Great Barrier Reef Marine Park Authority

AN ECONOMIC AND SOCIAL EVALUATION OF IMPLEMENTING THE REPRESENTATIVE AREAS PROGRAM BY REZONING THE GREAT BARRIER REEF MARINE PARK

REPORT ON THE REVISED ZONING PLAN

November 2003

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GLOSSARY AND DEFINITIONS

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
AFFA	Commonwealth Department of Agriculture, Forestry and Fisheries
AIMS	Australian Institute of Marine Science
BRS	Bureau of Rural Sciences
CRC	Cooperative Research Centre
DPA	Dugong Protection Area
DZP	Draft Zoning Plan
Economic Value	The economic value of an industry is the aggregate of benefits to consumers and producers. The economic contribution of an industry is often represented by its value-added [*see below*]. Economic value for consumers is the additional value they derive from consumption above the price paid. The economic value for producers is the difference between a producer's total revenue and the resource cost of the output [i.e. the cost of all inputs used in production]. Economic value of a natural resource encompasses a range of environmental, economic, social, cultural and indigenous values, many of which cannot be quantified in monetary terms. All relevant values should be documented in a way that provides a strong indication of their relative importance.
EMC	Environmental Management Charge
EPA	Environmental Protection Agency
FTEs	Full Time Equivalents
GBR	Great Barrier Reef
GBRMPA	Great Barrier Reef Marine Park Authority
GVP	Gross Value of Production. The total value of output produced by an industry.
JCU	James Cook University
Lump-sum equivalent	Lump-sum equivalent, or net present value, is the discounted value of all future income streams. It provides a dollar equivalent of the future income streams, such that an individual would be indifferent between receiving the future stream of payments or the lump-sum amount.
LGA	Local Government Area
NPV	Net Present Value
OESR	Office of Economic and Statistical and Research
RAP	Representative Areas Program
SD	Statistical Division
SSC	Scientific Steering Committee
TEV	Total Economic Value
VA	Value-added. Value-added is the value of outputs produced by an industry less the value of its inputs. In essence, this surplus equates to the sum of incomes earned directly from an industry's production process, including returns to labour and capital.

INTRODUCTION

The Great Barrier Reef Marine Park [the 'Marine Park'] was declared in 1975 to preserve the area's outstanding biodiversity while providing for reasonable use. Achievement of these objectives requires the establishment of an appropriate balance between conservation and human-use activities that may have significant impacts on the health of the Marine Park.

The existing balance between use and conservation is defined by the current zoning arrangements for the Marine Park. However, the level of ecological protection under the existing zoning arrangements is no longer considered sufficient to meet the conservation objectives specified under the *Great Barrier Reef Marine Park Authority Act,* nor is it considered to be a reasonable reflection of the value that Australians [including coastal Queensland communities], and the international community, place on protecting the Marine Park and Great Barrier Reef World Heritage Area [GBRWHA]. In recognition of this, the Commonwealth Government has requested the Great Barrier Reef Marine Park Authority [GBRMPA] to undertake the Representative Areas Program [RAP] through a rezoning of the Great Barrier Reef [GBR]. A number of other aspects of the existing zoning regime have been identified by the GBRMPA as requiring reform. For example, there are inconsistencies in zoning provisions across the four main sections of the Park. In addition, coastal areas have been added to the Marine Park in recent years for which no zoning arrangements are in place.

To broaden the conservation benefits of the zoning system for the Marine Park and to address the shortcomings in the existing zoning arrangements, the GBRMPA, through the RAP has developed a new Zoning Plan, the draft version of which was released on 2 June 2003 for public comment, and a final revised version, which was developed after consideration of submissions by GBRMPA in relation to the draft Zoning Plan [DZP], was completed on 31 October 2003.

This study, which has been commissioned by GBRMPA, assesses the expected economic and social impacts of the revised "Zoning Plan".

OBJECTIVES OF THE RAP PROGRAM

As the Zoning Plan was developed as part of the RAP, the Program's objectives are relevant to this report. They are to help:

- maintain biological diversity at the ecosystem, habitat, species, population and genetic levels;
- allow species to function undisturbed;
- provide an ecological safety margin against human induced disasters;
- provide a solid ecological base from which threatened species or habitats can recover or repair themselves; and
- maintain ecological processes and systems.

The design of the Zoning Plan is based primarily on the application of biophysical operational principles that were developed by an independent Scientific Steering Committee [SSC], and social, economic, cultural and management feasibility operational principles developed by an independent Social, Economic and Cultural Steering Committee [see www.gbrmpa.gov.au]. The biophysical operational principles refer to minimum amounts of protection required to protect biodiversity in the Marine Park ecosystem and meet the other objectives of the RAP. The SSC considers that to fully achieve the objectives of RAP, GBRMPA should protect at least the amounts of each bioregion and each habitat specified under the biophysical operational principles – none of the recommendations is for 'ideal' or 'desired' amounts of protection. In the opinion of the SSC, ideal or desired amounts required for certain protection are likely to be greater than indicated by the biophysical operational principles.

The range of social, economic and cultural principles used to develop the Zoning Plan relate to the formation of zoning arrangements that meet the biodiversity objectives of the program, while complementing human uses and values including minimising the impact on existing users.

The Zoning Plan provides for:

- protection of at least 20% of each of the 70 identified bioregions [30 reef and 40 non-reef];
- expansion of the total area of the Marine Park that is zoned as 'no-take' areas [Green Zones] from 4.6% to 32.5%;
- introduction of a single amalgamated zoning regime; and
- introduction of zoning for the 28 coastal areas, totalling 4830km^2, that became part of the Marine Park between 2 August 2000 and 4 July 2001.

This report is structured as follows:

- **Section 1** provides an overview and principal conclusions of the report;
- **Section 2** assesses the potential impacts on tourism;
- **Section 3** assesses the potential impacts on fisheries;
- **Section 4** assesses the total economic value of the Marine Park. This is a relevant reference point in assessing the overall impact of the proposed changes to the Marine Park;
- **Section 5** provides an overview of some of the key differences between the existing and proposed zoning plans;
- **Section 6** reviews economic benefits for regional economies from GBRMP use activities;
- **Section 7** assesses risk management benefits of the RAP;
- **Attachment 1** outlines the methodology for this report, including the rationale for the approach used and includes an explanation of the way by which the economic value of fisheries is determined; and

- **Attachment 2** details the databases used in the development of the Zoning Plan.

SECTION 1: OVERVIEW AND CONCLUSIONS

1.1 VALUE TO AUSTRALIANS

The Great Barrier Reef Marine Park is probably the best-known marine protected area in the world, and its great diversity reflects the size and maturity of the ecosystem, which has evolved over thousands of years. It is the world's most extensive coral reef system and is one of the world's richest areas in terms of faunal diversity. A strong indication of the high order of magnitude of the value that the Australian community attaches to the continued conservation of the Marine Park is reflected in independent surveys conducted by AEC showing the Australian public values the existence of the Great Barrier Reef ecosystem and wants it protected [AEC 2001, Moscardo 2001, AEC 2002, AEC 2003]. The most recent study showed that over three-quarters of Australians consider that the Great Barrier Reef is under threat and more than 90% want more of it protected in Green Zones. About 70% of Australians think that more than 30% of the Great Barrier Reef should be in Green Zones. About 82% think it is acceptable to lose some usage of the reef as a consequence of increased protection.

1.2 VALUE TO QUEENSLANDERS

Queensland coastal communities also value the Great Barrier Reef ecosystem and want it protected [AEC 2001, Moscardo 2001, AEC 2002, AEC 2003]. The most recent study by AEC [2003] showed that about three-quarters of people in coastal GBR communities think the reef is under threat and more than 90% want more of it protected in Green Zones – which is similar to the Australian public generally. About 64% of people along the GBR coast think that over 30% of the Great Barrier Reef should be in Green Zones and 80% of Queenslanders consider some loss of use is acceptable in the interests of achieving increased protection for the Reef.

1.3 ECONOMIC IMPORTANCE OF INDUSTRIES IN THE GBR CATCHMENT AND LAGOON

Tourism is the third most important industry in the GBR catchment area with a GVP for 2001 of $4,228 million, which is only surpassed by mining with an annual GVP of $6,910 million, and mineral processing with an annual GVP of $4,287 million. Tourism activities in the context of this report include those:

1. in the Marine Park;

2. adjacent to the Marine Park that are directly related to the Marine Park [for example, caravan parks and bait & tackle shops deriving economic benefits from visiting recreational fishers using the park];

3. adjacent to the Marine Park conducted by people attracted mainly to the area because of the Marine Park; and

4. occurring in the catchment, that are completely unrelated to the Marine Park.

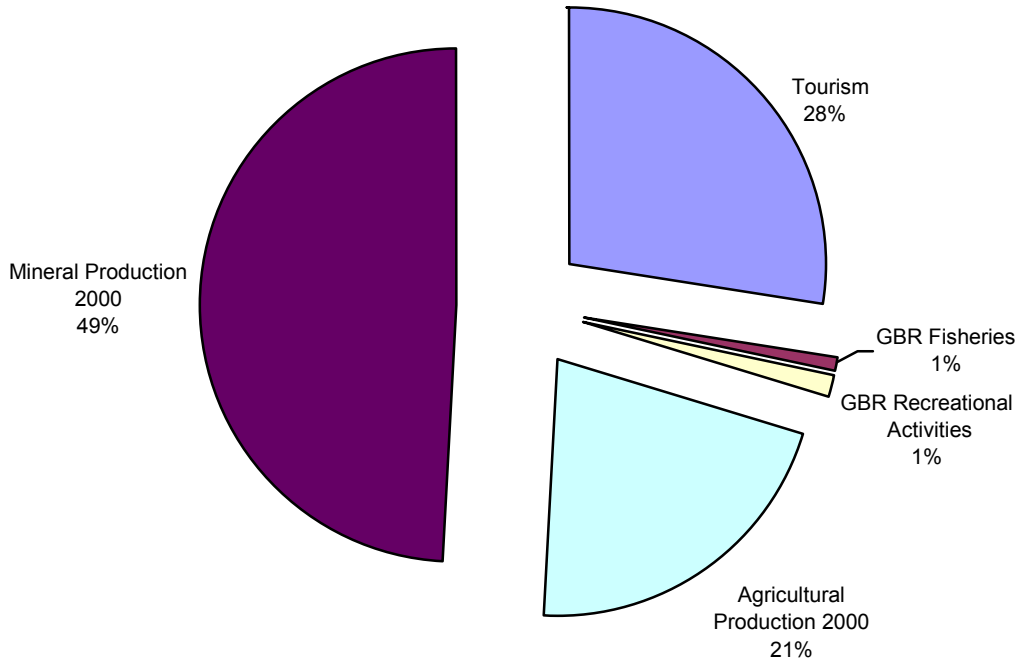
Tourism is easily the most significant industry in the Far North region, representing almost 65% of the combined GVP of mining, agriculture, fishing and tourism. Fishing has less than 5% of the combined GVP in this region [and less than 2.5% of GVP in each of the other regions]. In the Northern Region, mining is the principal economic activity, although tourism is also highly significant with 17% of GVP. Mining is also the dominant industry in the Fitzroy Region with over 80% of the combined GVP. Tourism and Mining have similar GVP in the Wide-Bay Burnett Region, with both industries having over 40% of

the combined GVP.

These industry proportions indicate that any collapse in the tourism sector would have far reaching effects in most of the statistical regions, but particularly in the Far North and Wide-Bay Burnett regions.

While the fishing sector in the GBR catchment is generally less important when compared with the other much larger industries, there may be a number of coastal areas where its relative contribution may be much higher than may be generally indicated in this report.

Figure 1: GVP in Key GBR Region Industries 2002



Source: Productivity Commission, 2003, Industries, Land Use and Water Quality in the Great Barrier Reef Catchment, Research Report Canberra.

1.4 OVERVIEW OF MARINE-PARK BASED TOURISM

A good indicator of the level of tourism in the Marine Park is the number of visitors using commercial reef-tour operators, which, in 2001-02, was 1.8 million.[1] It has been estimated that total average expenditure, including land-based accommodation and reef-tour charges, is $274 per visit, giving total expenditure of $478.4 million per annum [GBRMPA EMC data and OESR (2002)] from this group alone. Many other tourists visit using private transport. In addition it is estimated that around $111 million [OESR 2002] is spent annually at accommodation establishments located on islands within the Marine Park. The total expenditure on Marine Park tourism [including land-based accommodation] is, therefore, estimated at $589.4 million per annum, even for this narrowly defined group. The Productivity Commission [2003] estimated the value of tourism in the whole GBR catchment to be in excess of $4 billion per annum.

[1] Estimate derived from revenue received from the Great Barrier Reef Mark Park Authority Environmental Management Charge.

Total employment in the tourism sector in the GBR catchment is estimated at 47,660 FTEs [Productivity Commission (2003)]. Allocating this employment on a pro-rata basis between Marine Park and non-Marine Park based tourism, gives total employment in Marine Park based tourism of 6440 FTEs. These are people that work within the boundaries of the Marine Park on the water or at resorts. It is widely acknowledged that the GBR is a primary driver for tourism in the GBR catchment. The total value of the future stream of benefits from GBR-tourism is clearly of a very high order of magnitude, as reflected in the lump-sum equivalent of $24.9 billion in GVP [discount rate of 3%]. [See Sections 2.4 – 2.5, for more information.]

1.5 OTHER LAND-BASED TOURISM

A proportion of the $3,680 million[2] currently spent on land-based tourism in the region each year, and a significant proportion of the 41,220 land-based tourism jobs[3], could be placed at risk if there were significant reduction in the health of the Marine Park. Based on the results of an intrastate, interstate, and international visitor survey, Pearce et al. [1997] found the primary reason for trips to, or within, Queensland was to visit the Great Barrier Reef for:

- 14 % of intrastate visitors;
- 19% of interstate visitors; and
- 26% of international visitors to Queensland.

