucity of data from the literature on the effects of grazing practices on soil carbon losses, gains and sequestration potential, the literature reviewed suggests a number of studies which are required. For the Wet Tropics region, which includes extensive grazing lands, studies which would clarify the processes and outcomes under different grazing regimes and stocking rates on soil carbon include:

- effects of these grazing practices on the types of grasses which result;
- effects of different grazing regimes on soil bulk density and soil water;
- effects of biomass *per se* on soil carbon sequestration;
- effects of different forms of carbon on soil carbon sequestration and loss (particulate C, labile C, mineralizable C);
- influences of C:N ratios and MBC on soil carbon sequestration and loss under different grazing regimes;
- influences of different grass types (ephemeral/perennial; C3/C4) on soil carbon sequestration;
- the influence of fine root material on carbon sequestration rates;
- influence of root turnover rates under different grazing regimes on soil C; and
- influences of different soil types on soil carbon sequestration and loss under different grazing regimes.

These are research questions, which will require focus and funding to resolve, and further development into a research methodology. Individual methodologies are available to answer all the questions, and a comprehensive sampling regime within a well-developed research program is required to provide a robust result. Methods for assessing soil carbon would follow those utilized in the Australian National Carbon Accounting volumes (McKenzie *et al.* 2000; Skjemstad & Spouncer 2003).

The Project will prepare a research methodology and proposal for funding to enable the Project to incorporate grazing into the aggregated inventory. The underlying assumption is that carbon sequestration increases with ground layer condition, with the greatest improvement being from heavily degraded land to well-grassed land. Carbon credits can only be claimed, however, where there is a measurable and 'additional' increase in carbon sequestration over baseline levels. For instance, a shift from low sequestration (or loss) under heavily grazed country to moderate to high sequestration under rehabilitated rangelands would only occur if the leaseholder were compensated with ecosystem services payments for soil carbon sink management. Currently, despite the clear message that it is unproductive and uneconomic to overstock, many land managers often want to intensify cattle production rather than reduce it. In this light, payment for carbon would act as an incentive not to overstock.

These incentive payments would value-add Grazing Land Management scheme which include training land managers to assess the condition of their pastures. The training allows for the categorization of condition into simple classes from good, A, to bad, D. The main purpose of assessing range condition is to ensure sustainability of grazing practices. In the GLM process, land managers self-assess pasture condition at a number of points on their properties. This project aims to link GLM and levels of soil carbon sequestration in the Far North Queensland region.

2.2.2 Sustainable Agriculture

The Wet Tropics Regional Plan establishes management actions for sustainable agriculture based on best management practices (BMP). These are defined in terms of the percentage of farmers who adopt a specific management practice. Main agricultural industries focused on are sugar cane; banana; papaya; peanuts and potatoes; and dairy. Section 6.8.1 of the Regional Plan details BMP for each of these industries.

On the coastal lowlands, the major crop is sugar cane. It comprises up to 15% of some Wet Tropics catchments, and averages about 10% of Wet Tropics catchments. BMP for cane in the Regional Plan have been developed for fertilizer use, fallow area, tillage, pesticide use, vegetated riparian zones and green trash blanketing.

Research and development into sustainable sugar cane farming is funded by cane growers and sugar millers from levies. Over the past 10 years, significant effort has gone into development and implementation of new farming practices such as fallow cropping and minimum tillage systems. Better management delivers better soil health and improved environmental outcomes from the receiving waters of the Great Barrier Reef. These activities have resulted in many growers adopting green trash blanketing to reduce soil loss from farms equivalent to that from National Parks. As a result of the research, growers are also adopting minimum tillage, which improves soil condition, reduces the need for fertilizer inputs and increases the water retention capability of the soil, and retains organic carbon.

The environmental benefits of sustainable cane growing include production of organic nitrogen for the new plant cane and the build-up of organic soil carbon, reducing the need for chemical fertilizers, improved rainfall infiltration and water utilization, a reduction in soil loss, and energy savings because of reduced equipment time.

In 1998 the Canegrowers published their own Code of Practice, which includes recommendations on stream bank vegetation protection, the creation of artificial wetlands, erosion reduction, fertilizer application minimisation and irrigation water efficiency. In 2008, Terrain provided funding to run BSES courses (refer section 1.4.1.2.1). Adoption of these practices and recommendations could reduce the amount of N fertilizer added to sugarcane in the Wet Tropics region by around 20%.

