



Marine and Tropical Sciences Research Facility

Market Based Instruments, Ecosystem Services and Development in Mission Beach, Far North Queensland

Background Report 1:
Impacts of Development on Ecosystem Services



Anthea Coggan and Stuart Whitten



Australian Government
Department of the Environment,
Water, Heritage and the Arts



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Anthea Coggan¹ and Stuart Whitten²

¹ CSIRO Sustainable Ecosystems, St. Lucia

² CSIRO Sustainable Ecosystems, Gungahlin



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Correspondence:

Anthea Coggan
CSIRO Sustainable Ecosystems
306 Carmody Road, St. Lucia QLD 4067
Phone (07) 3214 2671
Email: Anthea.Coggan@csiro.au

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Introduction

Ecosystem services are the natural processes that transform natural assets into things that we as humans value. Humans are generally attracted to areas that possess high quality natural assets and well-functioning ecosystem services. However, infrastructure development and other human actions have the potential to damage natural assets, altering the provision of ecosystem services and affecting human wellbeing.

Mission Beach, located in the Wet Tropics of Far North Queensland (FNQ) is an area that has abundant natural assets and healthy ecosystems. Up until fairly recent times this area was relatively untouched by people other than Indigenous populations. However, the pristine, natural features of and improved access to the area is resulting in an increase in tourism and residential development, which is jeopardising the capacity of the natural system to provide ecosystem services. Statistics indicate this trend is only going to increase into the future.

With the Wet Tropics region containing two of Australia's World Heritage listed environs, the Wet Tropics Rainforest and the Great Barrier Reef, the management of development in the Mission Beach area is extremely important.

The Australian Government's Marine and Tropical Sciences Research Facility (MTRSF) implemented in North Queensland by the Reef and Rainforest Research Centre (RRRC) is a part of the Australian Government's \$100 million Commonwealth Environment Research Facilities (CERF) commitment. The vision for the MTRSF is that North Queensland's public environmental assets – particularly the Great Barrier Reef and its catchments, tropical rainforests including the Wet Tropics World Heritage Area, and Torres Strait – are sustained in their health through the generation, transfer and sharing of world-class research and knowledge (Department of the Environment and Water Resources 2005).

The goals of the MTRSF (Department of the Environment and Water Resources 2005) are to improve our understanding and the delivery of knowledge related to:

- Status of the ecosystems – condition, trend and interdependencies;
- Risks and threats to the ecosystems;
- Halting and reversing the decline of water quality; and
- Sustainable use and management of the natural assets.

The objective of the **implementing ecosystem goods and services** component of MTRSF Project 4.9.6 *Strategic Natural Resource Management and land use planning* is to “refine, tailor and apply the concept of market based instruments (MBIs) for implementing ecosystem goods and services”. The project objective highlights offsets as an MBI to manage environmental conservation in developing areas. It is likely that offsets will be explored in detail, however other MBI options may also be considered as part of this research. Due to the importance of ecosystem services and the development pressure placed on these, Mission Beach was chosen as a case study area in which to explore the development of an MBI.

The first step to designing any incentive scheme – whether it is market based or other – is to understand the problem and determine the objectives of the project (see Coggan *et al.* 2006). This document, the first in a series of Background Reports, explores the use of an MBI to manage ecosystem services and development. In this report we present an understanding of the key ecosystem services of importance to the Mission Beach region and the threats these services face. Ecosystem services of importance have been arrived at through review of literature.

This report is structured as follows: In the following section, ecosystem services are defined and discussed and a framework for determining ecosystem services of importance is presented. This is then followed by an introduction to the Mission Beach case study, and the key land uses and economic drivers for the region. We then explore the ecosystem services important to Mission Beach and provide a discussion on the likely impacts of development on ecosystem services. A conclusion is presented at the end of the document.

Ecosystem Goods and Services

What are ecosystem goods and services?

An 'ecosystem' is commonly defined as the interactions among and between species and their surrounding environments (Binning *et al.* 2001). A common perception of ecosystem services is that they transform natural assets or natural capital such as soil, biota, air and water into things that we value, for example, the fungi, worms and bacteria in our 'ecosystem' example transform raw ingredients such as sunlight, carbon and nitrogen into fertile soil (Figure 1). The goods or benefits produced from these processes include outputs with direct use such as food and fibre, manufactured goods and non market benefits such as life fulfillment processes. Ecosystems provide many services from which humans benefit now and in the future.

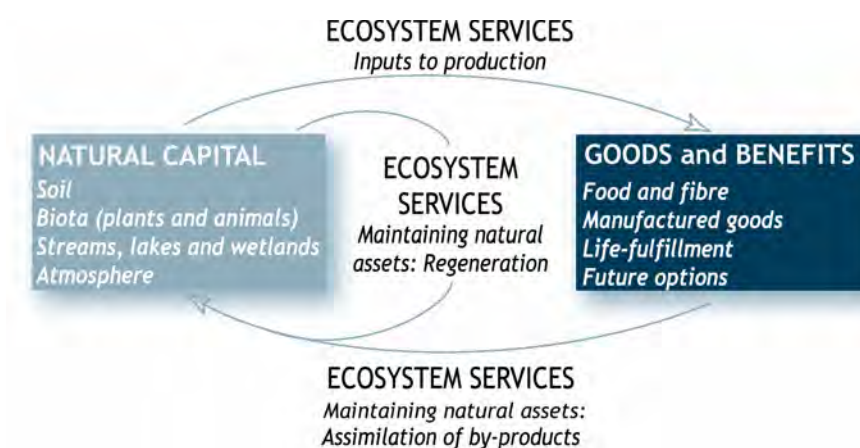


Figure 1: What are ecosystem services?
Source: Binning *et al.* (2001)

The quantity, quality and combinations of the natural assets results in ecosystem services such as (Binning *et al.* 2001):

- Pollination;
- Life fulfillment;
- Regulation of climate;
- Pest control;
- Maintenance of genetic resources;
- Maintenance and regeneration of habitat;
- Provision of shade and shelter;
- Prevention of soil erosion;
- Soil fertility;
- Maintenance of soil health;
- Maintaining healthy waterways;
- Water filtration;
- Regulation of river flows and groundwater levels; and
- Waste absorption and break down.

Ecosystem goods and their services contribute to the economic and social wellbeing of people in two ways (Binning *et al.* 2001):

1. Through the use of natural resources (derived from natural assets) they provide an input to the production of an output. For example, fruit production is dependent on the ecosystem service of pollination, which in turn is dependant on the natural asset of biota to provide insect pollinators; and
2. By maintaining natural assets through two different pathways, (a) by regenerating the natural assets, e.g. maintaining soil health through nutrient recycling or maintaining native plants and animals through the regeneration of native habitat; and (b) through the assimilation of by-products arising from production processes or from consumption of outputs, e.g. the assimilation of carbon dioxide from industry.

Similar to Binning and others' (2001) explanation of the human benefit from ecosystem services, the Millennium Ecosystem Assessment (2003) categorised ecosystem services into those that support, regulate, and provide nourishment and fuel, and those that provide cultural services to people.