It is therefore evident that there are significant land-based tourism benefits from protecting biodiversity in Marine Park, as many tourists stay in the broader GBR region after being attracted to the region primarily to visit the Great Barrier Reef. [See section 2 for more information.]

1.6 PROJECTIONS FOR TOURISM – 2020

ABARE [for the Productivity Commission (2003)] forecast inbound [international] tourism in the Great Barrier Reef Catchment to grow by 4.1% per annum over the 2001 to 2010 period, and by 5.5% per annum over the period 2010 to 2020. ABARE also forecast domestic tourism to grow by 0.3% a year over the period 2001 to 2020. These forecasts are based on evaluation of the main drivers of growth in tourism numbers, which include disposable income [which in turn is mainly related to world growth], population numbers, and various other factors affecting the choice of similar destination and the level of participation in leisure travel. [For further information, see Section 2.4.] The health of the GBR afforded by the Representative Areas Program will encourage domestic and international visitors to choose the Marine Park over other destinations.

[2] Estimate of GVP for tourism in the GBR catchment [Productivity Commission 2003] less GVP estimate for GBR marine-based tourism.
[3] Estimate of employment for tourism in the GBR catchment [Productivity Commission 2003] less employment estimate for GBR marine-based tourism.

1.7 FORECAST GVP AND VALUE-ADDED FOR GBR FISHERIES

ABARE was commissioned by the Productivity Commission [2003] for its *'Industries, Land Use and Water Quality in the Great Barrier Reef Catchment'* Report to examine trends in GBR industries including fisheries, and to forecast fishery values for 2010 and 2020.
Based on discussions with QFS and Queensland Seafood Industry Association [pers. comm. Gavin Dwyer, Productivity Commission], fisheries GVP was forecast to decline by 6% by 2010 and by 21% by 2020 period. With total GVP of GBR fisheries currently around $130.1 million per annum [see Section 3, Table 3], GVP for GBR fisheries is therefore forecast to fall to $122.3 million by 2010 and $102.8 million by 2020. Due to expected improved fisheries management, ABARE forecast value-added for GBR fisheries to increase 19% by 2010 and 31% by 2020. Applying these forecasts, value-added for GBR fisheries is expected to increase from the current level of $24.6 million [18.9% of value-added (Productivity Commission 2003)] to $29.3 million by 2010 and $32.1 million by 2020.

1.8 GBR FISHERIES EMPLOYMENT

Total employment for GBR fisheries is estimated at 1691 FTEs representing 45% of total employment by commercial fishing operators in Queensland of some 3771 FTEs [Productivity Commission 2003].

1.9 ECONOMIC VALUE OF RECREATIONAL FISHING IN THE GBR MARINE PARK

The economic value of recreational fishing, unlike commercial fishing, is not directly estimable since there is no requirement for recreational fishers to keep records of fishing catch and effort. Consequently, survey methods are typically used to estimate the economic value of recreational fishing as well as recreational fishing expenditure [although economic value of recreational fishing is not equal to expenditure, as discussed in Attachment 1].

Based on a survey of recreational fishing expenditure undertaken by Blamey and Hundloe [1993] and the current number of recreational fishing vessels, recreational fishing expenditure is estimated at $201 million [see Section 3.8.3 for more information]. However, the actual amount of recreational fishing expenditure attributable to fishing in the Marine Park, for 2002, may be lower than $200 million. An alternative estimate of recreational fishing expenditure is provided in the National Recreational and Indigenous Fishing Survey [2003] in which it is estimated there is a total of 198,327 recreational fishers in the GBR catchment and average recreational fishing expenditure in Queensland is $407 per fisher per annum. Based on these data the total estimated expenditure on recreational fishing in the GBR catchment is $80.7 million per annum.

KPMG [2000] has estimated that 1756 people are employed indirectly in various sectors as a result of recreational fishing and boating activities.

As discussed in Section 3.7, GBRMPA has estimated that new areas within the Marine Park where recreational fishing would not be permitted under the Zoning Plan are located where approximately 4% of recreational fishing takes place. This estimate is based on an analysis of boat ramp data, and the likely distance from boat ramps most recreational fishing vessels are likely to travel [5 km from shore]. Hence negative impacts on recreational fishers are expected to be low.

Conversely, in Conservation Park Zones [Yellow Zones] recreational fishing will still be permitted [subject to restrictions] but only limited commercial fishing will be permitted. Some recreational fishers may therefore experience less conflict with other fishers and therefore may realise benefits from introduction of the Zoning Plan.

1.10 SOCIAL AND CULTURAL VALUE IN THE GREAT BARRIER REEF MARINE PARK

The RAP is likely to increase the level of protection for some culturally or socially important sites and places by restricting access or impacts that might adversely affect the physical fabric or archaeological remains of cultural heritage places. [See section 4 for more information.]

1.11 INDIGENOUS CULTURAL VALUES

Indigenous peoples live in all regional and remote communities and towns along the GBRMP coast and in the Torres Strait Islands. In total, there are more than 50 recognised Traditional Owner groups, who assert native title rights and interests within the Marine Park. There are also a significant number of Indigenous people, including Eastern Torres Strait Islanders, with historical associations.

Traditional Owner group connections to the sea country extend as far offshore as the outer barrier reefs. Traditional groups once lived on the coastal plains out to the continental shelf, which is the same area that today is covered by sea and coral reefs. Traditional stories, cultural heritage values, and obligations to sea country are captured within their clan estate boundaries. [See Section 4 for more information.]

1.12 NATIONAL HERITAGE VALUE

There are more than 1200 shipwrecks in the GBRWHA, many of which have historic value, and on the islands are ruins and operating lighthouses that are of cultural and historical significance.

1.13 ENVIRONMENTAL AND SCARCITY VALUES

The environmental values can be understood from an overview of the species and habitats found in the Marine Park. The Great Barrier Reef Marine Park contains more than just coral reefs. It also contains extensive areas of seagrass, mangroves, soft bottom and deepwater communities. The reef is not a continuous barrier, but a broken maze of coral reefs and coral cays. It includes approximately 2,900 individual reefs, of which over 700 are fringing reefs. These reefs range in size from less than one hectare to more than 100,000 hectares, and in shape from flat platform reefs to elongated ribbon reefs. The Great Barrier Reef provides habitats for many diverse forms of marine life. There are an estimated 1,500 species of fish and more than 300 species of hard, reef-building corals. More than 4,000 mollusc species and over 400 species of sponges have been identified. Other well-represented animal groups include anemones, marine worms, crustaceans [prawns, crabs] and echinoderms [starfish, sea urchins].

The extensive seagrass beds found in the Marine Park are important feeding grounds for the dugong, a mammal species internationally listed as endangered. The reef also supports a wide variety of fleshy algae that are heavily grazed by turtles, fish, sea urchins and molluscs. The reef contains nesting grounds of world significance for the endangered Green and loggerhead turtles. It is also a breeding area for humpback whales, which come from the Antarctic to give birth to their young in the warm waters. The islands and cays support several hundred bird species, many of which have breeding colonies there.

1.13.1 Coral Reefs

An important dimension of economic value is scarcity, particularly in relation to irreplaceable environmental resources of outstanding natural universal value; such as exist within the Marine Park. Scarcity can be evaluated with respect to the scarcity of the reef itself but also in terms of the prevalence of marine protected areas.

A variety of threats impact on coral reef ecosystems globally, including the Great Barrier Reef. Wilkinson [2002] estimates that:

- 10% of world's reefs have been destroyed or severely degraded;
- 58% of the world's reefs are potentially threatened;
- 70% of reefs are already degraded in Indonesia & Philippines; and
- on current trends, 70% of the world's reefs will be gone in 40 years.

Furthermore, the over-exploitation of reef and marine areas is a serious concern in many developing and developed countries, because economic growth is seen to take precedence over environmental objectives.

1.13.2 Species

Species in the Marine Park currently under threat include:

- Dugong;
- Hump-backed dolphin;
- Irrawaddy dolphin;
- Whales [some species];
- Hump-headed Maori wrasse;
- Potato cod;
- Seabirds [some species];
- Triton shell; and

- Turtle [all species].

The scarcity of these species clearly increases the environmental value associated with their protection.

1.13.3 Bioregions

Each of the 70 identified bioregions is considered to be a distinctive part of the Marine Park – any loss in biodiversity within any of these bioregions could be irreversible. Hence protection of bioregions has a very high scarcity value.

1.13.4 Marine Protected Areas ['No-take' Zones]

Although Marine Park areas are widely accepted as an effective tool in marine conservation, most allow extraction of some natural resources. True 'no-take' marine sanctuaries are rare [Ballantine 1997, Roberts 1995] and they usually occur as a separate zone within a larger Marine Park area. The total area of 'no-take' areas, in proportional terms, is extremely small, with:

- Less than 1% of the oceans of the world closed to fishing;
- Just .0001% of US territorial waters closed to all fishing;
- Only 0.01% of coastal habitat protected in British Columbia; and
- Much less than 1% of Australia's marine jurisdiction, outside the Great Barrier Reef Marine Park, is protected.

1.13.5 Direct Non-use Values

Hundloe, Carter and Vanclay [1987] measured part of the existence value together with the option value for the Great Barrier Reef, via a mail survey of a sample of Australians. This contingent valuation study estimated a benefit of $45 million per year, which in current prices is equivalent to around $98 million. This study severely underestimates these values as it excludes Australians who have not visited the reef, overseas residents, who are also likely to value the area significantly, and a range of other direct non-use values such as bequest value, quasi-option value and spiritual values. [See Section 5 for more information.]

1.13.6 Ecosystem Services

Ecosystem services are indirect-use values associated with environmental resources. Ecosystem services are an indirect, albeit highly significant outcome associated with achievement of the direct objective of providing for the health of the Marine Park. The main categories of ecosystem services include:

- shoreline/coastal protection;
- maintenance of migratory species and nursery habitats;

- organic matter and nutrient storage and recycling;
- waste reception and recycling;
- fixation of solar energy and biomass production; and
- medical resources/bio-prospecting.

In each instance, there is limited work that has been done to elicit an economic value of these services in the GBR. Studies in areas such as the Galapagos Islands and Hawaiian reefs show these values to be worth many millions of dollars per year.

It is difficult to evaluate the value that the Australian community place on ensuring ecosystem services continue to occur effectively. Nonetheless, it is clearly the case that the valuation would be extremely high as the Great Barrier Reef, in facilitating the provision of a range of ecosystem services, fulfils many of the objectives of the following international conventions for which Australia is a signatory, including the:

- Convention on Biological Diversity [1992];
- World Heritage Convention [1972];
- Convention on the Conservation of Nature in the South Pacific [APIA 1976];
- Convention on Conservation of Migratory Species of Wild Animals [1979]; and
- Convention on the Law of the Sea [1982].

In addition, the value placed on meeting these ecosystem services, and other environmental objectives for the Marine Park, is reflected in the following national strategies:

- National Strategy for Conservation of Australia's Biological Diversity [1996];
- Intergovernmental Agreement on the Environment [1992]; and
- National Strategy for Ecologically Sustainable Development [1992].

Given Australia's obligations under these conventions relating to biodiversity and conservation of migratory species, a high priority should be attached to policy initiatives that promote achievement of outcomes supporting the maintenance of migration and nursery habitats, maintenance of biological diversity, and organic waste assimilation. [The approach for placing an appropriate weighting on such outcomes is to attach dollar values through application of environmental valuation techniques, although application of such techniques is beyond the scope of this report.]

1.13.7 Shoreline Coastal Protection

There are some 2,300 kilometres of coast adjoining the Marine Park. The conservation value of this area is likely to be very high because of the high value attached to properties and beaches along the coastline but also due to the high value attached to mangrove forests. Mangrove forests bordering the

Great Barrier Reef World Heritage Area are some of the most pristine and diverse mangrove forests in the world. These areas harbour more than half the number of all mangrove species in the world. Individual estuarine stands may contain up to 28 species and there are at least 37 species in the entire World Heritage Area.

Many species of animals, particularly some fishes and crustaceans, spend part of their life cycle living in the mangrove forest and the remainder living in other parts of the ecosystem, such as coral reefs. These inshore values are protected because there is a healthy coral reef system acting as a barrier to the impact of oceanic wave action. Furthermore, human constructions [for example, port facilities, shipping lanes, seaside homes, accommodation facilities etc] are also afforded high levels of protection from the impacts of high-energy oceanic wave action.

1.13.8 Medical Resources/Bioprospecting

Coral reefs and other marine ecosystem components may contain substantial biological information, which can be used for educational or medical purposes. Bioprospecting is the term given to looking for this biological, or genetic, information. Bioprospecting is conducted in the Marine Park but no dollar value estimates have been made of its current value. However, Cartier and Ruitenbeek [1999] did estimate that the value of Bioprospecting for the Montego Bay coral reef is some $108 million [NPV], suggesting that the dollar value of Bioprospecting on the Great Barrier Reef is likely to be very high.

Maintenance of the system [for example, through RAP] in which such valuable resources can exist, is essential to seeing their value retained. A growing number of other sectors are also benefiting from marine biodiscovery. These include agriculture [environmentally friendly chemicals] and environmental bioremediation. New antifouling treatments based on benign compounds that simply trick fouling organisms into not settling could attract over $US70 billion a year in sales.

1.14 OTHER INDIRECT ENVIRONMENTAL VALUES

Apart from ecosystem services, other indirect environmental values include indigenous cultural, lifestyle and spiritual values; tourism values; and fishing values. In addition, maintaining the following forms of indirect environmental values is also an important benefit associated with maintaining the health of marine environments:

- visual amenity/aesthetic value;
- research value; and
- education.

The Marine Park is particularly rich with respect to each of these types of indirect environmental values, and the maintenance of these values could be an important outcome associated with the RAP.