Data exist for the amount of fertilizer being applied per hectare for sugarcane over time, and hence this PDD is developing an approach for measuring nitrous oxide reduction under sugarcane. Our aim is to provide incentives for sugarcane growers to record and implement the recommendation of the BSES course and other BMP measures. Appendix 2 provides details of our approach.

2.2.3 Emissions from Project activities

Emissions of CO_2 and non-CO_2 gases from the Project will be accounted for in the development and operation of the Project. These will include:

- Vehicle transport by Project personnel to visit and measure the activities (calculated using published figures and distances travelled);
- Vehicles and equipment used for implementation and management of the activities (e.g. chainsaws, earthmoving equipment, mechanized equipment);
- Power use for Project activities; and
- Fertilizers added to plantings and other activities.

Measuring emissions as a result of environmental planting, fuel use, overall figure for nursery growing plant (electricity bill) will be documented for the Project. Many of the calculations can be obtained from the National Pollution Inventory, implemented and operated by the Australian Dept of Environment, Water, Heritage and the Arts.

2.2.4 Statement about non-CO_2 gases

Two main sources of non-CO_2 gases (methane and nitrous oxides) identified for the Project were biomass burning from all sources, and grazing and crops from Grazing Land Management and Sustainable Agriculture. Biomass burning of forests and plantations in the Wet Tropics region is anticipated to be insignificant over the Project period, as it is not a practice which is widely applied in the Project region to forests in farm forestry, afforestation, reforestation, or avoided deforestation activities. Biomass burning of grasslands is more widespread but is difficult to quantify. NCAS default values will be used to quantify likely non-CO_2 gas emissions from the project.

2.2.5 Statement on results and overall GHG benefits

The overall calculated GHG benefits to be derived from the Project are likely to be great. Over 60 landholders have put in Expression of Interest forms, 37 have been included in the inventory, and we are in the process of visiting each of these in turn to verify that they actually have what they have claimed.

2.3 Leakage

2.3.1 Document any offsite decreases in carbon stocks

Strong governance in Australia, and a Westminster legal system means that corruption is relatively low, so that activities such as illegal logging are not significant. It is difficult to move individual or corporate activities from one location to another without going through legal and bureaucratic processes, and the force of law is strong for trespass or theft. In addition, most landholders who are or will become part of the Regional carbon pool own their own land, and their sequestration activities will not involve displacement activities elsewhere. Landholder sequestration activities are voluntary. Leakage, in the sense of that occurring in developing countries' tropical forests, is not an issue here.

No leakage is involved with reducing fertilizer use on sugarcane.

It is possible that Grazing Land Management could involve increased grazing pressure where cattle taken off land in order to improve land condition cause deterioration in other areas and loss of carbon.

2.3.2 Document mitigation measures

We are currently developing our methodology for GLM. At a minimum we would anticipate that the entire property would be monitored for improved land condition to prevent possible leakage through transference of cattle grazing or other activities on farm.

2.3.3 Net effect of leakage

It is expected, based on the previous argument, that the net effect of leakage is likely to be negligible.

2.4 Climate Impact Monitoring

2.4.1 Monitoring Plan

The Project will utilise NCAT to monitor the sub-projects on a regular basis. NCAT routines and algorithms are being updated progressively as new understanding and data are obtained by the AGO. This will provide the Project with the ability to improve calculations of the carbon budget on the ground within the Project, and to respond to new initiatives, such as improved agricultural practices, water usage, fertilizer usage, forest silviculture techniques and so on.

Monitoring of Project activities by Degree Celsius will form a significant part of the role of the management team of Degree Celsius. Site and property monitoring will become a requirement of each contract, and the signatories to the project will be required to agree to monitoring activities from time to time by Degree Celsius personnel, and to validation and verification from certified validators and verifiers. The purposes of monitoring are two-fold. One is to ensure that the landholders and other signatories to the Project are doing what they have claimed they are doing, in order to protect the

Project's integrity, and to ensure that the Project's over-all claims are valid and not being over-estimated (or under-estimated). The second purpose is to provide technical expertise to help landholders to improve management techniques in order to gain more benefits from their efforts.

Coupled with monitoring will be review and revision of the Project's activities, protocols and operations. The reviews and revisions will be periodic on at least a five-year cycle.

Monitoring will also be coupled with a process of continuous improvement, and refinement of the calculations and measurements of carbon sequestration and biodiversity benefits. As new understanding emerges in this rapidly evolving field, new techniques and methods will arise which will require testing and analysis, and implementation if the refined methods and techniques prove to be of value and rigorous.