How do we know which ecosystem goods and services are important for a region?

All ecosystem services are important; however when focussing on one particular region such as Mission Beach, some ecosystem services will be more important than others, or face greater threats. Binning and others (2001) used a framework, conceptualised in Figure 2, as a process for prioritising ecosystem services. This framework begins with gathering information on the goods that are important to the region (economically, culturally, etc.), understanding which assets and ecosystem services are important to the production of these goods and then identifying and addressing the threats to these services. This framework is applied in the Mission Beach context later in this report. The next section provides an introduction to Mission Beach.



Figure 2: Framework for prioritising ecosystem services of importance.

Mission Beach and primary land uses of the region

Where is Mission Beach?

Mission Beach is located in the area that is commonly referred to as Far North Queensland (FNQ) and the Wet Tropics. The city of Cairns is the major urban centre of FNQ and the region extends north to Cape Tribulation, west to Herberton and south to Cardwell. Geographically the region comprises a narrow coastal plain backed by coastal ranges which give way to the elevated Atherton Tablelands and open country to the west (Far North Queensland Regional Planning and Assessment Committee 2000). Mission Beach itself is situated between Maria Creek to the north, Hull River to the south, Walter Hill Range to the west and the Coral Sea to the east (Figure 3). Mission Beach is located on the border of the Johnstone Shire (in the north, Figure 4) and Cardwell Shire (in the south, Figure 5 and 7). The township of Mission Beach is located in the Johnstone Shire, with the coastal zone of South Mission Beach in the Cardwell Shire (Figure 6).

Far North Queensland or the ‘Wet Tropics’ is often described as a unique region in Australia (McDonald and Lane 2000). Its geography and high rainfall means that not only does it contain spectacular scenery but it is one of the most biologically diverse and productive regions of Australia. In recognition of its importance, the Wet Tropics has two World Heritage listed areas within its confines – the Wet Tropics Rainforest and the Great Barrier Reef. Additional natural features of the area are listed in Table 1. The extensive natural features along with the tropical climate, vibrant economy and high quality of life, have meant that this region is generally perceived as a highly desirable place to live, visit and invest (FNQ RPAC 2000).

Table 1: Natural features of the FNQ / Wet Tropics region. Adopted from FNQ RPAC 2000: 21.

Wet Tropics Rainforests	The rainforests of the Wet Tropics of Queensland World Heritage Area represents one of the most important live records of the evolution of the earth's plants and their ecosystems.
Great Barrier Reef and Lagoon System	The Great Barrier Reef World Heritage Area has developed over millions of years and provides valuable habitat for fish and other marine areas.
Coastal Wetlands waterways and estuaries	The coastal wetlands, waterways and estuaries provide important habitat and breeding grounds for fish and other marine animals and also provide important flood and water quality services.
Coastal Ranges	The coastal ranges are an important visual feature of the region.
Forests and natural habitats	There are numerous forested areas outside the World Heritage Areas. These provide important habitat and ecosystem diversity.

There is extensive literature describing the extent and importance of the region's natural features (see for example FNQ NRM and Rainforest CRC 2004). The mapping already conducted for the region demonstrates the significance of the natural areas in terms of habitat but also in terms of the proximity of these significant natural areas to urbanising areas. Mapping conducted by local councils (Figures 4, 5, 6 and 8) and by environment groups (Figure 7) demonstrate the potential future conflict between urban and conservation uses of the Mission Beach land (this is explored further in the third background report of this series). This is particularly evident when the critical habitat mapping (Figure 7) is compared with the zoning mapping of the local councils (Figures 4, 5, 6 and 8).



Figure 3: Map of Far North Queensland and Mission Beach (Source: FNQ RPAC 2000).

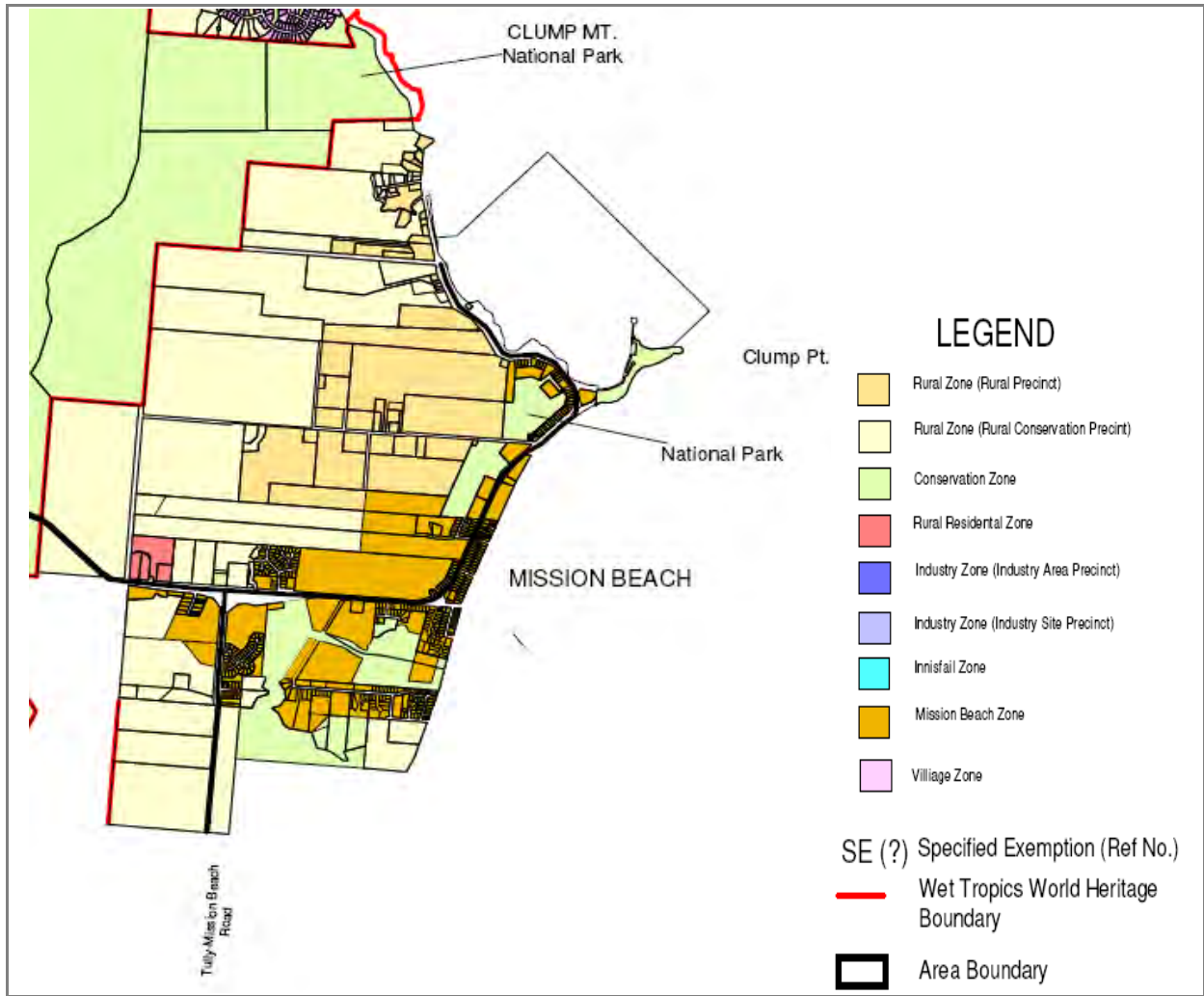


Figure 4: Mission Beach township mapping –
Johnstone Shire (Source: Johnstone Shire Council 2005a).