1.14.1 Visual Amenity/Aesthetic Value

There can be no question that the Marine Park has immense natural beauty and this was reflected when the GBR met criterion [iii] for World Heritage listing under the World Heritage Convention, which relates to '… exceptional natural beauty'. Lucas et al. [1998] held the view that the value of visual amenity/aesthetic value is potentially so large that uncertainty about its magnitude represents a sufficient rationale for application of the precautionary principle. Hence while there is no dollar estimate of visual amenity/aesthetic value, it does represent an important benefit flowing from implementation of any management initiative aimed at conserving the Marine Park, and, as such, it is reasonable to expect that there will be visual amenity/aesthetic value benefits attributable to the RAP.

1.14.2 Research Value

Research that is based on the Marine Park has an extremely high value to the Australian and international communities. By 1995 the Reef Data base of publications relating to the GBR Region contained 11,500 records [Lucas et al. 1998, pp. 48-49] reflecting the immense research value that has been derived from the Marine Park.
It is very difficult to estimate the research value of the Marine Park to the community. While anecdotal evidence suggests that increasing the coverage of Green Zones within the GBRMP is already leading to increasing use of the GBRMP by international researchers, the combined annual expenditure of some relevant research agencies/universities on research/eduction related to Marine Park is estimated in 2003 at $25 million. This estimate is the aggregate of a reef research-related proportion of the budgets of the following organisations:

- Australian Institute of Marine Science;
- Cooperative Research Centre for the Great Barrier Reef; and
- James Cook University [JCU] in Townsville.

This compares with an estimate of $19.4 million for scientific research in 1991-92 for the Marine Park [Driml 1994].

1.14.3 Education

The extensive education value of the GBR Marine Park is reflected in the following statistics relating to the number of students studying the GBR:

- 67,500 primary students nationally read and learn about the GBR [source: sales figures from publishers of marine resources for primary schools];
- There are 117 secondary schools in the GBR catchment and 414 primary schools in the GBR catchment that learn about the GBR; and
- There are currently 493 undergraduate students and 138 postgraduate students enrolled in marine/environmental management and marine biology courses at James Cook University's Townsville and Cairns campuses.

In addition, ABS data indicate that a total of 32,460 secondary students, nationwide, study the GBR annually. Based on the above estimates, over 100,000 Australian students study the GBR each year. These estimates exclude students from tertiary educational institutions other than James Cook University that study the GBR, and also exclude students in other countries studying the GBR. This is therefore a conservative estimate of the total number of students studying the GBR, and hence its high education value.

1.15 WORLD HERITAGE LISTING

The Great Barrier Reef, one of Australia's first World Heritage Areas, was inscribed on the World Heritage List in 1981 in recognition of its outstanding natural universal value; that is, it met the following natural criteria for World Heritage listing:

- An outstanding example representing the major stages in the earth's evolutionary history;
- An outstanding example representing significant ongoing ecological and biological processes;
- An example of superlative natural phenomena; and
- Containing important and significant habitats for *in situ* conservation of biological diversity.

The GBRWHA the world's largest World Heritage Area, extending 2300 kilometres and covering an area of 35 million hectares.[4]

Australia has an obligation to ensure that the GBRWHA is managed in a way that meets the requirements of the Convention. The benefit of the RAP in helping meet this obligation therefore represents a benefit that is additional to the benefit of maintaining the environmental values of the Marine Park for the Australian community *per se*.

1.16 STUDY LIMITATIONS

This study has three principal limitations arising from data availability, uncertainty about environmental impacts, and the scope of the study.

The first limitation is that benefits attached to the Zoning Plan are assessed without evaluating the impact of other proposed policies targeting improved management of the reef, such as improved water quality management systems. It is anticipated, however, that the Zoning Plan would be complemented by other management initiatives targeting improved reef health.

The second limitation is that this study does not estimate the dollar value of the range of environmental values attached to the Marine Park. This would potentially help clarify the trade-off to be made between economic-use values forgone as a result of increasing no-take areas, and the related environmental benefits. An environmental valuation study undertaken by Hundloe et al. [1987] – which reflects only part of the total environmental value attached to the Marine Park - is used [see below] to provide some indication of the relativity between environmental benefits and economic costs associated with the Zoning Plan.

[4] About 99.3% of the World Heritage Property is within the Great Barrier Reef Marine Park, the remainder being Queensland waters and islands.

The third limitation is that the timing of environmental benefits flowing from the Zoning Plan are not evaluated, as there is too much uncertainty to do so. Nonetheless, this limitation is not expected to have a material impact on the conclusions reached as the Zoning Plan helps manage a range of risks to the reef, many of which could potentially occur at any time in the future.

1.17 CONCLUSIONS

Scientific evidence shows that the Great Barrier Reef is under pressure from a variety of natural and human activities, and that various actions are necessary to protect the ecosystem for future generations. Thousands of people in communities along the Queensland coast depend on the Great Barrier Reef for their lifestyles and livelihoods.

Less than 5 per cent of the Great Barrier Reef Marine Park is currently protected in marine sanctuaries or Marine National Park Zones [known locally as Green Zones or 'no take' zones]. Australian and international scientific advice states that this is insufficient to ensure the long-term survival of the Reef.
The introduction of more Green Zones is just one of several important strategies to protect the range of plants and animals of the Reef on which so many people depend. Other vital activities include major efforts to improve water quality and to develop sustainable fisheries.
The Commonwealth Government, through the Great Barrier Reef Marine Park Authority, has implemented the Representative Areas Program to increase the number of Green Zones to protect the ecosystem of the Marine Park for the future, and to protect all the industries and communities that depend upon it.

An important element of the RAP is the production of a Zoning Plan that introduces a consistent management regime across the whole of the Great Barrier Reef Marine Park. This report provides information on the social and economic benefits and costs arising from implementing the RAP through the Zoning Plan. And in assessing the RAP and the Zoning Plan it is necessary to evaluate the net overall impact on the welfare of Australians as well as regional impacts. Some impacts are inevitable. But costs should be considered together with the potential benefits of the rezoning before making a final decision as to whether it is likely to enhance the welfare of the broader Australian community, including coastal Queensland.

Overall, there is a very good case for introducing the Zoning Plan purely on economic grounds given:

- The strong linkage between safeguarding and enhancing the value of economic-use activities and maintaining the Marine Park in a healthy state;

- Economic-use activities undertaken in the GBR Marine Park [i.e. tourism, fishing, and recreation] have direct GVP of in excess of $890 million per annum;

- Economic use activities directly employ around 10,000 people;

- Economic-use activities create economic flow-on benefits of some $760 million annually in GVP, and indirect employment of around 7000 people; and

- The principal economic cost of the Zoning Plan - the value of forgone fishing activity - is estimated at between $0.52 and $2.59 million per annum, including downstream impacts on fish processors.

Furthermore, it is evident that the Zoning Plan is justifiable purely on the basis of the environmental benefits. The principal economic cost of the Zoning Plan, the forgone fishing opportunity, is equivalent to between just 4.1 cents and 10.2 cents per annum for each Australian. This cost is much lower than the environmental value estimated by Hundloe et al. [1987] of $4.00 in 1987 for each individual that had visited the Marine Park, which is equivalent to around $8.70 in current prices.[5]

In summary, given the high value of the environmental and economic benefits of the Zoning Plan relative to the modest aggregate economic cost, the Zoning Plan is likely to deliver substantial net benefits for Queenslanders and the broader Australian community.

[5] Haycock and Driml [2002], however, identify a number of reasons why the Hundloe et al. estimate is likely to severely underestimate total environmental benefits [and in fact does not include any value for the vast array of ecosystem services].

SECTION 2: TOURISM

Data from the Productivity Commission [2003, pp 71-74] show that tourism in the GBR catchment earns $4.269 billion GVP annually and employs almost 48,000 people [who collectively represent 33 per cent of aggregate tourism employment in Queensland, and 9 per cent of all Australians employed by the tourism sector]. Tourism activities in the context of this report include those:

- in the Marine Park;
- adjacent to the Marine Park that are directly related to the Marine Park [e.g. caravan parks and bait & tackle shops deriving economic benefits from visiting recreational fishers using the park];
- adjacent to the Marine Park conducted by people attracted mainly to the area because of the Marine Park; and
- occurring in the catchment that are completely unrelated to the Marine Park.

Data are not available to discern the proportion of total GVP and employment that can be attributed to the existence of the GBR ecosystem. Current research by the Australian Bureau of Tourism Research may shortly provide some insight.

Maintaining biological diversity of the Great Barrier Reef ecosystem is essential for sustainable tourism use. The values of marine-based tourism in the Marine Park would be maintained and enhanced by implementation of the Zoning Plan. Given the increased attractiveness of a well-maintained reef ecosystem when many other reefs around the world are suffering from degradation, visitor numbers to the GBR are likely to increase. Even a minor increase in visitor numbers, such as five per cent, would represent a considerable boost to the economic impact of the tourism sector in the region.

Increased fish biomass and diversity mean a higher value experience for tourists with greater flow-on effects in terms of revisits, word-of-mouth and greater appreciation of the marine environment and Green Zones. Green Zones in a greater variety of locations also mean a greater range of products for them to choose from which also adds to their value of the 'reef experience'.

2.1 ECONOMIC SIGNIFICANCE

A good indicator of the level of non-extractive tourism in the Marine Park is the number of visitors using commercial reef-tour operators, which, in 2001-02, was 1.8 million.[6] By combining GBRMPA EMC data with accommodation data from OESR [2002] total average daily expenditure by visitors, including land-based accommodation and reef-tour charges, can be calculated at $274 per visit, yielding total expenditure of $478.4 million per annum. In addition it is estimated that around $111 million [OESR 2002] is spent annually at accommodation establishments located on islands within the Marine Park. The total expenditure on Marine Park tourism [including land-based accommodation] is, therefore, estimated at $589.4 million per annum.

Total employment in the tourism sector in the GBR catchment is estimated at 47,660 FTEs [Productivity Commission 2003]. Allocating this employment on a pro-rata basis between Marine Park and non-Marine Park based tourism, gives total employment in Marine Park based tourism of 6440 FTEs.

[6] Estimate derived from revenue received from the Great Barrier Reef Mark Park Authority Environmental Management Charge.

The proposed Zoning Plan would enhance and protect the $589 million marine-based tourism industry, and it is acknowledged that the GBR is a primary driver for other land-based tourism in the GBR catchment. Moreover, the RAP will provide a strong basis upon which the industry can continue to grow and continue to be one of the region's principal economic drivers.

2.2 NON-MARKET VALUATION

Non-market valuation techniques have also been applied to estimate the value of recreation in the Marine Park. A number of studies have measured the net economic benefits to visitors, by asking their willingness to pay [WTP], in addition to all other costs, to visit reefs or islands in the Marine Park. Studies in the past have elicited amounts of:

- $8 for each adult visitor to coral sites in the Marine Park [Hundloe, Vanclay and Carter, 1987];
- $15.12 a person [1979 dollars] for a visit to Green Island [Economic Associates, 1983]; and
- $36.29 a person for recreation at Heron Island [Sloan, 1987, 1983 dollars].

While the range of these values is large, the studies illustrate that visitors to the region experience significant benefits, which are not captured in the data for tourism expenditure.

2.3 LOCATION OF TOURIST VISITATION

Commercial GBR tourism data have been derived from the GBRMPA EMC Program, which can be used to assess the location of Green Zones in relation to tourist visitation areas. These point data (2,065,000 visit points) represent locations of commercial tourist visits (including recreational fishing) to one or many GBR tourist locations, in any single day, during 2002. These data are a spatial representation of GBR tourism usage in 2002.

From the EMC data, in the current Zoning Plan, there were approximately 635,000 location visits [or 31 % of total location visits] to Green Zones [i.e. Marine National Park B and National Parks zones in 2002]. In the proposed Zoning Plan, on present usage, this figure would approximately double to 1,231,000 [or 60% of total location visits] within Green Zones [i.e. Marine National Parks] (See Table 1).

Table 1: Location visits to green zones for both the current and Proposed Zoning Plans.

Plan	Location Visits	% Of Total Location Visits
Current Zoning Plan	634,723	31
Proposed Zoning Plan	1,231,491	60

Source: Based on GBRMPA overlay analysis (see GBRMPA internal report, November 2003]

The conclusion that can be drawn from the data reported in Table 1 is that the Zoning Plan would enhance commercial tourism [for example, diving, snorkelling] by providing benefits that flow from the establishment of Green Zones [greater abundance of fish species, improved habitat protection etc.] in many of the areas where tourists currently visit.

Moreover, if the geographic distribution of visitation remains the same, the addition of new Green Zones under the Zoning Plan would result in a significant increase in Marine Park experience for a great number of visitors. Furthermore, visitors to some non-protected zones may also receive an

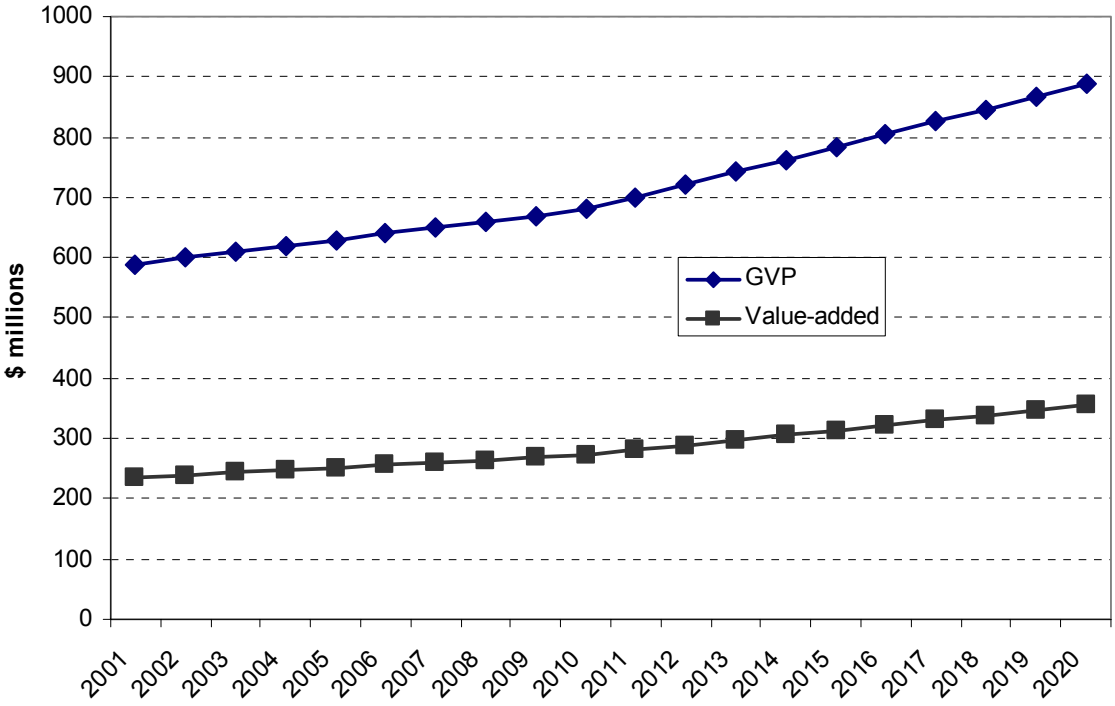
improvement in their Marine Park visitation experience as a result of positive spillovers or recruitment of marine life from protected zones.