Monitoring will be undertaken on at least a five-year rotation, so that each sub-project will expect to be monitored every five years. More frequent monitoring may occur for different reasons and purposes.

2.5 Adapting to Climate Change and Climate Variability

2.5.1 Regional climate change impacts

Refer to Section 1.1.1.1 above and Section 5.1.2 of the Regional Plan. In summary, regional impacts include:

- Increased number of extreme hot days above 35 degrees Celsius;
- Sea level rise by up to 90cm by 2100 and increased storm surge levels;
- Increased evaporation and reduced water availability;
- Changes in extreme events, such as cyclones, and shorter return times;
- Increased incidence in flood and possible erosion events;
- Increased water demand and irrigation requirements, heat stress in crops and increased drought severity;
- Potential shoreline recession, inundation of coastal lowlands and salt-water intrusion of estuaries and aquifers and reduced coastal habitats due to changes in tidal inundation;
- Loss of coral reefs;
- Changes to rainforest habitats, tree species and vegetation quality and reduction in upland rainforest habitats;
- Increased extinction rate; and
- Changes to the agricultural growing season.

2.5.2 Mitigation measures

Due to the particularly severe affects of climate change in the Wet Tropics identified above in Section 1.1.1.1, and summarised in Section 5.1.2 of the Regional Plan, this Plan has identified a number of higher order Management Action Targets and Management Actions (Refer Section 5.2 of the Regional Plan) including increasing carbon sinks in the region by 10% by 2012, quantifying and modelling impacts of climate change, and regular revision of policies in all sectors.

2.6 Carbon Benefits Withheld from Regulatory Markets

N/A

3 NET POSITIVE COMMUNITY IMPACTS

3.1 Net positive Community Impacts

This Project is based on and value-adds to the Regional Plan. The specific elements of the Regional Plan which are applicable to, and important for, the Project are further elaborated below.

3.1.1 Net Community Benefits

Water Quality

One study about water quality benefits is indicative of broad community benefits of natural resource management outcomes. Rolfe *et al.* (2005) examined the social and economic impact of protecting environmental values of three catchments including one catchment, the Douglas Shire Waters, in the Wet Tropics. This study can be seen as representative of characteristics needed to protect environmental values generally in waterways.

Reduction in sediment and nutrient loads will result in increased water quality and avoid the potential economic and social losses indicated in section 1.2.3. Additional benefits are expected and include:

- Recreation
- Recreational fishing
- Urban water treatment costs
- Aesthetics
- Property values
- Tourism
- Biodiversity across the landscape

The Douglas Shire is an important part of indigenous culture for the Kuku Yalanji indigenous people who place a high value on both the utility aspects such as swimming and food gathering, and spiritual aspects of waterways. The continuation of high values in these resources is essential for maintaining their cultural, spiritual and community health.

Two scenarios were modelled by Rolfe *et al*. (2005): one where there were no actions taken to reduce environmental values of waterways as expressed by the surrogate values of suspended sediment, phosphorus and nitrogen, and one where actions were taken in several broad areas including;

- Agricultural diffuse – eg combination of best practice measures including cane drain erosion control, minimum tillage, legume rotation;
- Riparian Rehabilitation – 200 kilometres of waterways are rehabilitated at an expected cost of $25,000/km;
- Urban Diffuse Retrofit – includes mainly urban stormwater management;
- Point Sources.

By 2026 the staged introduction of best practice management strategies will have resulted in the following reductions:

- Reductions in total sediment of 55,000 t/yr
- Reduction in total nitrogen of 163 t/yr; and
- Reduction in total phosphorous of 36 t/yr

Rolfe *et al.* (2005) drew on local, national and international literature to provide a summary of the expected economic impacts of improving water quality:

Table 8: Summary of Expected Economic Benefits (from Rolfe *et al*. 2005)