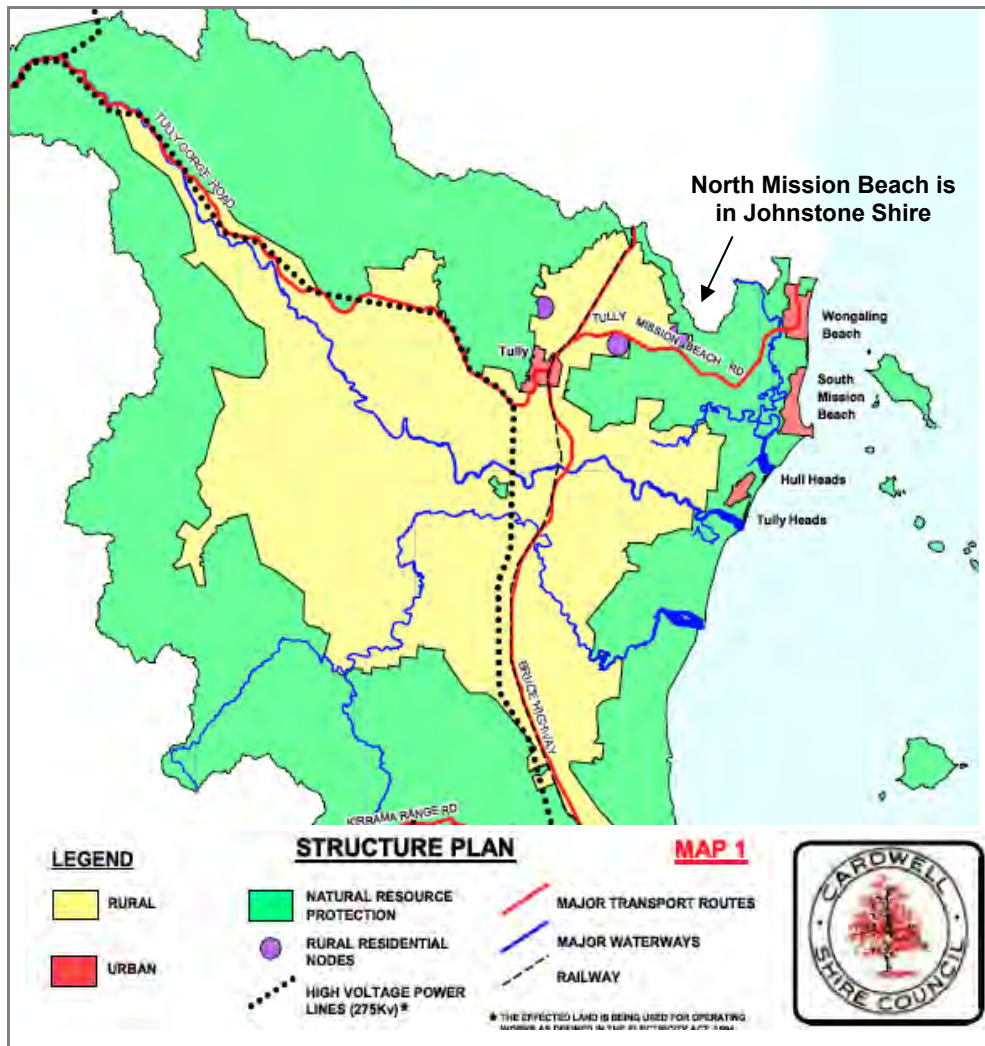


Figure 5: South Mission Beach, Cardwell Shire
(Source: Cardwell Shire Council 2005).