2.4 PROJECTIONS FOR TOURISM-2020

The projected visitation numbers for the Marine Park and tourism GVP and value-added are based on projections for tourism growth in the GBR catchment undertaken by ABARE for the Productivity Commission [2003]. ABARE forecast inbound [international] tourism in the Great Barrier Reef Catchment to grow by 4.1% per annum over the 2001 to 2010 period, and by 5.5% per annum over the period 2010 to 2020. ABARE also forecast domestic tourism to grow by 0.3% a year over the period 2001 to 2020. These forecasts are based on evaluation of the main drivers of growth in tourism numbers, which include disposable income [which in turn is mainly related to world growth], population numbers, and various other factors affecting the choice of destination and the level of participation in leisure travel. Overall, GBR catchment tourism is forecast to grow by 15.4% over the period 2001-10 and 30.5% over the period 2010-20, giving total forecast growth for 2001-20 of 50.6%. Applying these forecast rates of growth in tourism to the estimate of Marine Park tourism of $589.4 million in 2001, Marine Park tourism GVP for 2010 and 2020 can be estimated.

Growth in Marine Park tourism for 2001-2020 is illustrated in Figure 2 below.

Figure 2: Forecast Growth in Tourism GVP, 2001-2020



Source: Based on GBRMPA Annual Report 2002-03 [2003c] estimates of GBR-based tourism values, and ABARE forecasts of tourism growth, as reported in Productivity Commission [2003].

As reflected in the above figure, GVP for Marine Park tourism is forecast to grow to $680 million by 2010 and to $888 million by 2020. Value-added is forecast to grow to $272 million by 2010 and to $355 million by 2020. Assuming the ABARE forecast GVP growth applies to employment, direct Marine Park-tourism employment is expected to grow from the 2001 employment level of 6440 to 7112 by 2010 and to 9761 by 2020. [These are people that that work within the boundaries of the Marine Park on the water or at resorts.]

2.5 LUMP-SUM EQUIVALENT OF GBR TOURISM VALUES

The lump-sum equivalent[7] of all current and future forecast annual tourism receipts and value-added are reported in the table below for two discount rate scenarios.

Table 2: Lump-sum Equivalent of Future Streams of Tourism Income and Value-added

	GVP $ Million	Value-added $ Million
Lump-sum - 6%	13,240	5,296
Lump-sum - 3%	24,946	9,978

These estimates are based on the above forecast values for tourism, and, for the period after 2020 [2020 is the last period the ABARE forecasts relate to], it is assumed that the ABARE forecast average annual growth rate for 2010-20, of 2.7%, is sustained.

[7] The lump-sum equivalent, or net present value, is a single value that equates to a stream of future cash flows. A discount rate is used to scale down future cash flows. In this case a discount rate of 6% [real] is applied which is consistent with Queensland Treasury Guidelines for project evaluation. A discount rate of 3%, which is consistent with the rate used by Cesar et al. [2003] is also used.

SECTION 3: FISHERIES

3.1 INTRODUCTION

According to the Productivity Commission [2003, p. 74], fisheries [aquaculture, and commercial and recreational fishing] are among the smaller industries on the GBR.

The Zoning Plan has been developed with the intention of minimising disruption to people's uses and values, including the fishing industry. However, it is not possible to meet the biophysical operational principles without some impacts on fisheries.

3.2 COMMERCIAL FISHERIES

3.2.1 GVP

The GVP of commercial fishing is estimated from historical records of catches in the Great Barrier Reef marine Park. Historical records of catch in areas proposed for protection in the Zoning Plan for the GBR Marine Park are shown in percentage terms in Table 3. Using this estimate, average annual GVP for GBR Marine Park fisheries, for 1996-02, is estimated at $130.1 million.

3.2.2 Value Added

ABARE [2003] as referred to in the Productivity Commission [2003] report into 'Industries in the GBR catchment and Water Quality' estimated the value-added for GBR fisheries to be 18.9% of GVP. Using this estimate, average annual value-added for GBRMP fisheries, for 1996-02, is estimated at $24.6 million.

3.2.3 Employment

Total employment for GBR commercial fisheries is estimated at 1691 FTEs representing 45% of total employment by commercial fishing operators in Queensland of some 3771 FTEs [Productivity Commission 2003].

Table 3: Assessment of Potential Impact on GBR Commercial Fisheries of Implementation of Representative Areas Program[1]

Commercial Fishery	Mean Annual GVP[2] in the Marine Park [$ millions] varying years but 2001 only for Otter Trawl and 1998 – 2001 for Net	Max % fisheries areas affected by Zoning Plan	Max GVP & VA in fisheries areas affected by the Zoning Plan [$ Millions]		Net income reduction scenarios [GVP & value-added]: 20 – 50%								Impact assessment
					20%		30%		40%		50%		
			GVP	VA	GVP	VA	GVP	VA	GVP	VA	GVP	VA	
Otter Trawl Fishery (2001-2002)[3]	68.3	6%	4.10	0.77	0.82	0.15	1.23	0.23	1.64	0.31	2.05	0.39	Low, due to mobility (except for some inshore banana prawn grounds, see below).
Line Fishery (1996-2002)[4]	33.9	16%	5.42	1.03	1.08	0.21	1.63	0.31	2.17	0.41	2.71	0.51	Low impact from RAP due to effect of Queensland Government Reef Line Plan.
Net Fishery (1998-2002)[5]	5.2	13%	1.13	0.21	0.23	0.04	0.34	0.06	0.45	0.09	0.57	0.11	Low in some areas, but high in some areas due to lack of mobility of netters.
Pot - Mud Crab Fishery (1996-2002)[6]	1.5	13%	0.52	0.10	0.10	0.02	0.16	0.03	0.21	0.04	0.26	0.05	Medium. Large portion of commercial pot and mud crab fisheries occur in estuarine and intertidal foreshore areas outside the GBRMP
Pot - Spanner Crab (1996-2002)[7]	3.7	17%	0.63	0.12	0.13	0.02	0.19	0.04	0.25	0.05	0.31	0.06	Variable. May be possible to divert some fishing effort south of the fishery area in the GBRMP.
Pot – Blue Swimmer Crab Fishery (1996-2002)	.07	10%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Medium. As all of the fishery is located within the Marine Park there may be limited opportunities to divert fishing activity.
Tropical Rock Lobster Fishery (1998-2000)	5.0	0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Low percentage of fishery located in proposed Green Zones.
Aquarium Fish and Coral Collection Fisheries (1998-2000)	4.5	12%	0.54	0.10	0.11	0.02	0.16	0.03	0.22	0.04	0.27	0.05	Likely to be low when new collection arrangements come into force.
Sea Cucumber Fishery (1996-2002)	3.0	19%	0.57	0.11	0.11	0.02	0.17	0.03	0.23	0.04	0.29	0.05	The adaptability of the fishery is expected to be high due to the low financial impact of the Zoning Plan.
Trochus Fishery (1996-2002)	0.7	8%	0.06	0.01	0.01	0.00	0.02	0.00	0.02	0.00	0.03	0.01	Low nominal amount of value-added in proposed Green and Yellow Zones.
Commercial Beam Trawl Fishery (not quantified)[8]	0.25	No Accurate Data	No Accurate Data										Most beam trawling occurs outside the GBRMP, however, impacts may be higher in some areas within the Marine Park.
Banana Otter Trawl (1996-2001)[9]	4.0	17.5%	0.71	0.13	0.14	0.03	0.21	0.04	0.28	0.05	0.35	0.07	Some inshore banana prawn grounds affected.
TOTAL	130.1	10.51%	13.68	2.59*	2.74	0.52	4.10	0.78	5.47	1.03	6.84	1.29	

Source: GBRMPA [2003a] Fisheries Matters to be considered in the RAP, Internal Working Paper.
Notes:[see following page]

Notes to Table 3

1) The overall area zoned to prohibit fishing does not equate to an equivalent area lost to fishing because fishing activity will still be able to occur in alternative fishing grounds.

2) GVP prices are those paid to commercial fishers at the wharf.

3) Excludes otter trawl for banana prawns / inshore otter trawl. These figures estimate trawl effort data on the basis of VMS polling of trawl vessels during the night time hours. The trawl "effort" has been apportioned to areas affected by the zoning on the basis of frequency of polling occurring in that grid or site square to areas affected by the zoning on the basis of frequency of polling occurring in that grid or site square.

4) These figures do not take into account the reduction in the harvest of the reef line fishery or the Spanish mackerel fishery as a result of recently introduced QFS total allowable catch quotas.

5) To represent realistically the spatial distribution of net fishing effort, QFS grid data has been allocated on the basis of site data. Sites adjacent to the mainland have been allocated on the basis of 50% in the GBRMP and 50% in adjacent internal waters of Queensland. Effort in existing GBR Marine Park zones (other than Princess Charlotte Bay) where commercial netting (using large-mesh nets) are prohibited were removed from the data coverage and assigned to adjacent sites. Hinchinbrook and Shoalwater DPA "A" Zones prohibit or severely restrict commercial netting, and effort in these areas have been excluded from any coverages with effort assigned to abutting sites in the GBR Marine Park.

6) To realistically represent the spatial distribution of mud crab effort fishing effort, QFS grid data has been allocated on the basis of site data. Sites adjacent to the mainland have been allocated on the assumption that 50% occur within the GBR Marine Park and 50% in adjacent internal waters of Queensland. This assumption was developed using satellite imagery, water depth data and local knowledge of the fishery.

7) Preliminary analysis of commercial spanner crab data indicates that the spatial pattern of fishing effort has changed in the last 5 years. Estimation of GVP affected by the draft and revised Zoning Plan has been undertaken using 1996-02 data. However, GBRMPA considers that basing the assessment on more recent data, while not feasible at this stage, would be more appropriate and is likely to show a lower impact of the Zoning Plan on GVP for the spanner crab fishery.

8) The data supplied by the QFS is not at a scale that allowed calculation of the GVP occurring in areas affected by the Zoning Plan. Knowledge of the beam trawl fishery in the GBR region estimates that about 50% of the fishery is likely to occur in the GBR Marine Park.

9) These figures are trawl effort data that are grid and site specific, refined with day-time VMS polling of trawl vessels.

Overall, it can be seen that, under the Zoning Plan, protected zones are proposed to be located where, historically, 10.51% of catch with an annual GVP of an estimated $13.68 million has been taken. This equates to a value-added [that is, value over and above the costs of the fishing effort] of some $2.59 million. However, fishing operators will be able to adapt to some extent, and hence potential effects will be considerably less than the $2.59 million per annum indicated in Table 3 above which is the maximum estimate of the total loss if they had no capacity to adapt.

The capacity to adapt will vary from fishery to fishery, and from fisher to fisher. Factors which will impact on the adaptability of fisheries include:

- the percentage of the fishery being located in the proposed protected zones;
- the sustainability of existing fisheries management arrangements and practices;
- the availability of alternative fishing grounds;
- search costs associated with locating suitable new fishing grounds;
- the impact of changes in fishing effort on fish stocks in those areas where fishing activity may be displaced following implementation of the new zoning plan;
- spillover and recruitment benefits from protected areas, that could potentially arise in some fisheries as a result of the number, size and fecundity [fecundity is higher for older fish and there are more older fish in protected areas] of stocks increasing in protected areas. Realisation of spillover and recruitment benefits would be dependent on movement of larvae, and juvenile and adult fish from protected into non-protected areas;
- the dependence of fishers on GBR fisheries income compared with other sources of income; and
- the recent [trawl] and soon-to-be-introduced [eg reef line] fleet rationalisation offsetting the effects of reduced fishing area and/or catch reduction.

Spatial modelling of fishing fleets' catch rates, and modelling of fleet profitability would be required to accommodate rigorous evaluation of all of the above issues and to assess in more detail fishery impacts associated with the Zoning Plan. In the absence of such modelling, the approach adopted in this report is to undertake scenario analysis in relation to the proportion of potential losses. The scenario analysis is based on an examination of the total loss to the fishing industry under alternative percentage losses in GVP. [i.e. GVP in the area affected by the Zoning Plan]

3.3 ADAPTABILITY OF GBR MARINE PARK COMMERCIAL FISHERIES TO CHANGES IMPOSED UNDER THE DRAFT ZONING PLAN

The potential for each fishery to adapt to the Zoning Plan is assessed in this section. This assessment is based on a more detailed report about the anticipated impacts of the Zoning Plan on GBR fisheries [GBRMPA 2003a].