Type of Benefit	Benefit	Expected impacts under the 'No Intervention' scenario	Expected impacts under the 'Intervention' scenario
Use	Direct recreation	Expect a major change in population use as it becomes unsafe for activities such as swimming	Expect some increase in population use as swimming and other activities becomes more attractive
	Recreational fishing	Expect reduction in spending from current estimates of $1.5 m/year in shire	Expect increase in expenditure as fish catch rates improve
	Commercial fishing	Expect reduction in value of catch from current levels of $3.24m/year in shire, and $53m/year in region	Expect increase in expenditure and value of catch assuming that fish catch rates improve.
	Urban water treatment costs	Expect water treatment costs to increase. Current water charges are $19.1 m per annum.	Expect water treatment costs to be maintained
	Industry water treatment costs	Some impact likely, but will vary according to type of use	Little impact predicted
	Agricultural water treatment costs	reduction in water quality Gross value of agricultural production in Shire is $18.6 m. Value of aquaculture in region is $18.46 m.	Little impact predicted
Indirect	Property values	Expect reduction in property prices – impact may potentially be much larger	Expect some increase in property prices
	Aesthetics	Likely to be some impacts on top of recreation use and property value impacts	May be small impacts on top of recreational use and property value impacts
	Tourism reputation	Some impact predicted if recreation and amenity values affected. Current level of expenditure in region of $2,064 M per annum	Small impact predicted
Non-use	Biodiversity in waterways	Expect potential losses in biodiversity to be a key issue for people	Expect people to have some value for improving biodiversity
	Biodiversity in estuary and coastal areas	Expect potential losses in biodiversity to be a key issue for people	Expect people to have some value for improving biodiversity
	Indigenous cultural heritage	Increased protection afforded to traditionally important resources eg. protection of indigenous values (viz. fish traps, and totemic species), maintenance or improvement of protected areas.	Little impact predicted

3.1.2 Stakeholder Participation

This section is a summary of Part A and Appendix B of the Regional Plan for Natural Resource Management 2004-2008 FNQ NRM Ltd & Rainforest CRC (2004).

With the consolidation of the Wet Tropics NRM activities under FNQNRM Ltd trading as Terrain (an explanation of the history of the Wet Tropics Plan can be found above under Section 1: Original Conditions and Background) came the development of the 2004-2008 Regional Plan where stakeholder involvement was pivotal. The Board of Terrain NRM is selected from the community and is the primary mechanism to involve the community in making decisions about natural resource management. Board meetings are open to the public and minutes are available on the Board's website (www.terrain.org.au).

Community ownership is essential to manage natural resources effectively to gain community commitment to joining partnerships and implementing solutions. In other words, the process is just as important as the content, and successful implementation will be achieved only if all those with an interest in the process and its outcomes believe they have had adequate opportunity to contribute to the process including:

- Defining the problems
- Setting management actions; and
- Developing solutions.

A three-stage public consultation process was implemented. Stage one aimed to build the capacity of the community to participate and provide input into development of the plan. Amongst other things it involved:

- Over 30 community workshops held over an 18 month period;
- Advisory groups were consulted comprising 230 individuals representing key government agencies, community groups and organisations involved in managing NRM in the region;
- A Science Panel was formed which provided regular input;
- A key stakeholder reference group was formed and met three times until the formation of the Board.

Stage two focused on gathering input into a range of draft targets and potential management actions drawn from the existing strategies in the region. This stage involved:

- Community information sessions held in eight locations during March and April 2004 attended by about 600 people. Attendees received a survey which gathered community feedback about a range of targets and actions that had been implemented;
- Based on feedback, a two-day water quality forum was held in May 2004 which was attended by industry, government, science and community representatives, amounting to 80 participants;
- A local government forum was held to involve those in local government;
- A forum involving peak industry bodies was held to develop an Industry Engagement Strategy and develop partnerships;
- More focused consultation processes were held for setting biodiversity targets (involving 250 participants), sustainable use targets (inviting over 2200 producers); and
- A capacity-building working group was established to advise the Board on social and economic issues.

Both these stages coincided with high levels of media exposure and the public release of the condition reports and summaries.

The third stage was the formal public consultation process in which the draft Plan was circulated to all stakeholder groups and the public for a six-week period. Various meetings were held during this period that provided an opportunity to discuss the content of the Plan and clarify issues. About 40 formal submissions were received and considered and appropriate improvements made.

Aboriginal Cultural and Natural Resource Management Plan was also developed which addressed the inadequate involvement of indigenous people. The Aboriginal Plan is a bottom-up approach, which occurred over two years, and involved Traditional Owners creating their own plan, as well as playing a significant role in the development of the overall Regional Plan. The process of developing this plan can be found in Smyth & Bahrdt (2004) at this web address http://www.nrm.gov.au/publications/case-studies/pubs/indigenous-engagement-case-study-4.pdf.

3.1.3 Conflict Resolution

Sustaining the Wet Tropics: A Regional Plan for Natural Resource Management 2004-2008 was developed by the community, and is itself a pro-active response to potential conflict.