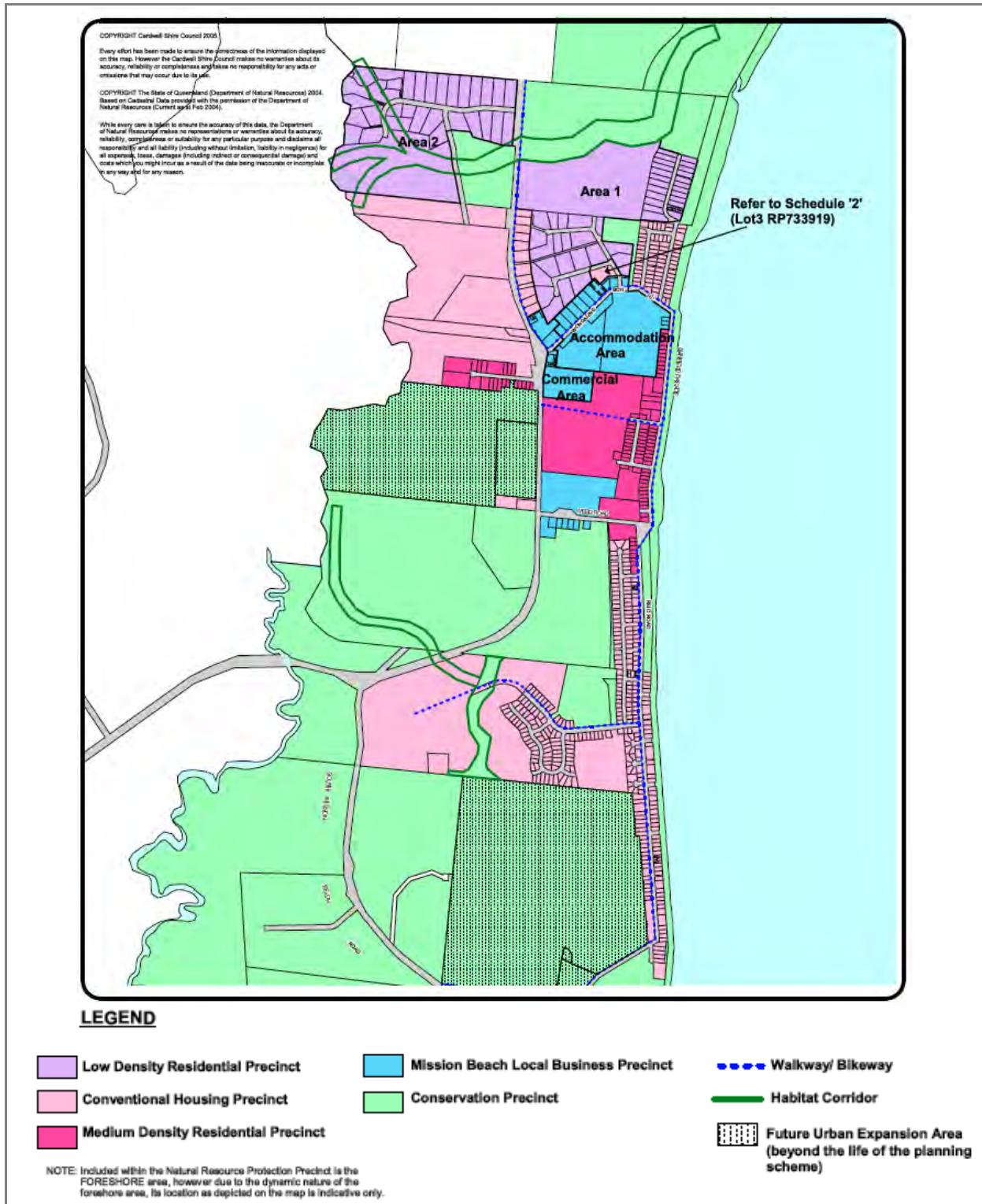


Figure 6: South Mission Beach Coastal Zone –
Cardwell Shire (Source: Cardwell Shire Council 2005).

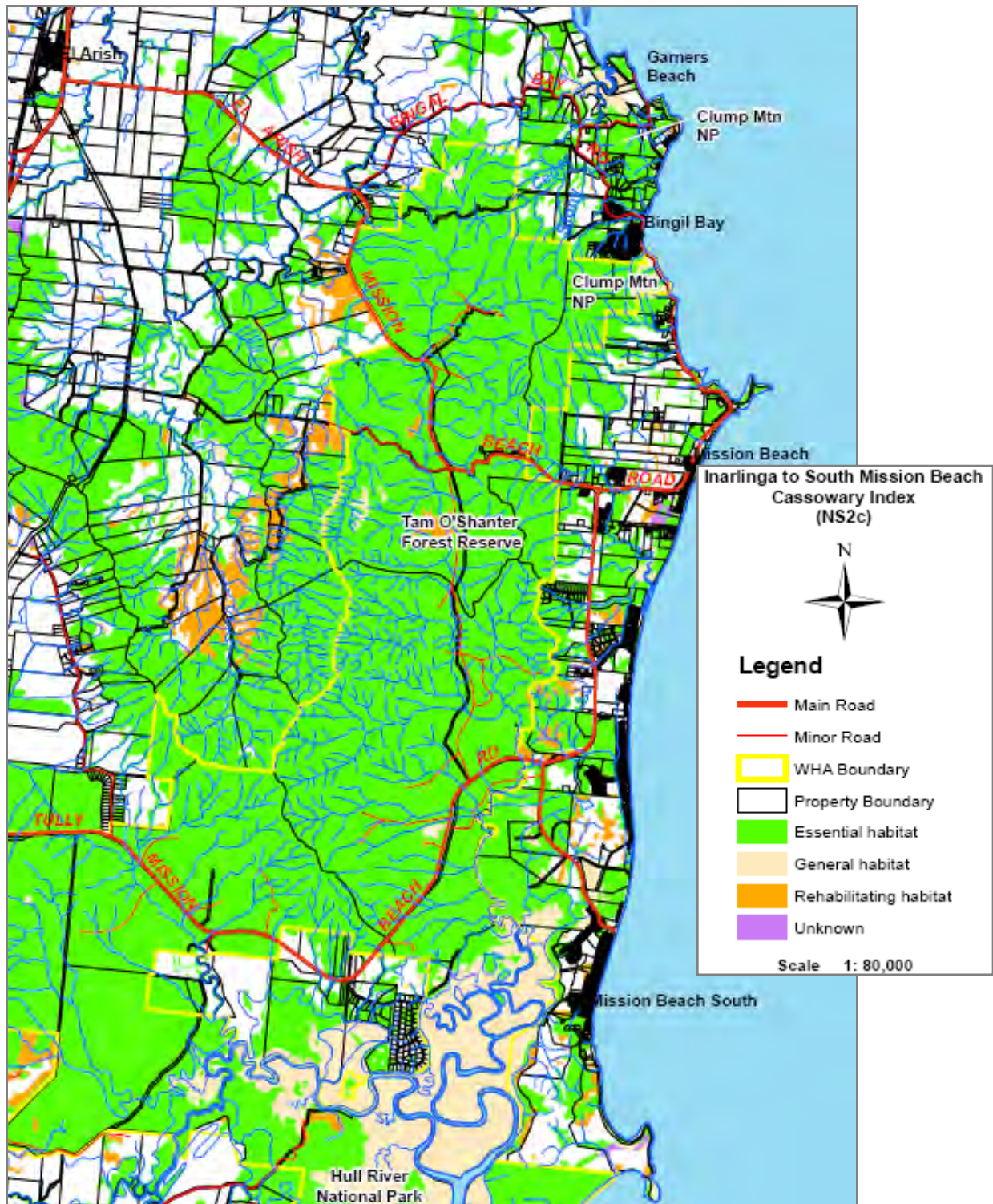


Figure 7: Essential cassowary habitat in Regional Ecosystems Mapping (Source: BioTropica Australia 2005).