3.3.1 Otter Trawl Fishery (including banana otter trawl fishery)

GVP in proposed no-take areas in the GBR Marine Park:	$4.81 million
Value added component:	$900,000
Expected degree of adaptability to Zoning Plan:	High

Fishery characteristics which promote a high degree of adaptability to the Zoning Plan include:

- the Queensland east coast otter trawl fleet is characterised by a high degree of mobility;
- most trawlers involved in the fishery operate in several areas and travel a considerable distance to do so; and
- the Queensland east coast otter trawl fishery has undergone major rationalisation in the last three years, with the number of otter trawlers operating in the fishery being reduced from 750 to about 530.

There may be some inherent cost to industry from having to undertake trawl operations further away from normal ports of operation or in unfamiliar waters.

An important equity consideration is that the Commonwealth and Queensland Governments [administered by the Queensland Rural Adjustment Authority] – made payments of $20 million in early 2000 for the voluntary surrender of almost 100 commercial fishing licences. Part of the agreement associated with the rationalisation that occurred at this time, and agreed at the Great Barrier Reef Ministerial Council, was that areas in which there had been little or no trawling would be closed to trawling as part of the Queensland Trawl Plan. Additional closures would be implemented through the RAP.

3.3.2 Line Fishery

GVP in proposed no-take areas in the GBR Marine Park:	$5.42 million
Value added component:	$1.03 million
Expected degree of adaptability to Zoning Plan:	High

Fishery characteristics which promote a high degree of adaptability to the Zoning Plan include:

- the mobile nature of most operators in the fishery to relocate to alternative fishing grounds;
- impending management changes by the QFS[8] [under the proposed fishery reforms, catch reduction by over a third is anticipated];

[8] The Coral Reef Finfish Management Plan approved by the Queensland Government introduces a 36% reduction in latent effort [from 1550 to less than 400 commercial operators] and a reduction in catch of 36% [from 4800 tonnes to some 3060 tonnes]. Recent Regulatory Impact Statement proposes further management intervention in the Spanish mackerel fishery. Recent legislation approved by the Queensland Government introduced catch quota and removes latent effort in the Spanish mackerel fishery.

- high likelihood of significant spillovers [stock-enhancement effects] from protected to non-protected zones; and

- a relatively small proportion of reef area is affected by the Zoning Plan. Under the Zoning Plan, an additional 20.9% of reef area is to be closed to fishing, whereas an additional 27.9% of the entire Marine Park is proposed to be zoned as 'protected areas' under the Zoning Plan.

Recognition by fisheries managers, QFS, that 'no-take' areas are an important part of the fisheries management package working towards ecological sustainability of the commercial coral reef finfish fishery indicate that the fishery could well achieve long-term commercial benefits as a result of the RAP. It is reasonable to conclude that the Zoning Plan would impose minimal cost on this fishery, but there may be some transitional costs such as the cost of using other fishing grounds. However, if, as proposed by QFS, fleet rationalisation takes place [reduction from current 1550 endorsement holders to less than 400] then very little search activity would be required, as there would be less competition on those fishing grounds where commercial fishing is allowed to continue under the Zoning Plan.

3.3.3 Beam Trawl Fishery

Beam trawling is restricted to specific inshore areas and bays and therefore much of it occurs outside the Great Barrier Reef Marine Park. The average GVP [1996–2001] of the beam trawl fishery in the GBR region is estimated at $0.5 million and it is calculated that only up to half of this value of catch is captured in the GBRMP - but these figures are not as robust as estimates for other fisheries. Generally, beam trawl fishers also operate in the inshore net and mud crab fisheries. All trawling, including beam trawling, is prohibited in Yellow, Green and Dark Blue Zones. Several Yellow Zones proposed in the Zoning Plan are in areas important to the beam trawl fishery. Alternative beam trawl areas are not available.

3.3.4 Commercial Net and Inshore Line Fishery

GVP in proposed no-take areas in the GBR Marine Park:	$1.13 million
Value added component:	$0.21 million
Expected degree of adaptability to Zoning Plan:	Low in one areas/high in others

The main fishery characteristic that would facilitate adaptability to the Zoning Plan is that a large portion of the commercial net fishery in the GBR region is likely to take place in the estuarine and intertidal foreshore areas adjacent to the Marine Park.

Conversely, adaptability may be limited for those fishers with commercial mud crab and possibly beam trawl fishery endorsements, who may realise impacts from the Zoning Plan across all of the fisheries in which they participate. Low mobility and the low income of some fishers may also limit adaptability.

3.3.5 Blue Swimmer and Mud Crab Fishery

GVP in proposed no-take areas in the GBR Marine Park:	$530,000
Value added component:	$100,000
Expected degree of adaptability to Zoning Plan:	Moderate

All of the commercial pot - and mud crab - fisheries in the GBR region occur in the GBR Marine Park and hence there may be limited alternative fishing opportunities. The low mobility, and low-income status, of many fishers may also contribute to low ability to adapt to the Zoning Plan. Therefore, there could be a relatively high social impact (relative to the size of the loss in value-added).

3.3.6 Spanner Crab Fishery

GVP in proposed no-take areas in the GBR Marine Park:	$630,000
Value added component:	$120,000
Expected degree of adaptability to Zoning Plan:	Low [for some fishers].

The ability to divert fishing activity that previously occurred in the Yellow and Green Zones to areas in the south of the fishery will aid adaptability, but conversely, factors that reduce adaptability for some fishers include:

- a potential cost associated with relocating further south to continue to operate in the fishery for the many fishers that live in communities adjacent to the northern-most recognised spanner crab fishing grounds [eg. Gladstone]; and

- the need for some fishers to buy quota[9] in order to continue to participate in the Spanner Crab fishery, as they will need to relocate to a different management area from where they have previously fished.

3.3.7 Sea Cucumber

GVP in proposed no-take areas in the GBR Marine Park:	$570,000
Value added component:	$110,000
Expected degree of adaptability to Zoning Plan:	High

The degree of adaptability of the fishery is expected to be high because of the low financial impact of the Zoning Plan.

3.3.8 Commercial Trochus

GVP in proposed no-take areas in the GBR Marine Park:	$60,000
Value added component:	$11,000
Expected degree of adaptability to Zoning Plan:	High

The main factor pointing to a relatively high degree of adaptability is the low nominal amount of value-added located in the Green and Yellow Zones. However, there are few alternative suitable sites for trochus collection and a small number of fishers. As the overall financial impact is expected to be relatively minor, the degree of adaptability of the fishery to the Zoning Plan is expected to be relatively high.

[9] This represents a transfer of wealth from one group to another, and hence does not represent an economic cost *per se*. However, it does represent a significant adjustment cost for those fishers having to buy additional quota.

3.3.9 Rock Lobster

GVP in proposed no-take areas in the GBR Marine Park:	$0
Value added component:	$0
Expected degree of adaptability to Zoning Plan:	High

As none of the fishery is located in the proposed new "no-take" areas, the Zoning Plan imposes no economic cost on the rock lobster fishery.

3.3.10 Aquarium Fish and Coral

GVP in proposed no-take areas in the GBR Marine Park:	$540,000
Value added component:	$100,000
Expected degree of adaptability to Zoning Plan:	Low in some areas/high in others

These fisheries are highly specialised in terms of targeted species and there is little conflict with other fishing sectors. Because they are specialised operations and require good shore-based and boat-based husbandry for product quality control, they are restricted in their ability to relocate. Their boats, shore facilities and air [and other] transport arrangements have been established near the places they work. Aquarium fish and coral collectors have detailed knowledge of the specific areas where they undertake their operations, and hence it will not be easy for some operators to move to other areas. However, coral collection management arrangements are under review and the proposed new arrangements would see the abolition of 'coral leases' and the introduction of more extensive collection areas.

3.3.11 Impact on Processors

The ABS survey of manufacturing establishments [ABS cat. 8221.0] provides data at the national level for seafood processing, but there are no available data at the State level. Aggregate turnover in Australia for seafood processing establishment was estimated to be $1,270 million for 1999-00, with value-added estimated at $270 million and employment of 4179. Assessing these estimates to the GBR region on the basis of GVP from commercial fishing in the GBR, gives an estimated GVP of $68.56 million for fish processing, value-added of $14.58 million, and employment of 226 persons.

Based on these estimates, and total GBR commercial fishing GVP of $130.1 million, each dollar in GVP for commercial fishing equates to $0.53 in GVP and $0.11 in value-added. Using this relationship and the potential impacts on the commercial fishing industry under the scenario analysis presented in Table 3 [i.e. GVP impacts of between $2.74 million/annum and $6.84 million/annum], the potential loss in value-added for the processing sector is estimated at between $301 400 and $752 400 per annum.

3.3.12 Input suppliers

Upstream impacts [impacts on suppliers to the fishing industry] of any contraction in the commercial fishing industry are expected to be relatively minor because most operators are unlikely to reduce the number of days they fish despite any reduction in catch rates[10] This means that regional impacts may be quite minor.

3.3.13 Additional Fishery Cost Factors Not Taken into Account in This Study

The above fishery impacts do not take account of the economic impact of increased steaming cost for some fishers, who are unable to access fishing grounds within the same radius from their home that they are accustomed to fishing. This is believed to potentially represent a cost impost for aquarium and coral collection fishers and for some crab and net fishers. No attempt is made to estimate these costs for this study. These costs are unlikely to be significant relative to the costs related to forgone fishing opportunity, but may impose financial costs on a small number of fishers/processors. When the RAP is implemented, potential costs would need to be investigated during the RAP implementation process, and the transition for affected fishers would need to be carefully managed.

3.4 SCENARIO ANALYSIS FOR COMMERCIAL FISHERIES

The intent of this assessment is to undertake broad-level scenario analysis of the potential cost to the commercial fishing industry associated with the Zoning Plan, to provide some indication of the order of magnitude of fishery costs.

As mentioned above, the total affected area of commercial fishing grounds represents an area where some $13.68 million in GVP, or $2.59 million in value-added, would be taken if observed fishing patterns were to continue. However, significantly less than the $2.59 million in value-added will be lost due to the adaptability of fishers.

In addition, in the longer term *only* the resource rent component of value-added (value-added includes all returns to capital and labour *plus* resource rent), would be lost because labour and capital would be diverted to other industries. Consequently assessing the impact of the Zoning Plan on value-added provides an over-estimate of economic losses. However, this shortcoming in use of value-added as a measure of economic impact may be offset, to some extent, by expected increases in resource rent arising from improved fisheries management [Productivity Commission 2003].

In Table 3, 'what-if' analysis is conducted to evaluate the extent of losses to fishers and downstream processors and fish marketers, under 4 scenarios for percentage reductions in GVP for the affected area. [i.e. 20%, 30%, 40% and 50% reductions in GVP historically taken from the affected area.]

A total loss under the 50% reduction in GVP scenario is taken as the upper bound estimate of the impact on the fishing industry because, due to the adaptability of fishers, it is highly unlikely that catch rates would fall by more than 50% with respect to that fishing time that, in the absence of the Zoning Plan, would have been spent fishing in the proposed 'no-take' zones. There would be no upstream losses [i.e. no losses for suppliers to the fishing industry] because, as mentioned, the level of fishing activity is likely to be unaffected by the Zoning Plan, only the catch rates.

[10] Once the decision is made to remain in the industry, the decision by operators to fish on any given day [subject to other fishery management rules] will be based on whether expected revenue exceeds variable costs. Consequently, there is likely to be some scope for catch rates, and therefore revenue, to decline before the decision is made to reduce the number of fishing days.

Under the scenario analysis in Table 3, the annual reduction in value-added for the commercial fishing industry is estimated at between $520 000 (If fishers' GVP falls by 20%, with respect to fishing days that would have been spent in no-take areas without the Zoning Plan), and $1.29 million (50% reduction scenario). This gives a total impact on the commercial fishing industry *and* processors (see section 3.3.11) of between $821 400 and $2.04 million per annum.

3.5 FORECASTS OF ECONOMIC VALUE OF COMMERCIAL FISHING IN THE GBR MARINE PARK

3.5.1 Forecast GVP and Value-added for GBR Fisheries

ABARE was commissioned by the Productivity Commission [2003] for its *'Industries, Land Use and Water Quality in the Great Barrier Reef Catchment*' Report to examine trends in GBR fisheries, and to forecast fishery values for 2010 and 2020.

Based on discussions with QFS and Queensland Seafood Industry Association [pers. comm. Gavin Dwyer, Productivity Commission], fisheries GVP was forecast to decline by 6% by 2010 and by 21% by 2020 period. With total GVP of GBR fisheries currently around $130.1 million per annum [see Table 3], GVP for GBR fisheries is therefore forecast to fall to $122.3 million by 2010 and $102.8 million by 2020.

Despite the forecast reduction in GVP, ABARE forecast value-added to increase by 19% by 2010 and 31% by 2020, and this positive forecast is largely a reflection of expectations for improved fisheries management. For GBR fisheries, therefore, value-added is forecast to increase, from $24.6 million (current estimate) to $29.3 million by 2010 and to $32.1 million by 2020.

3.5.2 Lump Sum Value of GBR Fisheries

In Table 4 the lump-sum equivalent[11] of current and forecast GVP and value-added for GBR fisheries are reported. The estimates in Table 4 are based on the above forecast values. For the period after 2020, which is the last forecast period, it is assumed that 2020 values are maintained. This is, therefore, possibly an overestimate of the GVP of the fisheries in the long term. If the forecast trend continued then fisheries values would continue to decline.

Table 4: Lump Sum Equivalent of Fisheries Values

	GVP $ Millions	Value-added $ Millions
Lump-sum equivalent, using 3% discount rate	3626	890
Lump-sum equivalent, using 6% discount rate	2398	560

3.6 CHARTER & GAME FISHING

[12] Some game boats target pelagic species including marlin, sailfish [generally tag and release fishing] and tuna; others target coral reef fish and Spanish mackerel; and inshore/fishing guide charters, target species such as barramundi.