Conflict and its resolution occur at a number of levels. For instance, there can be conflicting values for pest plants and animals between Aboriginal and non-Aboriginal people. Traditional Owners see some feral animals, such as pigs, as valuable resources because they are hunted for food. This and other aspects have been dealt with in the Caring for Country section of the Regional Plan.

Management Plans have been developed for dealing with conflicting uses. For instance, management plans have been introduced by the Great Barrier Reef Marine Park Authority (a partner to Terrain) to protect the natural values of the Great Barrier Reef from over-fishing and over-loving by tourism. The management plans include zoning for specific uses and for protection, and research into new fishing techniques and technology to achieve ecological sustainability.

Individual government agencies have a major role in supporting Regional NRM bodies. There are gaps, overlaps and conflicts between policy and practice between these agencies. Terrain is working cooperatively with the agencies to identify the conflicts and work toward agreements on agency actions.

Landholders participating in the regional carbon pooling initiative will be required to enter into a contract with Degree Celsius. The contract will include a detailed property management plan and a standard Dispute Resolution clause that includes clauses for notifying other participants, a 21-day period in which dispute resolution must be attempted, followed by procedures to resolve the dispute via the Mediation Rules of the Law Society of Queensland.

3.2 Offsite Community Impacts

3.2.1 Identify potential negative community impacts

Rolfe *et al*. (2005) examined a number of socio-economic indicators of the Douglas Shire (in the region) by age, household income, educational qualifications and employment. All indicators pointed to a relatively prosperous region built on a diverse educational and occupational structure. With respect to water quality, their study concluded that the likelihood of residence being significantly disadvantaged by policies and actions to improve water quality was low, as the community has the relevant skills base and capacity to absorb any impacts associated with higher water quality objectives with minimal disruption.

Assuming this information is indicative of the broader ecosystem services impact on communities, the likelihood of the community being disadvantaged by broad scale NRM activities is low, since the costs would be spread broadly and many activities will be voluntary or assisted with a small incentive. It will represent at most a 0.4% opportunity cost by taking a riparian strip away from cattle grazing, based on a total of 84,650 ha used for cattle grazing (Rolfe *et al.* 2005). Without these activities the community would suffer a range of disadvantages as reflected in sections 1.2.4 and 1.2.5 above.

3.2.2 Mitigation of identified negative impacts

The negative impacts seem confined to opportunity costs of landholders. These opportunity costs are not imposed on the landholders who enter into the arrangement to sequester Biocarbon, or abate GHGs, voluntarily.

3.2.3 Evaluate unmitigated negative offsite social and economic impacts

It is unlikely that there will be any significant unmitigated negative offsite social and economic impacts, given the overwhelming positive impacts for biodiversity, climate, water quality and a healthy community.

3.3 Community Impact Monitoring

The assumption of this criterion is that the community may be negatively impacted by the project. However within the democratic tradition, and rule-of-law underpinnings that exist in Australia, the social and economic aspects of the community are well protected by policy and legislation. Section 1.1.4 summarises the socio-economic aspects of the community.

The Project – value-adding community NRM activities – takes the concept of biosequestration to a new plane. The Regional NRM Plan is a plan by and for the community to help protect, maintain and/or improve the condition of natural resources and their associated cultural values in the Wet Tropics. It is based on the assumption that integrated regional natural resource management activities will support not only natural resources but also lifestyles that depend on them.

In this regard, community impact monitoring includes monitoring the condition of the natural resources. The Plan itself has monitoring at its core in terms of targets and actions which are set out in Aspirational Targets (Objectives) or statements about desired long term condition of natural resources (over 50 years); measures for achieving the targets are set in terms of resource conditions that are specific, time bound and measurable within a timeframe of 10-20 years; management action targets are short term targets for actions that will contribute to the longer-term resource condition targets, and the objectives.

The Plan integrates statutory and non-statutory programs, and identifies targets and actions beyond regulation. Statutory plans are strong on development control of future actions but are unable to address liabilities of previous decisions and provide for restoration, rehabilitation and off-reserve conservation. These actions often require community involvement and a more diverse set of actions, such as incentives or capacity building.

The Plan is intended to be dynamic, responsive to community needs and continuously improved as more information becomes available.

3.4 Capacity Building

Capacity Building is a key component of the Regional Plan. The information for the capacity building section is based on qualitative key informant interviews undertaken throughout the region.

Capacity building was identified as a key issue for Aboriginal people specifically:

- Lack of awareness and understanding of Aboriginal issues by NRM stakeholders;
- Lack of meaningful involvement in NRM planning and management activities at all levels;
- Need for training and capacity building in NRM;
- Lack of infrastructure, support and resources to undertake NRM projects.