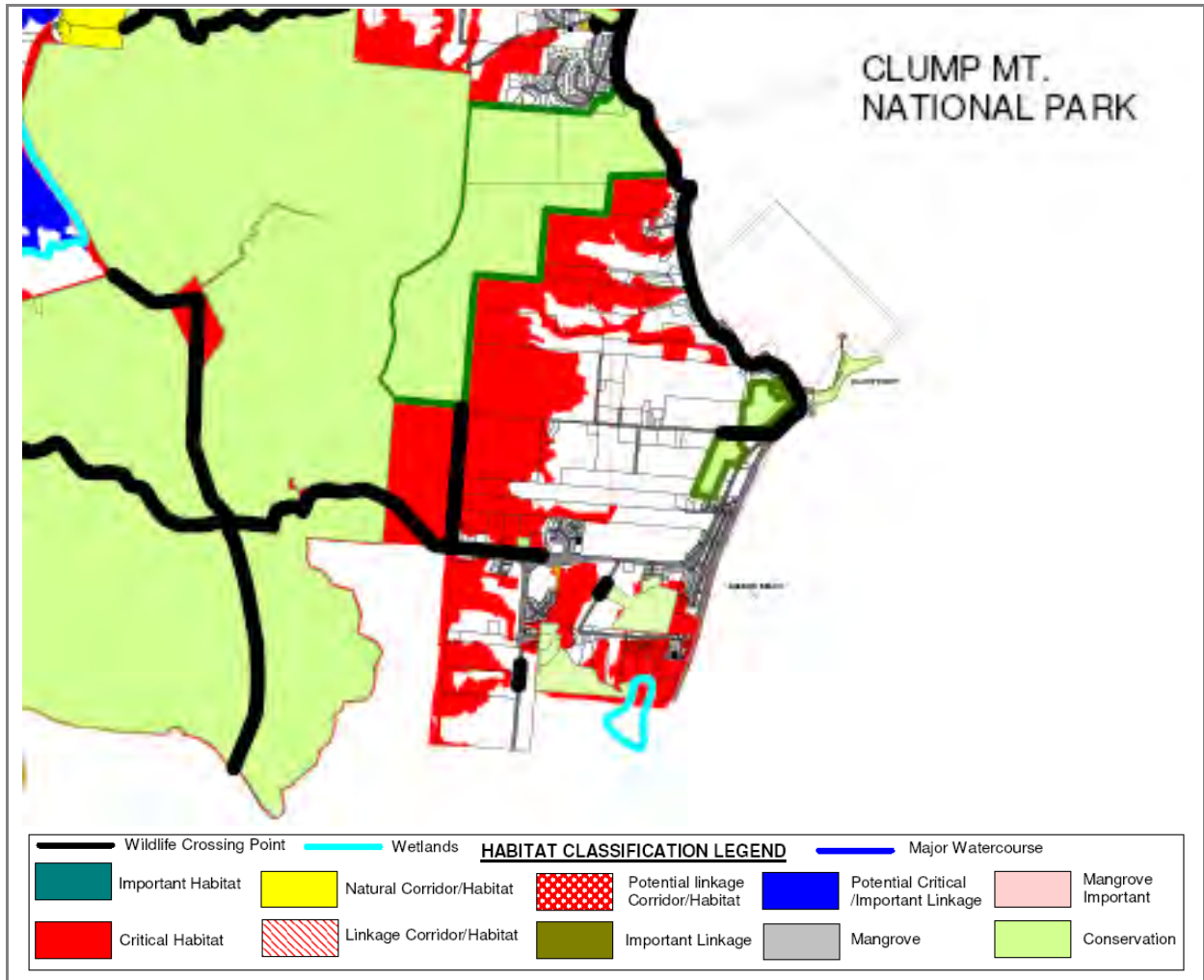


Figure 8: Johnstone Shire Natural Areas – Mission Beach Area (Source: Johnstone Shire Council 2005a).

Land use in Mission Beach

The first step for evaluating ecosystem services is to understand the services of importance to the region (Figure 2). This is conducted in this section by firstly assessing the land uses of importance for Mission Beach. For each land use the major ecosystem services are then discussed. Because the broader objectives for this project are about innovative instruments (MBIs) for environmental conservation in developing areas, we limit our discussion of land uses and ecosystem services in Mission Beach to those that are related to development – that is tourism and residential development. While agriculture is important to the region, agriculture and the ecosystem services essential to agriculture are not discussed in this report.

Tourism

The major industries in Far North Queensland are tourism, horticulture, and sugar and sugar processing. In 1999, expenditure by tourists in the Far North (\$1,856 million) was almost three times the Gross Value Product (GVP) of agriculture (\$682 million) (Productivity Commission 2003:265). Driml (1999) notes that based on 1996 figures, commercial tourism and recreational fishing and boating in the Great Barrier Reef World Heritage Area is estimated to generate nearly \$770 million per year .

With the development of the Cairns International Airport, tourism has been the fastest growing industry over the past decade (FNQ RPAC 2000:31). Key visitor attractions include the Great Barrier Reef, the Wet Tropics Rainforest, scenic landscapes and natural areas. Nature-based activities are currently and expected to remain the major draw-card and promotional product for the region (FNQ RPAC 2000:31). Mission Beach is highlighted as one of a number of areas within the Wet Tropics that is experiencing high tourism demand and pressure (FNQ RPAC 2000, FNQ NRM and Rainforest CRC 2004; Johnstone Shire Council 2005b: 186).

The attraction to the region for tourists is well demonstrated by promotion material such as “With its 14 km of pristine palm-fringed beaches, its blue waters, and the tropical islands off shore and the majestic backdrop of World Heritage rainforest, Mission Beach is one of the highlights of the ‘Great Green Way’” (www.tropicalaustralia.com, accessed November 2006).

Table 2 presents the visitor numbers, visitor nights and expenditure of tourists in the Johnstone Shire in 2004 (it is assumed that a large proportion of these accommodation statistics would be for Mission Beach). It can also be assumed that tourists numbers would be higher than those reflected by Johnstone Shire as similar statistics from Cardwell Shire are not available. The favoured activities of the tourists are presented in Table 3.

Table 2: Tourism in the Johnstone Shire (2004)
(Source: Johnstone Shire Council 2005b: 218).

	International (‘000)	Domestic Overnight (‘000)
Visitors	759	1,298
Visitor nights	5,336	7,180
Expenditure	\$902,000	\$1,093,005

Table 3: Favoured activities of tourists to the Mission Beach region
(Source: Johnstone Shire Council 2005b: 219).

International Tourists		Domestic Tourists	
Go shopping for pleasure	83%	Eat out at restaurants	66%
Go to the beach (including swimming and diving)	66%	Sightseeing	52%
Visit National Parks / State Parks	55%	Go to the beach (including swimming and diving)	43%
Visit wildlife parks / zoos / aquariums	54%	Go shopping for pleasure	34%
Visit local markets	49%	Pubs, clubs, discos	25%
Visit botanical or other public gardens	42%	Bushwalking / rainforest walks	24%
Go on guided tours or excursions	42%	Other outdoor activities (e.g. horse riding, rock climbing, white-water rafting, bungee jumping, four-wheel driving, etc.)	24%
Visit friends and relatives	40%	Go on a daytrip to another place	20%
Pubs, clubs, discos	38%	Visit friends and relatives	18%
Visit historical / heritage buildings, sites or monuments	33%	Visit National Parks / State Parks	16%

Urban development

The same features that attract tourists to the region are also drawing in an increased number of residents. Residents are also attracted to the region by employment that services tourism. Population for the FNQ region is expected to increase from 191,980 in 1996 to low, medium and high series estimates respectively of 259,000, 270,500 and 287,520 by 2016 (FNQ RPAC 2000: 45, Table 4). This includes low, medium and high series projections for the Cardwell Shire population, increasing from 9,110 in 1996 to 12,460, 13,020 and 13,840 in 2016 respectively, and Johnstone Shire population projections increasing from 19,780 in 1996 to low, medium and high projections of 22,010, 22,970 and 24,410 respectively by 2016. FNQ NRM (2004:75) note that an additional 8,700 hectares will be needed to accommodate the projected urban population in the Wet Tropics region.

Mission Beach is one locality highlighted as already absorbing a large portion of population growth and is projected to continue to do so. For example, between 1996 and 2001 the Cardwell Shire (which contains South Mission Beach) recorded the highest growth rate in the Wet Tropics (3.4%) and although the increase in real terms was relatively small (1,630 persons), this growth rate was the third highest of any coastal Local Government Area in the State, behind only Noosa (3.8%) and the Gold Coast (3.6%) (Weston and Goosem 2004: 27).

The number of building approvals in the Johnstone Shire has rapidly increased since 2001/2002 (Johnstone Shire Council 2005b: 234) (Table 5). The significance of the zones in which development is occurring is discussed in detail in Coggan *et al.* (in press). In the third report it is noted that clearing in urban areas is exempt from native vegetation legislation (can be cleared without offsets) and that clearing can also occur for house sites in conservation zones (considered of high conservation value). The numbers in Table 5 also indicate that the density of subdivision applications in these zones is fairly high.