The annual GVP of the charter and game fishers that operate in the GBRMP is approximately $50 million, based on estimates by Fenton [2002] and GBRMPA [2003a]. Based on the distribution of charter fishing effort estimated from logbook reports between 1997 and 2001, the revised Zoning Plan closes 13% of sites that charter fishers may currently access. If the Zoning Plan were to be implemented, charter fishers would be able to access the Conservation Park Zone, and the Buffer Zone, as well as the General Use and Habitat Protection Zones. [In comparison, the draft Zoning Plan released in June 2003, would have closed 18% of sites.]

3.6.1 Charter Fishing

Fishing activity in proposed no-take areas in the GBR Marine Park: 13% days fished

Expected degree of adaptability to Zoning Plan: High

Factors pointing to a high degree of adaptability include:

- offshore and coral reef components of the charter fishery are highly mobile and can use alternative areas if areas they now fish are zoned Green;
- a significant amount of income is derived from non-fishing passengers; for example, some boats may be chartered for dive trips;
- charter boats operating in areas adjoining protected areas will, over time, experience positive spillovers as abundance of target species[12] is expected to increase in these areas;
- recognition by the QFS that 'no-take' areas are necessary to encourage the ecological sustainability of the coral reef finfish fishery, indicates that in the longer term charter operations may experience positive spillovers from protected areas;
- most coastal and estuarine charters will not be affected by the zoning proposed in the Zoning Plan because rivers, creeks and intertidal foreshore areas are not in the Marine Park; and
- the management changes in the recreational coral reef finfish and Spanish mackerel fisheries introduced by the Queensland Government.

The components of the charter fishery that operate in the Marine Park, with the least potential to adjust their local operations, are inshore boats from coastal communities that target local fishing spots and some single-day reef fishing charters that can reach inshore reefs. In considering the recreational and charter fishing importance of these reefs, the GBRMPA avoided zoning these reefs as no-take areas wherever possible.

Most of the potential affect of the Zoning Plan is in the Offshore Gladstone/Mackay Area in the Capricorn Bunker Group of Reefs and Swains Reef complex, and some specific localities in the Whitsundays area and reefs off Cairns.

3.6.2 Game Fishing

Fishing activity in proposed no-take areas in the GBR Marine Park: Unknown

Value added component:	Unknown
Expected degree of adaptability to Zoning Plan:	High

Some important game fishing areas in the Cairns/Lizard Island area have been zoned as Buffer [Olive Green] zones, which specifically allows trolling for pelagic species, while excluding all other forms of fishing.

In relative terms, Queensland has by far the highest number of game boats [primary and part-time] in the western and central Pacific region. The Queensland game boat fishery is concentrated offshore Cairns/Lizard Island, Townsville and Brisbane. Recognised game fish include billfish [black marlin, blue marlin, and striped marlin, sailfish, spearfish, and broadbill swordfish], but the major species targeted is black marlin. There have been several studies undertaken on the value of the game boat fishery, but estimates of GVP vary considerably.

GBRMPA has used its knowledge of the game fishing industry's preferred sites, to minimise impacts on the fishery. However, there are insufficient data to allow the proportion of fishing effort affected by the Zoning Plan to be reported.

3.7 RECREATIONAL FISHING

3.7.1 Impact of the Zoning Plan

Overlay analysis was undertaken on recreational fishing, tourism and GBRMPA zoning datasets (GBRMPA internal report, November 2003). The aim was to produce statistics of recreational fishing use of the GBR for before and after the proposed rezoning.

The input data used for the overlay analysis included:

1) Sunfish tag data consisting of point data (36 640 point fishing locations) across the Queensland coast. Each point indicated a day of fishing activity that had been recorded by Sunfish members from 1985 to 2000. These Sunfish members can be considered experienced and/or regular recreational fishers, although it is not clear whether the data are representative of all recreational fishers;

2) boat ramp point data from Queensland Transport (QT) (265 boat ramp points) and Surf Life Saving Club (SLSC) Association (83 points). The GBRMPA data contain more remote boat ramps than are recorded by Queensland Transport. These data were buffered to a range of 5km to represent the estimated 94% of fishers who fish within 5km of the coast (See discussion following Table 7); and

3) the GBRMPA zoning datasets used were the current Zoning Plan and the Proposed Zoning Plan of 1 November 2003.

Sunfish recreational fishing data

In the current Zoning Plan, Marine National Park B, National Park, Preservation and Scientific Research zones are zones where all recreational fishing is prohibited. Unsurprisingly, there are only 20 points of data from 1995 to 2000 indicating that Sunfish members had fished within a no take recreational fishing zone. These 20 points (out of a total 36, 640) could be explained by the estimated 1km spatial error for these data.

In the proposed Zoning Plan, Marine National Park, Preservation and Scientific Research zones are also closed to recreational fishing. There are 485 fishing locations representing approximately one per cent of total fishing locations within these zones (See Table 5). However, these 485 locations can be considered as minimal when compared to the approximately 36 640 fishing locations that are still potentially available. From these data, it may be concluded that the proposed Zoning Plan will have minimal impact on recreational fishers.

Table 5: Available Sunfish recreational fishing locations in the Proposed Zoning Plan Zones

Zone No.	Zone	Fishing Locations	% Of all Fishing Locations	Available Recreational Fishing (Y/N)
0	Outside GBR	31766	87	Y
6	Scientific Research	1	0	N
7	Preservation	1	0	N
8	Island	70	0	N
9	General Use	1338	4	Y
10	Habitat Protection	1622	4	Y
12	Conservation Park	1358	4	Y
14	Marine National Park	485	1	N
16	Commonwealth Island	1	0	N

Boat ramps

The current Zoning Plan prohibits recreational fishing in Marine National Park B, National Park, Preservation and Scientific Research zones. Some 17 km^2 (or less than one per cent) of these zones are situated within 5 km of Queensland Transport boat ramps (See Table 6). This suggests a low impact (for example, 0.4%) of the current Zoning Plan to most recreational fishers who have departed from GBR boat ramps.

Table 6. Percentage area of all 5km Queensland Transport boat ramp buffer zones with the Current Zoning Plan Zones that are (Y) or are not (N) available to recreational fishers.

Recreational Fishing (Y/N)	Area km^2	Percentage
N	17	< 1
Y	4095	> 99
Grand Total	4112	100

In the proposed Zoning Plan, recreational fishing is prohibited in Marine National Park, Preservation and Scientific Research zones. Some 169 km^2 (or 4% of these zones) are situated within 5km of Queensland Transport boat ramps (See Table 7).

Table 7: Percentage area of all 5km Queensland Transport boat ramp buffer zones with the Proposed Zoning Plan Zones that are (Y) or are not (N) available to recreational fishers.

Recreational Fishing (Y/N)	Area km^2	Percentage
N	169	4
Y	3943	96
Grand Total	4112	100

Assuming the location of recreational fishing activity is linked to proximity to boat ramps, these data suggest that under the Zoning Plan Green Zones would be placed where less than 5% of recreational fishing activity occurs. One of the reasons for the low impact on recreational fishers is that the Zoning Plan mainly increases Green Zones in non-reef and reef areas considerable distances offshore from coastal communities.

While use of boat ramp data in this way is an imprecise means of estimating impacts on recreational fishing, it indicates likely low impact given that 80%[13] of recreational fishing vessels are under 5.1 metres in length, and therefore unlikely to travel great distances from shore. In support of this finding, the National Recreational Fishing Survey [2003] also showed that only 6% of recreational fishing effort in Queensland occurred more than 5 km from shore including fishing effort originating from communities adjacent to the Marine Park.

The above analysis demonstrates that in developing the revised Zoning Plan, the GBRMPA has tried to ensure that recreational fishing closures are minimised and that the Zoning Plan will have limited impact on the majority of recreational fishers.

The main recreational fishing areas affected by the Zoning Plan are inshore areas in the Rockhampton, Whitsunday, Townsville, Innisfail and Cairns regions, and reefal and shoal areas in the Capricornia Bunker reefs area off Gladstone, Townsville and Cairns.

[13] Department of Transport Vessel Register Database May 2003.

While overall there will be an increase in the area of the Marine Park effectively closed to recreational fishing, the Zoning Plan is expected to deliver net benefits for recreational fishers. This low impact on recreational fishing is a result of an attempt to minimise impacts on recreational fishers in developing the Zoning Plan while still achieving the biophysical operational principles. Potential benefits of marine sanctuaries for fisheries include:

- protection of important habitat, spawning areas, aggregation sites and nursery grounds;
- increased stock abundance and spawning biomass;
- increased mean age and size;
- improved reproductive potential;
- enhanced settlement and recruitment of juveniles;
- protection of genetic diversity;
- maintenance or enhancement of yields in adjacent fished areas;
- reduced variability and uncertainty in fisheries yields; and
- increased likelihood of sustainable exploitation.

It is also relevant to note that it was found that RAP objectives could be achieved by continuing to allow recreational fishing to occur outside Green Zones. Only limited line fishing is permitted in Conservation Park Zones [Yellow Zones]. Consequently, with less fishing effort in Yellow Zones, some recreational fishers may experience higher quality fishing experiences due to the possibility of increased abundance of target species.

3.8 ESTIMATION OF ECONOMIC VALUE OF RECREATIONAL FISHING IN THE GBR MARINE PARK

The economic value of recreational fishing, unlike commercial fishing, is not directly estimable since there is no requirement for recreational fishers to keep records of fishing catch and effort. The principal way of deriving an estimate of the economic value of recreational fishing is through use of survey techniques. The purpose in this section is to review the survey work that has been undertaken with respect to recreational fishing in the Great Barrier Reef catchment area, and also to review estimates of the total value of recreational fishing that have been derived on the basis of these surveys.

3.8.1 Expenditure Survey – Blamey and Hundloe [1993]

Blamey and Hundloe [1993] found that expenditure by recreational fishers averaged $3900 a year [$5000 in current prices], and more recent research conducted by Queensland Fisheries Service is consistent with this finding. This expenditure includes registration fees, ice, bait, fishing and boating equipment, safety equipment and travel and vehicle costs, accommodation associated with boating activities.

3.8.2 Number of Recreational Fishing Vessels

According to Queensland Department of Transport Vessel registration data, there are currently 56,602 vessels registered in the GBR catchment area. Based on Queensland Fisheries Service logbook data that indicates around 71% of the registered vessels in the GBR region are used solely for recreational fishing and boating [Innes and Gorman 2002], it is estimated that there are 40,187 vessels used for recreational fishing in the region.

3.8.3 Total Expenditure Related to Recreational Fishing in the Marine Park

Assuming the expenditures of owners of the 40,187 registered vessels undertaking recreational fishing in the GBR catchment area was consistent with Blamey and Hundloe [1993] survey findings [i.e. $5000 per annum], the total expenditure for 2002 on recreational fishing in the GBR catchment area is estimated at $201 million. [In comparison, the Productivity Commission found that recreational fishing in the GBR catchment and in the Marine Park generated a GVP of approximately $240 million (Productivity Commission 2003)].

However, a high proportion of boat-based fishing is reported to occur in estuaries, creeks and close in-shore areas. [As mentioned, information provided in a recent Sunfish survey indicates that access to reef and island areas offshore in the Marine Park require use of vessels over 5.1 metres in length, and 80% of vessels are less than 5.1 metres in length.]

Therefore, the actual amount of recreational fishing expenditure attributable to fishing in the Marine Park, for 2002, is likely to be lower than $201 million, although it is beyond the scope of this study to quantify the amount of fishing that occurs outside the Marine Park in estuaries, creeks, and inter-tidal areas.

3.8.4 Expenditure Survey – National Recreational and Indigenous Fishing Survey [2003]

An alternative estimate of recreational fishing expenditure is provided in the National Recreational and Indigenous Fishing Survey [Henry and Lyle, 2003] in which it is estimated there is a total of 198,327 recreational fishers in the GBR catchment and average recreational fishing expenditure in Queensland is $407 per annum. Based on these data the total estimated expenditure on recreational fishing in the GBR catchment is $80.7 million per annum.

This estimate is based on much more recent expenditure data than the 1993 Blamey and Hundloe study indicating that it may be a more accurate indicator, although further research would be required to determine which estimate is likely to be more robust.

3.8.5 Willingness to Pay for the Recreational Fishing Experience

Survey techniques are typically required to elicit information about the additional benefit fishers receive over and above their total expenditure, and such a study was undertaken by Blamey in 1991. Blamey estimated that the net economic benefits based on willingness to pay for recreational fishing in the Marine Park area, was in the range of $52 million to $124 million per annum, which in current dollars is equal to $69 million to $175 million.

3.8.6 Employment

KPMG [2000] has estimated that 1756 people are employed indirectly in various sectors as a result of recreational fishing and boating activities.

3.8.7 Regional Impacts on Recreational Fishing Within the GBR Catchment

Regional impacts, or economic flow-on impacts are unlikely to be substantial, for the following reasons:

- recreational fishers are likely to divert their fishing activity to other areas, if the areas they have traditionally fished become Green Zones; and
- recreational fishers mostly reside in the region, and will continue to spend their disposable income in the region.

In addition, fishing is a relatively minor contributor to economic activity in the GBR Region [see Table 19]. Hence, at a broad regional scale, a small proportional change in output is unlikely to have any significant economic or social effects [apart from those at the local government level].

3.8.8 Projections of Recreational Fishing Activity - 2020

The major factors influencing growth in the recreational fishing sector will be population growth and changes in the recreational fishing participation rate. The ABS has projected the Queensland population to grow at a rate of 0.8% a year over the period 2001 to 2010, and by 1.4% a year over the period 2010-2020.

Recreational fishing participation rates in Queensland appear to have been falling in recent years. It is estimated that, in 1996, 28.1% of the Queensland population fished recreationally. Subsequent estimates have the rate falling to 26.1% in 1998 and 24.6% in 2001 [DPI RFISH survey data]. As noted by the Productivity Commission [2003], the increasing range of other recreational opportunities available could be causing this change. Taking account of the declining participation rate and growing population, the Productivity Commission estimated that growth rates in recreational fishing participation, in the GBR catchment, for base, low and high cases, are as shown in the table below.