The Wet Tropics Regional Plan adopts four key conceptual areas of specific importance, three of which are relevant to this PDD:

Awareness: Individuals within the community being aware of regional NRM issues and understanding the link between these issues and the long-term viability of the community.

Information and knowledge: Natural resource managers and users equipped with, or having access to, the necessary technical, people management, project management and planning skills to participate in the development and implementation of sustainable NRM at the property, local and regional scale.

Facilitation and Support: Support systems in place to ensure the engagement and motivation of the community to build social capital and enable skilled NRM managers and users to exercise ownership over regional NRM decision making processes, and effectively implement actions arising from these processes.

Seven key capacity and capacity building requirements in the Wet Tropics region were identified, including:

1. Community Engagement in NRM;
2. Motivation to participate in NRM;
3. Awareness of NRM issues;
4. Skills and training;
5. Knowledge of NRM;
6. Facilitation and support; and
7. Institutional change.

These are further detailed in the Wet Tropics Regional Plan.

In terms of capacity building, the measurable targets and actions (which drive the Plan) are enabling actions where the focus is on achieving the biophysical resource condition targets established in the Plan. In other words, enabling capacity building within the community is not an end in itself but an action that is directed at achieving the resource condition targets. For instance, improving water quality depends on improving landholder understanding of the issues involved and capacity to implement more sustainable land management practices.

Other capacity and capacity building requirements focus on procedural and process issues including: issues associated with community and stakeholder involvement in decision making; procedures for integrating and including local and traditional knowledge with 'scientific knowledge'; developing community ownership of NRM targets; and management actions and the development of trust amongst key stakeholders and industry interest groups involved in NRM. These procedural issues need to be embedded and integrated with management actions associated with the achievement of each resource condition target.

The lack of quantifiable data precludes the identification of quantifiable targets *per se* and this is the subject of a specific Capacity Building Assessment and Research program directed at informing on-ground capacity building activities in the Wet Tropics.

3.5 Best Practices in Community Involvement

The Regional Plan identifies that an integral component of capacity building is community involvement and participation. The community is the mechanism through which the targets will be achieved. Capacity Building and Best Practices in Community Involvement are in many respects two sides of the same coin.

The planning process was described in section 1.1.4. In summary, it involved six Community Working Groups focused around key NRM assets of biodiversity, sustainable landuse, coasts, and rivers. A Community Capacity Building working group was also formed together with a Traditional Owner Advisory Committee. Membership of these groups was non-exclusive and involved community members with both technical and practical skills. More than 70 people were involved.

A Key Stakeholder Reference Group involving key representatives of government, community and industry, and separate Working Group of Traditional Owner Elders who progressed negotiations and made decisions on behalf of the Indigenous community oversaw these groups. A Science Panel provided high-level scientific support assuring best practice in decision-making, and for the

preparation of the technical reports that underpin the Regional NRM plan. These include a Background Report, two Condition Reports, a report on Community Capacity and Capacity Building and the Aboriginal Plan.

Capacity building must be embedded in direct, active and meaningful involvement of the community in all aspects of NRM planning and implementation including defining the problems, setting targets and developing solutions.

The Community Targets and Management Actions are defined in the Regional Plan (Section 9.2) and focus on developing and implementing a program to coordinate and develop research directed capacity building targets. Seventeen management actions have been developed to track the success of this target.

4 NET POSITIVE BIODIVERSITY IMPACTS

4.1 Biodiversity changes as a result of the Project

Biodiversity is a primary asset of the Regional Plan and key activity areas of the Plan include biodiversity conservation including providing landholders, community groups and other NRM managers with understanding the skills to contribute to biodiversity conservation. A major aspiration target of the Regional Plan for biodiversity is "No Net Loss" and where possible viable populations of regionally significant species will be maintained or recovered, and threatened ecological communities will decrease through increasing their extent and improving their quality.

About a quarter of the Wet Tropics Region is managed by private landholders and much of this land retains considerable biodiversity. Non-regulatory approaches such as those adopted by the Regional Plan include financial incentives, management agreements, covenants, and adoption of industry codes of practice to provide opportunities for biodiversity conservation. Community groups and networks have played a vital role in monitoring, organizing and linking individuals in community conservation activities.