Table 4: Population projections for the Mission Beach region (Source: FNQ RPAC 2000: 44).

Local Government Area	1996 Census	Population Projections – Hire Series			
		2001	2006	2011	2016
Atherton	10,130	11,040	11,900	12,740	13,530
Cairns	113,500	128,100	146,000	164,210	182,230
Cardwell	9,110	10,510	11,670	12,780	13,840
Douglas	9,700	11,320	12,930	14,620	16,330
Eacham	6,290	6,670	7,020	7,340	7,620
Herberton	5,250	5,730	6,200	6,640	7,030
Johnstone	19,780	21,090	22,340	23,460	24,410
Mareeba	18,220	19,400	20,500	21,580	22,520

Table 5: Development applications to the Johnstone Shire Council (Source: Johnstone Shire Council 2005b).

Development Applications to Council	2002		2003		2004	
	No.	New Lots	No.	New Lots	No.	New Lots
Urban	5	23	17	88	13	117
Economic Development	1	1	2	-	1	-
Conservation	nd		nd		4	32
Rural Residential	2	6	4	4	9	26
Rural	9	7	20	73	29	56
Town Planning						
Impact Assessments	36		45		52	

Ecosystem Services important to Mission Beach

Having established the land uses of importance for the Mission Beach region (primarily tourism and housing), in this section we assess the ecosystem services that support these land uses.

Ecosystem services important to tourism

The tourism and recreation experiences of the Wet Tropics World Heritage Area (and therefore also Mission Beach) are predominantly ‘nature based’ (Driml 2000: 201; FNQ RPAC 2000: 31). Nature-based activities that tourists enjoy (and spend money in the area to enjoy) include:

- Visiting National Parks;
- Swimming/diving at the beach;
- Swimming in mountain streams and water holes;
- Sightseeing/scenic views;
- Staying in resorts near the beach that offer ‘seclusion’ and peace and quiet;
- Walking along rainforest fringed beaches;
- Privacy of remote beaches; and
- Getting glimpses of wildlife in their natural environment.

Binning *et al.* (2001), in their study of ecosystem services in the Goulburn Broken Catchment of Victoria also highlighted tourism and recreation as an important ‘good’ for the area. The key ecosystem services important to recreation and tourism along with a description of each and how they relate to the Mission Beach case study are provided in Table 6. Some additional ecosystem services considered important for Mission Beach are also included in Table 6.

Table 6: Ecosystem services critical to recreation and tourism in Mission Beach (Source: (1) and (2) are descriptions from Binning *et al.* 2001).

	Ecosystem service type (1)	Description (2)	Importance to tourism in Mission Beach
Based on the GBCMA study	Maintenance and regeneration of habitat	<ul style="list-style-type: none"> • This ecosystem service is the process of maintaining biota through the process of regeneration, the maintenance of viable populations of fauna and the management of vegetation to facilitate production, dispersal and growth of seed. 	<ul style="list-style-type: none"> • Nature based tourism is reliant on nature. It is essential that natural areas are maintained. • Tourism activities reliant on this are all rainforest experiences as well as experiences associated with fauna such as the cassowary.
	Maintaining healthy waterways	<ul style="list-style-type: none"> • Balance of fish, invertebrates, plants and algae in waterways with appropriate in stream, floodplain and riparian habitats. • Water quality relates to the chemical composition of the water. 	<ul style="list-style-type: none"> • Visitors enjoy swimming in water holes and at the beach and reef. • Healthy waterways are essential in the production of good quality water related tourism experiences.

	Ecosystem service type (1)	Description (2)	Importance to tourism in Mission Beach
Based on the GBCMA study	Regulation of river flows and groundwater levels	<ul style="list-style-type: none"> Collection and distribution of water through rivers, lakes, wetlands and groundwater systems. 	<ul style="list-style-type: none"> Impacts on the production of all plants and animals which make up the nature in nature based tourism. Water bodies are also directly used for recreation (swimming in water holes). Water systems also provide flood mitigation services, this will be important to maintain tourism infrastructure (resorts) located in areas at risk of flooding.
	Waste absorption and breakdown (P, N and Carbon)	<ul style="list-style-type: none"> Organisms absorb and breakdown waste. 	<ul style="list-style-type: none"> Important to maintaining the 'pristine' environment of Mission Beach and surrounds that attracts tourists.
Additional for Mission Beach	Life fulfillment	<ul style="list-style-type: none"> These services are defined as the provision of aesthetic, beauty, cultural, intellectual, spiritual inspiration, sense of place, existence value, scientific discovery and serenity 	<ul style="list-style-type: none"> Mission Beach prides itself as pristine and secluded. Tourism is reliant on maintaining the aesthetic beauty and serenity of the area.
	Regulation of climate	<ul style="list-style-type: none"> Services provided by plants, animals and other organisms to regulate atmospheric composition and weather patterns. 	<ul style="list-style-type: none"> Plants provide shade and shelter that influence the micro climate. In the long run, climate change is likely to have an impact on the health of the reef, a major attraction to tourists. In the short term, an ecosystem service may be in the protection of natural (e.g. beach) and built assets from storm events.
	Water filtration and prevention of soil erosion	<ul style="list-style-type: none"> This service relates to the functions performed by soil components and vegetation in minimising soil loss and in filtering sediment to maintain water quality 	<ul style="list-style-type: none"> Sedimentation will directly affect enjoyment of streams and waterways as well as indirectly affecting the health of the reef thus having implications on tourism experiences.

Ecosystem services important to housing and urbanisation

Many of the ecosystem services important to tourism are also important to housing. Research highlights that residents of the wet tropics view the Wet Tropics World Heritage Area as an integral and cherished part of their surrounding natural and cultural landscape and natural environment (Weston and Goosem 2004). Local residents regularly visit natural places, Bentrupperbäumer and Reser 2002 (in Weston and Goosem 2004: 212) found that significantly more local residents visit the World Heritage Area than overseas and domestic Australian visitors – in a survey of ten sites, forty percent of all visitors were found to reside locally.

Binning *et al.* (2001) list ecosystem services of importance to housing as:

- Life fulfillment;
- Maintenance and regeneration of habitat;
- Provision of shade and shelter; and
- Waste absorption and breakdown.

Provision of shade and shelter is the only ecosystem services important to housing and urbanisation that is not discussed as a part of the ecosystem services of importance to tourism in Table 6. The provisions of shade and shelter ecosystem service is the service provided by vegetation that ameliorates the extremes in weather and climate at the local scale (Binning *et al.* 2001 refer to this as the paddock scale). Provision of shade and shelter is important to plants and animals, is required for the regeneration of habitat and the maintenance of water systems (Binning *et al.* 2001: 26). While Binning *et al.* (2001) consider shade and shelter at the paddock scale, for Mission Beach shade and shelter will also be broader as it relates to services that buffer the region from the effects of extreme weather events such as cyclones.