Table 8: Projections for Growth in Recreational Fishing Participation from 2001 to 2010 and 2020

2010			2020		
Base	Low	High	Base	Low	High
1.18%	-6.61%	11.84%	1.13%	-13.73%	22.35%

Source: Productivity Commission [2003].

These projections are used to estimate the change in number of recreational fishing vessels, and the change in economic value from recreational fishing over the period. To forecast total recreational fishing expenditure and aggregate willingness to pay, it is assumed that expenditure, and average willingness to pay, per fisher, remains constant throughout the forecast period.

Table 9: Projections for Recreational Fishing Vessels & Total Economic Value for Recreational Fishing, 2010 & 2020

	2001	2010			2020		
		Base	Low	High	Base	Low	High
Vessels	40,187	40,663	37,529	44,946	40,643	34,668	49,168
Expenditure [$ million]*	201	203	188	225	203	173	246
Expenditure [$ million]^	80.7	81.7	75.4	90.3	81.6	69.6	98.7
Willingness to pay [$ millions]	117	119	110	131	119	101	144

Based on Blamey and Hundloe [1993] expenditure data.

^ Based on National Recreational and Indigenous fishing survey [2003] data.

Source: Estimates based on recreational fishing value [see above] and Productivity Commission [2003] projections of recreational fishing participation levels.

3.8.9 Lump-sum values

The lump-sum equivalent of all forecast willingness to pay, and expenditure data are reported in the table below. For the period after 2020 it is assumed that the constant level of recreational fishing activity for the 2010-20 period is sustained. [Refer to Attachment 1 for methodology.]

Table 10: Lump-sum Equivalent of Future Recreational Fishing Values

Discount Rate	Gross Financial Value	Value-added for Recreational Fishing Expenditure [$ Millions]	Willingness to Pay [$ Millions]
3%	5264	1990	4586
6%	3205	1172	2792

Based on Blamey and Hundloe [1993] expenditure data.

Table 11: Lump-sum equivalent of future recreational fishing values*

Discount Rate	Gross Financial Value	Value-added for Recreational Fishing Expenditure [$ Millions]	Willingness to Pay [$ Millions]
3%	1661	665	4586
6%	1011	405	2792

*Based on expenditure data from National Recreational and Indigenous Fishing Survey, Henry and Lyle [2003].

SECTION 4: TOTAL ECONOMIC VALUE

4.1 INTRODUCTION

While it has a number of limitations[14] the estimation of the total economic value [TEV] of the Marine Park provides an important reference point in assessing the impact of proposed Marine Park management changes. Theoretically, TEV is an aggregate measure of all use and non-use values reported in monetary terms, but typically many of the components of TEV will need to be reported in their original units as it is often not feasible to attach monetary values to items that are not traded in commercial markets - if goods are not traded then the monetary values society places on them are not directly observable, and must be derived using non-market valuation techniques.[15]

4.2 COMPONENTS OF THE TOTAL ECONOMIC VALUE OF THE MARINE PARK

TEV is a valuation framework that incorporates market and non-market values of the natural environment to people and encompasses a range of use [direct and indirect] and non-use values attached to the Marine Park – some of which are more strongly influenced by the health of the Marine Park than others.

The table below lists more than 30 use and non-use values associated with the Marine Park. Use values include both commercial use values [tourism and fishing], non-commercial use values [scuba diving, boating, snorkelling, recreational fishing, etc], and ecosystem services such as research, maintenance of biodiversity, visual amenity value, shoreline protection and a range of important ecological processes such as maintenance of migratory species and habitat protection. Non-use values are the values people attach to the knowledge that Marine Park is being maintained in a healthy state.

[14] There are a number of limitations of the TEV in reflecting community values - see Haycock and Driml [2002] for an overview of these limitations - particularly with respect to identifying environmental values. The TEV approach is also limited in its capacity to take account of the importance of sustainability for maintaining use values.

[15] Non-market valuation techniques include a range of survey methods and related-market techniques. For a review of non-market valuation techniques see Pearce 1999,and the New South Wales Environmental Protection Agency's Guidelines for Preparing Economic Analyses.

Table 12: Total Economic Value of the Great Barrier Reef

<table>
<tr><th colspan="3">TOTAL ECONOMIC VALUE</th></tr>
<tr><td>Non-use Values</td><td colspan="2">EXAMPLES
• Existence;
• Bequest;
• Option;
• Quasi-option; and
• Religious &/or spiritual [indigenous & non-indigenous].</td></tr>
<tr><td rowspan="2">Use Values</td><td>Direct Use Values</td><td>Indirect Use Values</td></tr>
<tr><td>Examples
EXTRACTIVE USE:
– Commercial fishing;
– Mariculture;
– Genetic and medical resources;
– Biochemicals; and
– Raw materials.
NON-EXTRACTIVE USE:
– Indigenous cultural values;
– Non-indigenous cultural values;
– Tourism;
– Recreation [extractive & non-extractive];
– Aesthetic values;
– Scientific knowledge;
– Education;
– Historical information & places; and
– Research.
SERVICES:
– Shipping & other transport;
– Storage & assimilation of human refuse [e.g. sea dumping, nutrients]; and
– Artistic inspiration.</td><td>Examples
GOODS:
– Vicarious use.
SERVICES:
– Shoreline protection;
– Regulation of local energy balances;
– Sediment binding [from river run-off];
– Biomass production & fixation of solar energy;
– Storage & recycling of organic matter;
– Storage & recycling of nutrients;
– Maintenance of migration & nursery habitats;
– Maintenance of biological diversity;
– Regulation of local chemical composition of seawater & microclimate; and
– Global life support.</td></tr>
</table>

The components of non-use values in the above table include existence, bequest, option, quasi-option and religious and/or spiritual values. These non-use values can be defined as follows:

- **Existence value** is the value of knowing that a natural area is retained in its natural state, and this can include amenity enjoyed through books and photographs, spiritual values, cultural and heritage values, community values and vicarious use value, which is the satisfaction derived from knowing other people enjoy a natural amenity;

- **Bequest value** is the value the current generation obtains from preserving the environment for future generations;

- **Option value** is the value that individuals collectively place on retaining an environmental attraction in good condition for the purpose of providing them [or others] with the option of using the resource [e.g. visiting the GBR] some time in the future. Annual visitation of some 1.8 million visitors indicates the value attached to the future potential enjoyment of the reef is extremely high;

- **Quasi-option value** is the welfare obtained from the opportunity to get better information by delaying a decision that may result in irreversible environmental loss. This kind of value may be obtained when future technologies or knowledge enhance the value or understanding of a natural resource; and

- **Religious and/or spiritual values** derive from perceived benefits obtained by people who have a religious or spiritual connection to the Great Barrier Reef. These beliefs may be held by indigenous and/or non-indigenous people.

Cumulatively, the above direct environmental benefits are often referred to as environmental amenity values.

Indirect use values include many of the values associated with ecosystem services such as maintenance of habitats and waste assimilation. Most of these values will be non-market values. These ecological processes are not used directly, but they do support direct uses. Therefore, while ecosystem services may not have apparent economic value, the loss of these services may result in monetary losses felt by businesses dependent on their existence, and broader losses to the economy [Haycock and Driml 2002].

4.3 OTHER COMPONENTS OF THE TEV OF THE GBR MARINE PARK

4.3.1 Social and Cultural Values in the Great Barrier Reef Marine Park

To a large extent legislation can reflect community values, and legislation relevant to the GBRMP and GBRWHA which include reference to cultural heritage values include - Historic *Shipwrecks Act* [1976*], Great Barrier Reef Marine Park Act* [1975], *Cultural Record [Landscapes Queensland and Queensland Estate] Act* [1987], Queensland *Heritage Act* [1992], *United Nations Draft Declaration on the Rights of Indigenous People*.

4.3.2 Current State of Knowledge of Cultural Values in the GBRMP and WHA

Greer et al. [2000] have established that while some elements of social value in relation to indigenous interests have previously been identified by the GBRMPA, these are not wide-ranging and there is little or no clear knowledge of the non-indigenous values:

- **Aesthetic Value:** Currently limited to a single report on scenic resources, although a PhD on some aspects of aesthetics is currently being undertaken;

- **Historic Value:** Minimal research and identification of non-indigenous uses, places or values, other than the Register of Historic Shipwrecks [Queensland Museum];

- **Scientific Value:** A number of archaeological reports and theses are available on the archaeology of indigenous use in some areas of the GBR. There are also several reports on specific shipwrecks and historic sites on islands; and

- **Social Value:** Previous studies on the GBR have generally focussed on indigenous values, while little is known of equivalent qualities for non-indigenous groups. It has been recognised that social values are often expressed through *practices*, such as people using the reef and islands for recreational fishing, camping, or tourism. Previous studies of 'users' of the GBR have tended to see these as socio-economic phenomenon, without exploring or addressing the ways that these individuals, groups and communities relate socio-culturally to the reef. In some instances these uses, associations and relationships take on the aspect of 'traditional' practices, which are important in defining communities and relationships [Knowles' 1997 study of the Tasmanian World Heritage Area values is particularly relevant to this]. Although these practices and social values may also be linked to long-term historic associations, time-depth is not necessarily the underlying component; that is, 'tradition' is dynamic and changing.

The finding of Greer et al. [2000:82] is as follows:

> 'In summary, it would seem that the current state of knowledge of cultural heritage values within the GBRMP and WHA is extremely limited. This should be compared with the knowledge base for natural heritage values [see Appendix 4 in Lucas et al. 1997]. Undertaking an evaluation of cultural heritage values in the absence of further research would, to continue the comparison, be like assessing the current status and value of the dugong in the absence of hard data on its biology, habitat and ecology'.

The Representative Areas Program is likely to increase the level of protection for some sites and places by restricting access or impacts that might adversely affect the physical fabric or archaeological remains of cultural heritage places. Since so little is understood of the social values held by non-indigenous users, it is extremely difficult to determine potential effects on social and cultural heritage values as a result of the RAP limiting access or excluding certain uses. Nonetheless, it seems likely that maintenance of the system will be critical to the maintenance of social and cultural values through time.

4.3.3 Indigenous Cultural Values

Indigenous peoples live in all regional and remote communities and towns along the GBR Marine Park coast and on Torres Strait Islands. In total, there are more than 50 recognised Traditional Owner groups, including Eastern Torres Strait Islanders, who assert native title rights and interests within the Marine Park and a significant number of Indigenous people with historical associations to the region.

Traditional Owner group connections to the sea country extend as far offshore as the outer barrier reefs. Traditional groups once lived on the coastal plains out to the continental shelf, which is covered by sea and coral reefs today. Traditional stories, cultural heritage values, and obligations to sea country are captured within their clan estate boundaries.

Traditional Owner groups have a general objective of maintaining 'living maritime culture' through use, practices and custodianship of the marine resource, and, in reflection of this objective they have voiced some concern over the impacts of tourism, fishing and shipping on the marine resource.

There is also concern from a number of Traditional Owner groups and marine management agencies that the cultural values derived from traditional hunting of Green turtles and dugong could be at risk

unless culturally appropriate and scientifically valid management arrangements are introduced. The GBRMPA, in conjunction with Native Title Representative Bodies, Queensland Parks and Wildlife Service and Traditional Owner groups, is working to develop management arrangements which will provide for conservation of Green turtles and dugong, thus protecting the value derived by indigenous groups from hunting in the Marine Park. Implementing the RAP contributes to this initiative.

The Great Barrier Reef Marine Park encompasses the regions of five Native Title Representative Bodies, including: the Torres Strait Regional Authority, the Cape York Land Council, the North Queensland Land Council, the Central Queensland Land Council, and the Gurang Land Council.

Traditional Owners are concerned about their cultural and heritage values as being represented in Marine Park management as a mere record what they did in the past. Traditional owners are actively pursuing their rights and interests in a present and future sense through long-term cooperative management arrangements with marine management agencies.

4.3.4 Shipping

Commercial shipping in the GBR is significant. In any one year there may be up to 2000 shipping transits through the Great Barrier Reef [Wachenfeld 1998: p. 115]. It would be possible to estimate the value of the Marine Park to shipping by assessing the additional shipping cost that would be incurred if ships were not permitted to enter the Marine Park.

Significant volumes of exports pass through the ports of the GBR, and the value of exports from GBR ports is estimated at $14.5 billion [Source: OESR Regional Profiles (2001)] [See Table 13 below]. However, the value of shipping is not equivalent to the value of the exports. The value of shipping is in the reduction in transport costs relative to the next best option, or the increase in prices for producers compared to a scenario whereby they had to supply other markets [assuming this is what would happen were shipping to be closed off]. As the economic value of shipping is maintained by the Zoning Plan, no attempt is made to estimate the value of the Marine Park to shipping in this report.

Table 13: Major Commodities and Values, in Dollars and as a Percentage of the Total Queensland Export Market, by Port of Departure

Port	Value $ Million	Major Commodities	% of Qld Exports
Bundaberg	171.3	Sugar	1%
Gladstone	3,482.4	Coal, Coke and Non-ferrous metals	19.6%
Rockhampton	111.4	Agricultural Produce and Cattle	0.1%
Hay Point	3,737.7	Coal, Coke and Briquettes	21%
Mackay	221.0	Sugar and Mixed Agricultural Produce	1.2%
Abbot Point	386.4	Coal, Coke and Briquettes	2.2%
Bowen	0		0%
Townsville	2,683	Non-ferrous Metals, Metalliferous Ores, Agricultural Produce	14.8%
Lucinda	122.1	Sugar	2.2%
Innisfail	95.6	Sugar and Mixed Agricultural Produce	0.5%
Cairns	266.2	Sugar, Mixed Agricultural Produce Fish, Crustaceans, Molluscs and Aquatic Invertebrates	1.5%

Source: OESR Regional Profiles 2001

4.3.5 National Heritage Value

There are more than 1200 shipwrecks in the GBRWHA, many of which are considered historic. In addition, there are ruins, and operating lighthouses of cultural and historical significance on the islands.