The Regional Plan has developed a number of targets in conjunction with community groups and experts from State Government agencies and research institutions. Appendices L-N of the Regional Plan display composite maps showing regional management and rehabilitation priorities, and significant waterways and wetlands. These have been further refined to focus on four areas of regional significance for the conservation of biodiversity, which are:

1. Lowland forests and corridors centred on Mission Beach;
2. Southern Atherton Tablelands/Evelyn. High Quality Rainforest on Basalt Soil;
3. All native unprotected forest in lowlands north of Daintree River to Emmagen Creek;
4. Coastal lowland forests between Cardwell and Ingham.

An extensive and well-deliberated series of biodiversity targets and associated actions are found in Section 4.7 of the Regional Plan together with their integrated links to other areas such as soil and water conservation.

Without the Plan, its targets and actions, it could be anticipated that there would be a net loss of biodiversity.

The Catterall and Harrison (2006) report on rainforest restoration was released subsequent to the Regional Plan. They found that much of the reafforestation is carried out through what is termed "environmental plantings", of high density planting (1-2 m spacing) of locally provenanced species. This aims to develop a closed tree canopy, which suppresses grass and favours rainforest seedlings. Research has shown that a much larger range of rainforest-dependent plants and animals use ecological restoration plantings than do monoculture plantations (Catterall and Harrison 2006). Together with farm forestry, restoration amounts to about 1.5% of the area of the Wet Tropics originally cleared. While this may not be a spectacular result so far, importantly, the work has focused on corridors connecting patches of rainforest, so the biodiversity benefits will not be insignificant and certainly more than if nothing had been done.

4.1.1 Use of non-native species

The Regional Plan explicitly recognises that pest management is an integral component of the overall management of natural resources. The first principle of the Regional Plan is to stop the introduction of a new ecologically invasive species into the region, and the Plan promotes community awareness and encourages responsible behaviour with respect to plants and animals that have potential to become pests. The Plan advocates:

- Increasing the capacity of local councils to coordinate their pest management efforts across the region;

- Increasing public awareness of weeds and animal pests through a regional "Weedwatch" program;
- Providing cost efficiency of control prior to weeds becoming major infestations;
- Providing support to Local Councils to strategically manage and raise awareness of weeds of national significance;
- Preventing the spread of existing weeds and animal pests into neighbouring regions; and
- Mitigating the impact of feral pigs, especially in areas of biodiversity significance and adjacent to good quality agricultural land.

Use of non-native species is actively discouraged in the Regional Plan and a number of Targets and Management Actions exist to implement this policy. One of the key Resource Condition Targets for biodiversity (refer RCT B4 pg 40 of the Regional Plan) is that "no new deliberate introductions of ecologically invasive species that threaten terrestrial ecosystems after 2006". This Target is supported by six measurable management actions.

Another key target (refer RCT B5 pg 50 of the Regional Plan) is the eradication of weeds that have the capacity to invade and destroy ecosystems. These Category 1 weeds include pond apple, *Annona glabra*, the ponded pasture grass *Hymenachne amplexicaulis* as well as introduced forage legumes for pasture such as *Leucaena leucocephala*.

RCT L6 seeks to control outbreaks of new agricultural pests and plants and has a number of targets and measurable actions to support the objective.

4.1.2 Threatened species within NRM boundary and impact of NRM activities on these

A complete list of rare and threatened plant species known or expected to occur within the constituent catchments of the Wet Tropics is shown in Appendix A of the Biodiversity Report of the Regional Plan. A complete list of rare and threatened animal species known or expected to occur within the constituent catchments of the Wet Tropics is shown in Appendix B of the Biodiversity Report.

4.1.3 Statement about non-use of invasive species and genetically modified organisms

Refer to 4.1.2. GMO are not an issue in the Region.

4.2 Offsite Biodiversity Impacts

The major objectives of Terrain NRM in terms of Biodiversity are:

- The extent, diversity and condition of native ecosystems and the services and functions they provide will be maintained and, where possible, rehabilitated;
- Viable populations of regionally significant species, including threatened plants and animals, will be maintained or recovered;
- The number of threatened ecological communities will decrease through increasing their extent and improving their quality to achieve a net gain;
- Aboriginal knowledge of biodiversity will be conserved and revitalised;
- Production systems will be developed around land management practices that conserve biodiversity.

One of the main purposes of the Regional Plan is that resilience in the form of biodiversity is built into all the natural systems of the region. Negative impacts as a result of poor choice of plants for revegetation are of course possible but not well understood. Positive offsite consequences, however, are many and include buffering the edges of remnant forest, and facilitating dispersal of flora and fauna among remnant forest patches.