The ecosystem services important to housing and a description of why these are important to housing at Mission Beach are provided in Table 7.

Table 7: Important ecosystem services to housing in Mission Beach.

Ecosystem services (from Binning <i>et al.</i> 2001)	Why is this important to housing?
Maintenance and regeneration of habitat	This service enables the continuing health of the nature that people who live in the area appreciate every day in an aesthetic appreciation sense and regularly visit to recreate.
Maintaining healthy waterways	Healthy waterways give aesthetic and recreation enjoyment to residents. Healthy waterways are important to health through the provision of drinking water and to reduce water borne disease risk.
Regulation of river flows and groundwater levels	Recreation and flood mitigation benefits.
Waste absorption and breakdown (P, N and Carbon)	Maintain 'pristine' environment management of waste can also have health benefits.
Life fulfillment	People live in the areas due to the high visual amenity, quiet pace of life, etc.

Ecosystem services (from Binning <i>et al.</i> 2001)	Why is this important to housing?
Regulation of climate	The Wet tropics are vulnerable to tropical storms and cyclones, there are high housing benefits of services that regulate climate or at least reduce the impact of extreme climate events.
Water filtration and prevention of soil erosion	Maintains good water quality for recreation and drinking.
Provision of shade and shelter	Reduces the impact of extreme temperatures on houses. Provides shade and shelter that is important to the regeneration of habitat.

Development as a threat to the key ecosystems services of Mission Beach

It is regularly noted that the very features that attract people to an area are impacted on by the very presence of people and the facilities that people desire to visit or live in the area. Housing for residents and accommodation for visitors and the infrastructure (roads, etc.) for both will impact on the ecosystem services important to Mission Beach. Land use change, particularly the initial change from 'natural' to 'developed' is one of the most significant direct pressures on the coastal zone. More remote areas are progressing from a natural state to a more developed state that supports agriculture and tourism development (e.g. Cardwell, Mission Beach, Port Douglas and the Daintree region) (Weston and Goosem 2004).

The pressures and underlying causes of these are highlighted by FNQ NRM and Rainforest CRC (2004) – these are reproduced in Table 8. Table 8 also highlights the significance of development on ecosystem services.

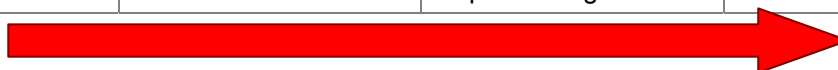
Table 8: Drivers and pressures to ecosystem services of Mission Beach (Source: Weston and Goosem 2004: 95).

Underlying drivers	Direct pressures
<ul style="list-style-type: none"> • Regional population growth • Changes in regional land use • Land tenure patterns • Demand for community infrastructure: <ul style="list-style-type: none"> • Water supplies • Electricity • Roads • Telecommunications • Tourism and recreation • Economic development, world trade and technological advances • Weather and climate change 	<ul style="list-style-type: none"> • Clearing of native habitat • Habitat fragmentation • Altered drainage patterns and flow regimes • Introduced pest species • Alteration / degradation of habit: <ul style="list-style-type: none"> • Grazing • Altered fire regimes • Diseases • Pollution • Introduced pest species: <ul style="list-style-type: none"> • Environmental weeds • Exotic fauna

Binning and Young (undated) disaggregate these drivers and pressures into macro causes and institutional failures that lead to land use changes (for whatever purpose) and the direct threatening process to the ecosystem services (hence the direction of the arrow in Table 9). The institutional pressure of market failure (highlighted in Table 9) is the focus of this research project. To design an effective MBI is firstly important to understand the causes of market failure such that these can be addressed in the instrument design. Market failure, its causes and solutions are discussed in later reports.

Table 9: Drivers and pressures on ecosystem services
(Source: Adopted from Binning and Young [undated] p. 10).

Macro cause / influence	Institutions	Land use change	Direct threatening process
• Population growth	• Lack of information about Ecosystem Services	• Urban Development	• Habitat modification and/or destruction
• Economic growth	• Market failure	• Infrastructure	• Habitat fragmentation
	• Policy failure	• Agriculture	• Over-harvesting of species
		• Forestry	• Environmental change
		• Industrial processing	



How might development impact on flora?

The impact of development on plant communities will depend on what the land was used for prior to development and the intensity of this use. If the land was untouched vegetation prior to development and requires extensive clearing, the impact on flora quantity and quality will be significant. If the land was previously grazed, development could result in either an increase or decrease in quantity and quality of flora depending on the nature of the pre-existing grazing system (Coggan *et al.* 2005).

Urban and tourism development can sometimes see large land clearing activity in either one hit or as a result of cumulative allowances to clear. While there have been incidences of large clearing events (large in relation to past clearing in the area and for previously uncleared vegetation)¹, it is the accumulation of many small clearing allowances that is resulting in increased landscape fragmentation and significant impacts on flora. With fragmentation comes an increase in edge effects and flora increasingly impacted by different climates (wind and heat), water cycles and weeds (Weston and Goosem 2004; Mack *et al.* 2000; Tyser and Worley 1992).

How might development impact on fauna?

Fauna is impacted by development directly through the removal of habitat or indirectly through the fragmentation of habitat and general negative interactions with humans (e.g. increased traffic impacts, weeds and increased numbers of predators such as dogs and cats).

The primary fauna impact is related to how close the development is to undeveloped environments. For example, in shrubby woodland vegetation in California some bird species are more likely to be found close to human development than other bird species which tend to cluster away from humans (Odell and Knight 2001). Further, residential development also

¹ For example, clearing of native vegetation to make way for a marina, resort and residential development at Oyster Point, just south of Cardwell (Weston and Goosem 2004: 98).

commonly attracts bird species that prey on other birds or that are nest parasites (Hansen *et al.* 2002). Odell and Knight (2001) found a similar effect for mammals with domestic pets such as dogs and cats in higher abundance close to human development and red foxes and coyotes more abundant away from humans. Development could attract fauna that impacts on fauna in neighbouring undeveloped areas.

In contrast, the relative density of human development does not appear to impact on either avian and mammal communities. Odell and Knight (2001) found no difference in the relative abundance of either birds or mammals with regard to different densities of development. However, there were significant differences between areas of development and non-development. That is, once humans are present there is an impact, but the number of humans after the first is irrelevant to the extent of impact.

The combined relationships of proximity to development and density of development suggest that rural subdivision would have the least negative impact on native biota if it was located in the more developed areas (e.g. in agricultural land as opposed to virgin forest) and if it is concentrated in high density clusters leaving larger areas of rural or forested land where development does not occur.

One species of fauna of significance to Mission Beach is the cassowary. The coastal lowlands of Mission Beach are also an area where cassowary densities are highest (Weston and Goosem 2004: 92). The cassowary is important to the region on a number of levels. As a keystone species, the cassowary is a major and often sole disperser of seeds for over 100 species of rainforest trees and vines (BioTropica Australia 2005). The cassowary is also important to the local indigenous people who have customs, stories, songs and dances about the cassowary. The cassowary is one of the most threatened vertebrate species in the country and such is listed as endangered under both state and federal wildlife legislation.

Development not only destroys an already compromised amount of cassowary habitat, it also disrupts individual cassowaries' movement paths, can segregate feeding and breeding sections of an individual's range, and predisposes the species to genetic isolation and local extinctions. It is increasingly recognised that development has direct impacts of habitat removal but also indirect impacts on cassowaries by increasing the bird's vulnerability to other random events and threatening processes such as disturbance, dog predation and road kill (Weston and Goosem 2004: 92).

Kofran and Chapman (2006) examined the causes of cassowary mortality in the Wet Tropics. Examining data from the Queensland Parks and Wildlife Service, of the 140 cassowary deaths in the Wet Tropics, 55% were from motor vehicle strikes and 18% were from dog attacks. Mission Beach was the location of 63% of these deaths. These statistics indicate that in contrast to other birds (see Odell and Knight 2001); the cassowary will be affected by the density of development. This is not so much by the location of development but if increased density allows for more residents in the Mission Beach area. More residents will mean more vehicle use and an increased rate of cassowary impact from roads and vehicles.

The cassowary itself performs a significant ecosystem service. Without the cassowary, habitat maintenance and regeneration is likely to be significantly compromised. This could have flow on effects to other values that are important to residents and tourists. For example, healthy waterways and a healthy reef and flood mitigation services as well as climate regulation. Because of the social, economic and environmental benefits associated with the conservation of the cassowary, the cassowary will be used as a proxy for biodiversity health with a viable cassowary population the instrument success measure. Mission Beach will be the location of focus. The second working report for this project specifically explores the impacts of urbanisation on the cassowary and analyses why cassowaries are undersupplied

at present and with development. The discussion in the second working report is significant to the design parameters of the policy instrument.

How might development affect water?

The high rainfall of the Wet Tropics is a defining feature of the region. In addition to the use of water in productive agriculture, water in streams and rivers is important to maintaining human life and the World Heritage listed forested stream ecology (FNQ NRM and Rainforest CRC 2004: 88) and of course, the values of the Great Barrier Reef. Water quality and quantity is critical to maintaining the infrastructure and the nature that attracts people to places like Mission Beach. Healthy waterways are also critical to the culture of the local Aboriginal people.

Water quality – sediments and nutrients

Weston and Goosem (2004) note that water quality is primarily influenced by vegetation clearing and the management of land and land uses whether it is for grazing, urban development or industrial use. Water quality in Mission Beach is likely to be influenced by both clearing and the management of urban areas. A review of water quality for the wet tropics (Hunter *et al.* 2003) found that salinity was generally not a problem; however total nitrogen and phosphorous in river systems ranked moderate to poor. There is not much information on sedimentation.

Disposal of sewage waste is a major issue in residential developments. This is especially the case in development along river and lake shores, coastal areas or in proximity to ecosystems of significant aesthetic and conservation value (LaGro Jnr. 1996). Sewage in high to medium density residential areas of the wet tropics is treated to basic secondary level only. Sewerage in rural and rural residential areas and some villages is treated via septic tank (FNQ NRM and Rainforest CRC 2004).

Water quantity

The quantity of water and its flow affects geomorphology, riparian vegetation, aquatic plants, wetlands, aquatic macroinvertebrates, freshwater fishes, other vertebrates and end of system environments (Armour *et al.* 2004: 21). Natural flow regimes are also important to the aboriginal culture and lifestyle (e.g. need flows at certain times of the year to conduct actions to reduce toxins in poisonous plants).

Analysis of the impacts of urbanisation on water quantity conducted in other catchments note that the major and most direct influence is through the establishment of many small dams and storages (Coggan *et al.* 2005). These storages are often constructed to manage sediment and nutrient runoff but also tend to restrict water supply. It is unlikely that urbanisation in the coastal areas of the wet tropics will affect water quantity through land use. However, increased numbers of residents will have an increased total demand on water resources and thus will affect overall water quantity.

Other effects of development in Mission Beach – Life fulfilment, visual amenity and aesthetics

Aesthetic, meaning ‘visually pleasing’, is a social construct pertaining to the appreciation of beauty and the resultant quality of life of residents. Aesthetics of land therefore integrates natural, agricultural and urban land uses. Because what is pleasing to one individual is not necessarily pleasing to another and what is pleasing today may not be pleasing in the future. As a result, the aesthetic value of land is a complex bundle of values that are difficult to untangle and effectively measure. Aesthetic values for Mission Beach could include the quality and quantity of views (i.e. ridgelines free from houses, pristine beaches, etc.), privacy, open space, balance of agriculture, vegetated and residential areas, and good air quality.

Aesthetics and the visual amenity of an area are a result of the life fulfillment ecosystem services. Whilst the visual amenity of an area attracts people, aesthetic values are impacted on by the presence of people. More people in an area impact on values such as quantity and quality of views, sense of privacy and open space.

The residents of Mission Beach have already expressed their concern with the current and potential aesthetic impacts of development in the region. The main concern is that development will result in the loss of the character of the region (FNQ RPAC 2000: 29, 35). One aesthetic concern of residents in the Mission Beach region is the loss of quantity and quality of cassowary habitat and the impact of increased traffic volumes on cassowaries (Johnstone Shire Council 2005b: 222). That is, residents obtain a direct cultural/aesthetic type ecosystem service from cassowaries. The fact that residents appreciate the natural terrestrial and marine environment connects a viable cassowary population as also an indirect ecosystem service (cassowaries provide services to the rainforest, etc.). The aesthetic ecosystem services from cassowaries are likely to be the same for tourists.

Conclusions

This paper is the first in a series exploring the potential of an MBI (and perhaps more specifically offsets) to manage the supply of ecosystem services in a Wet Tropics region experiencing residential development. Mission Beach, in the Wet Tropics is introduced as the case study for this exploration.

Using a similar framework as Binning *et al.* (2001), ecosystem goods and services important to Mission Beach are highlighted as those that support the tourism industry and the aesthetic values held by residents. These ecosystem services are those that maintain the natural values of the area but could also include services that regulate climate impacts to the region. The natural environment also has a life fulfillment ecosystem service to both residents and visitors (visual amenity as well as strong cultural values, etc.).

There are many components that constitute the natural environment of the wet tropics. Through the review of the literature it is revealed that the cassowary is a significant, keystone species to natural environment. As such, our investigation of innovative instruments to manage for conservation in developing areas will use a viable cassowary population as proxy and an objective for any instrument developed.

The second report of this series details the impacts of urbanisation on the cassowary and also begins to discuss the cause of the undersupply of cassowaries in a developing environment. The second background report discusses the economics behind the undersupply of the cassowary in the current framework for coordination of resources, the market. Given that this research project is focused on the design and application of an MBI to resolve the impacts of urbanisation, understanding the causes of the market failure is critical to end result MBI design.

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Further Information

Marine and Tropical Sciences Research Facility
PO Box 1762
CAIRNS QLD 4870

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