4.3 Biodiversity Impact Monitoring

4.3.1 Biodiversity variables to be monitored

Section 4.7 of the Regional Plan details the variables monitored in terms of Resource Condition Targets and Management Actions against these Targets. There are around 200 Management Actions, which are to be monitored, of which the list below provides an indication of their scope in relation to biodiversity variable to be monitored:

- Extent and condition of native vegetation;
- On-line link to SLATS (see below);
- Extent and condition of Community-based vegetation works;
- Extent of remnant vegetation through detailed vegetation mapping;
- Effectiveness of financial and other incentives;
- Extent of revegetation projects that are less than 1 ha located in regional rehabilitation priority areas;
- On-going monitoring of Phytophthora-related dieback at established sites in upland and highland rainforest sites to determine long-term impact;
- Number of benchmarks and monitoring programs as a basis for managing key threatening processes such as fire regimes, grazing pressure and visitor impacts, implemented;
- MoU with adjacent regional bodies developed;
- Guideline development for the management of key freshwater habitats, including development controls that prevent the further channelization of watercourses;
- Complete biodiversity audits for Local Government to develop shire biodiversity plans.

The Statewide Landcover and Trees Study (SLATS) is a major vegetation monitoring initiative of the Queensland Department of Natural Resources and Mines using satellite imagery to compare vegetation cover of the State between 1988, 1991, 1995, 1997 and 1999. The resolution of SLATS is one hectare. Between 1991 and 1995 the clearing rate for the Wet Tropics was 3,583 ha per year. This was reduced substantially for the period 1997-1999 to 1,275 ha per year. Clearing was reduced again in the 1999-2001 period to 1,007 ha. It has subsequently increases, as has been discussed elsewhere in this PDD.

SLATS can further break down data by catchments, which showed that tree clearing for grazing in the upper Herbert catchment accounted for most clearing in the Terrain NRM Plan area. Together with NCAT, SLATS methodologies provide a sophisticated basis for monitoring biodiversity.

4.4 Native Species Use

Because biodiversity is the major focus of reforestation activities in the Wet Tropics, the main planting methodologies use only native species. Catterall and Harrison (2006) describe that recent studies have begun to provide information on the comparative patterns and rates of biodiversity development across a range of reforestation methodologies. This research has shown that a range of rainforest dependent plants and animals use the closely spaced ecological restoration plantings by five years of age. By ten years, the plantings show some similarity to rainforest in biodiversity measures. Similar aged timber plantations support a range of more general native fauna and flora which are less dependent on rainforest though older timber plantations, of 40-70 years, have shown a rainforest-like biodiversity if they were planted close to existing rainforest and had developed a rainforest understorey.

4.5 Water and Soil Resource Enhancement

4.5.1 Project activities that enhance water and soil resources

Two sections of the Regional Plan are devoted to Land Resources (Section 6.0) and Water Resources respectively (Section 7.0). Each of these sections provides an overview of the ecosystem services these main resources offer, and describe the status and threats associated with the resources in the Wet

Tropics. Most of the land in the region is used for cultivation or grazing. Threats associated with these activities include, for land; soil acidification, soil fertility decline, dryland salinity and erosion. For water, threats include water quality issues associated with total nitrogen and total phosphorus as results of agriculture; hill slope erosion as a result of over grazing, amongst other things; and degraded riparian zones.

The Plan provides details of the management response to these threats including rehabilitating natural systems, improved land management practices of grazing areas, continual assessment of pasture condition, and an integrated planning framework.

As part of the Regional Planning process, Terrain developed a suite of Best Management Practices for major agricultural industries. They focused on their relevance to beneficial water and soil resource outcomes, including the development of relevant Management Action Targets, specifically to collate and calibrate targets for soil loss rates for different erosion and sediment management strategies.

4.5.2 Enhancement of activities against baselines

Terrain has developed an extensive suite of management action targets, and measurable management actions for Land and Water resources, and these are found in Sections 6.8 and 7.5 respectively of the Regional Plan.

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Appendices

Appendix 1: Degree Celsius Field Guide for Carbon and Biodiversity Assessment
Appendix 2: Nitrous Oxide from Sugarcane Crops –Methods for calculation
Appendix 3: Frequently Asked Questions from landholders
Appendix 4: Risk Assessment
Appendix 5: *Curricula vitae* of management team members
Appendix 6: Summary of site mensuration results and analysis
Appendix 7: Sugar Cane distribution & Grazing Distribution