4.4 MANAGEMENT COSTS

Policy development, management, monitoring and research costs incurred to maintain the TEV of the Marine Park, which equate to an estimated $79 million per annum [1999 figures][16], should be deducted from other components of the TEV in estimating the overall TEV for the Marine Park.

The policy development, management, monitoring and research effort for the GBR Marine Park [GBRMPA 1999, and 2002-03 GBRMPA budget], comprising:

- $30 million in GBRMPA budget for 2002-03;
- $30 million per annum in GBR-related expenditure by Commonwealth Agencies [for example, AIMS, AMSA, Coastwatch, AQIS, Dept of Defence];
- $5 million per annum for Reef CRC [non-GBRMPA contributions, both cash and in-kind in 1997/98 related to the GBR]; and

[16] *'Framework for Management'* [See http://www.gbrmpa.gov.au/corp_site/key_issues/conservation/reporting.html]

- $14 million for Queensland Agencies [E.g. GBR-related operating expenditure includes QPWS, QDoT, QBFP, QFMA, QWP, Universities].

4.5 SUMMARY OF DIRECT USE VALUES

Table 14 below includes a summary of all use values associated with the Marine Park, expressed in terms of both gross value and value-added. Direct employment for each of the primary use activities is also reported.

Table 14: Summary of Current Great Barrier Reef Marine Park Use Values [2002 unless stated]

	Gross Financial Value $ Millions	Value-added[a] $ Millions	Employment FTEs
Tourism[b]	589.4	235.6	6,440
Commercial fishing[c]	130.1	24.6	1,691
Charter & game fishing[c]	50	20	
Recreational fishing – expenditure[d]	201	80.4	1,756
Less: Management costs	79	NA	179
Total [annual]	891.5	360.75	10,066
Total [lump-sum equivalent, using 3% discount rate]	29,717	12,025	
Total [lump-sum equivalent using 6% discount rate]	14,858	6,012	

[a]Value-added is estimated to be around 40% of total revenue for the tourism industry [Productivity Commission 2003], and around 18.9% of GVP for the fishing industry [Productivity Commission 2003].
[b]OESR [2002] [resort expenditure data], GBRMPA EMC data [tourism numbers data], [Marine based tourism expenditure data], Productivity Commission [2003] [employment data].
[c]QFS, & GBRMPA [GVP data]; and Productivity Commission [2003] [employment data]
Fenton [2002] [charter fishing data] & GBRMPA.
[d]QLD Department of Transport Vessel Register Data, Blamey and Hundloe [1993] [recreational fishing expenditure data].

The gross financial value of all GBR marine-use industries is estimated at $891.5 million per annum and the aggregated contribution to the Australian economy is estimated at $360.75 million. In lump-sum terms [applying a discount rate of 3%] these values are equivalent to $29.7 billion and $12.0 billion respectively.

4.6 SUMMARY OF TOTAL ECONOMIC VALUE

In summary the TEV for the Marine Park encapsulates:

- $891.5 million in GVP for direct GBR-use industries, which is equivalent to $360.75 million in annual value-added. In lump-sum terms this is equivalent to $29.7 billion [GVP] and $12.0 billion [value-added];

- Economic flow on benefits for regional economies, estimated to be equivalent to $760 million per annum in GVP [for more information see Section 6.4].

- The range of cultural, social and indigenous values associated with the Marine Park; and

- The range of environmental values associated with the Marine Park, including existence and option values; and the plethora of values associated with provision of ecosystem services. Part of the existence and option value have been estimated at $98 million per annum by Hundloe et al. [1987] and the value of guarding against loss in biodiversity caused by crown-of-thorn starfish was estimated by Hundloe et al. at $33.9 million per annum.

4.7 ESTIMATES OF TOTAL ECONOMIC VALUE FOR OTHER REEF SYSTEMS AND MARINE PARKS

It is instructive to compare these findings with the TEV estimated for other reef systems throughout the world. Table 15 contains estimates of TEV from a range of relevant studies.

Table 15: Estimates of Total Economic Value of Other Reef Systems[17]

Location	Annual Value Per Hectare [$US]	Net Present Value Per Hectare [$US]	Total NPV [$US]	Author
Galapagos Islands*	120	2,400	2.8 billion	De Groot 1992
Montego Bay Jamaica*	23,820 – 61,200	0.4 million – 1.03 million	273 million - 702 million	Gustavson 1998
Indonesian Coral Reefs*	1,373 – 11,619	22,883 – 193,650	NA	Cesar 1996
All of the earth's coral reefs*	6076	101,267	NA	Costanza et al 1998
Florida Keys National Marine Sanctuary*	NA	50,000	44.6 billion	NOAA 1995
Hanauma Bay, Oahu	NA	NA	1.05 billion	Cesar et al 2002
Kihei Coast, Maui^	NA	NA	522 million	Cesar et al 2002
Kona Coast, Hawaii^	NA	NA	389 million	Cesar et al 2002
Hawaii – overall^	NA	NA	9.7 billion	Cesar et al 2002

As cited in Haycock and Driml [2002]
^Reported as a 'lower bound' estimate for the total economic value of reefs for the Main Hawaiian Islands.

Given the range of estimates presented in Table 15, it can be seen that the estimates provided in this study are likely to be conservative. This is partially because environmental values have not been estimated for this study. Although it should be noted that in the recent study by Cesar [2002] in relation to the TEV of Hawaiian reefs it was found that 85% of reef values, as estimated by economic valuation techniques, are related to tourism values. Without the benefit of comprehensive environmental valuation studies, it is not possible to determine if this relationship holds with respect to the Marine Park.

[17] The Great Barrier Reef has not been included in this table due to the difficulty in estimating its TEV, and the fact that too many values cannot be estimated accurately.

SECTION 5: OVERVIEW OF THE KEY DIFFERENCES IN THE EXISTING & PROPOSED ZONING PLANS

5.1 INTRODUCTION

This Section evaluates the difference in degrees of protection for the Marine Park offered under the current zoning arrangements compared with the proposed Zoning Plan. Other key differences between the existing and proposed Zoning Plans, such as improved consistency of the zoning system, are also evaluated in this Section.

5.2 INADEQUACIES IN EXISTING ZONING SYSTEM

5.2.1 Total Protected Area

Only 4.6% of the Marine Park is presently included in 'no-take' zones. Scientific advice states this is inadequate to protect the range of habitats to ensure resilience and conservation across the ecosystem. The current zoning does not adequately protect the range of biodiversity now known to exist across the Marine Park.

5.2.2 Area Protected in Reef and Non-reef Regions

A much higher level of protection is currently focused on coral reefs [around 22% of reef area is currently protected compared to an overall level of protection of 4.6%], and this focus occurred because coral reefs were relatively well understood, had a high profile and were perceived to be particularly fragile or under threat.

More information is now available regarding important habitats, connectivity, and functionally important species in the non-reef bioregions. Science acknowledges that there is much that could be of crucial importance to the system as a whole, although we may have little information to date. All habitats within the Marine Park have intrinsic ecological value and are interlinked with coral reef habitats. Seagrass beds, algal and sponge gardens, sandy and muddy seabed communities, oceanic trenches and other environments make up 94% of the total area of the Marine Park are intrinsically linked to the overall health of the Great Barrier Reef, yet only about 3% of these habitats are afforded higher level protection in Green Zones.

5.2.3 Size and Number of Existing Protected Areas

Only one marine sanctuary in the Marine Park meets the biophysical operational principle recommending a minimum size of 20 kilometres in any dimension and only four are greater than 400km^2 overall. Of the 135 existing Green Zones in the Marine Park, all but one are relatively small, being less than 20 x 20 kilometres. Only 11 of these Green Zones are more than 10 kilometres x 10 kilometres in size. The level of replication of protection for habitats that are similar is also low, with 43% of habitat areas [bioregions] having less than three replicate examples of that habitat included in Green Zones.

5.2.4 Improved Protection of Bioregions Needed

Seventy habitat types [or bioregions] across the Marine Park have been identified by the GBRMPA in conjunction with experts. An analysis of the existing zoning shows that 12 bioregions currently have zero 'no-take' zones, and 26 that have only 1-5% of their area in 'no-take' zones. Table 16 shows that only 14 of the 70 bioregions have at least 25% of their area in Green Zones.

Table 16: Number of Bioregions That Have the Indicated Percentage of Green Zones

	Zero Green Zones	<1-5% of Bioregion in a Green Zone	5-25% of Bioregion in a Green Zone	>25% of Bioregion in a Green Zone
Reef bioregions	1	8	11	10
Non-reef bioregions	11	18	7	4
Total bioregions	12	26	18	14

Source: Great Barrier Reef Marine Park Authority.

From Table 17 below it can be seen that 30 bioregions have less than 3 replicate Green Zones, which provides considerably less insurance against unforeseen natural disturbances and human impacts than recommended in the biophysical operational principles.

Table 17: Number of Existing Green Zones Per Bioregion

Number Green Zones/ Bioregion	Number of Bioregions
0	13
1	5
2	12
3	8
4	6
5	6
>5	22

Source: Great Barrier Reef Marine Park Authority.

These data clearly indicate that the existing network of highly protected Green Zones within the Marine Park is likely to be insufficient to protect biodiversity of the GBR ecosystem.

5.2.5 Compliance Difficulties

Compliance with existing GBR zoning regulations has occasionally been difficult to enforce because some zone boundaries are difficult to identify on the water. This creates enforcement difficulties, especially in areas away from shoreline. Where practicable, coastal features have been used in inshore areas to locate zone boundaries in the Zoning Plan. In addition, coordinate-based mapping has been adopted to facilitate navigation and enforcement in the new zones.

5.2.6 Inconsistencies

Use and entry provisions for equivalent zones in different sections of the Marine Park are inconsistent, at present, leading to confusion on the part of the users, and compliance and enforcement problems.

5.2.7 Incompleteness

Between 2 August 2000 and 4 July 2001, 28 coastal areas, totalling 4830km^2, were added to the Marine Park, and the inshore habitats included in these areas are crucial parts of the GBR ecosystem as a whole. The new inshore areas also include places that are very important to coastal communities for recreational fishing and boating and for traditional use of marine resources. Currently they are not zoned and GBRMPA is required, by law, to apply zoning to these areas as soon as is practicable.

5.3 LINK BETWEEN RAP OBJECTIVES AND ENVIRONMENTAL BENEFITS

The environmental benefits of the Zoning Plan should be linked to the objectives of the RAP, as:

- the SSC consider that the biophysical operational principles used to develop the Zoning Plan, provide for a minimum level of protection required to meet the RAP objectives; and

- as demonstrated above, there is a much smaller degree of protection for the Marine Park, afforded under the existing Zoning arrangements compared with the proposed Zoning Plan.

Furthermore, more detail about the environmental benefits can be gleaned from further review of the environmental attributes of the Marine Park [as outlined in Section 1] as these attributes effectively represent what is being enhanced and safeguarded by meeting the RAP objectives.

5.4 PROVISION OF A SINGLE CONSISTENT ZONING PLAN

The Zoning Plan builds on the framework established by previous zoning plans for the Far Northern, Cairns, Central, Mackay/Capricorn and Gumoo Woojabuddee Sections to provide a single, consistent zoning plan for the entire Marine Park. The Zoning Plan also provides zoning for the 28 new coastal areas that have been included in the Marine Park since the year 2000. Both of these reforms promote improved management of use activities and therefore improved environmental outcomes for the Marine Park.

5.5 ZONE CATEGORIES

The Zoning Plan provides for the division of the Marine Park into zones and makes provision for the purposes for which each zone may be used or entered. The zones are:

- General Use Zone;

- Habitat Protection Zone;

- Conservation Park Zone;

- Buffer Zone;

- Scientific Research Zone;
- Marine National Park Zone;
- Preservation Zone; and
- Commonwealth Islands Zone.

All these zones exist in the Marine Park at present. The General Use Zone provides for the widest range of activities, while the Preservation Zone is the most restricted. The Commonwealth Islands Zone provides for the use or entry of areas of the Marine Park [above mean low water] that are Commonwealth Islands, or parts of Commonwealth Islands. [The Marine Park does not include areas that form a part of Queensland.]

The Zoning Plan also provides for the management of remote natural areas of the Marine Park, and the designation of shipping and special management areas, as well as additional purposes for which zones may be used or entered.

Table 18 shows the amount of area proposed in each zoning category under the Zoning Plan. The 'General Use' Zones, Habitat Protection Zone and Marine National Park Zones are the three most significant in terms of area, collectively making up over 95% of the Marine Park.

Table 18: Estimated area statement for the Zoning Plan*

Standard Zone Name	Area km^2	Percentage
General use	116530	33.8
Habitat protection	97250	28.2
Conservation park	5160	1.5
Buffer	9880	2.9
Marine National Park	114530	33.2
Scientific research	155	0.04
Preservation	710	0.2
Commonwealth Islands	180	0.05
Total*		100

*There is a 1% error associated with the area estimates; rounding error accounts for any difference between sum of zone categories and total.

SECTION 6: ECONOMIC BENEFITS FOR REGIONAL ECONOMIES

6.1 INTRODUCTION

The purpose of this section is to assess the importance of the GBR Marine Park to regional economies. This section includes an overview of the demographic statistics for each of the local government areas [LGAs] in the Marine Park catchment, and this information is used to help evaluate the capacity of people located in the GBR to adapt to change following implementation of the RAP. The demographic information is also important for demonstrating the likely resilience of communities to any substantial decline in GBR industries that could arise following a collapse in reef health and/or a collapse in the health of bioregions in the broader Marine Park.

6.2 ECONOMIC IMPORTANCE OF INDUSTRIES IN THE GBR CATCHMENT

Table 19 on the following page shows the GVP for all of the main industries in the Great Barrier Reef[GBR] catchment for 2001, and projections of growth for each of the industries over the period 2001-2020.[18] From the table it can be seen that tourism is the third most important industry in the GBR catchment area with a GVP for 2001 of $4,228 million, which is only surpassed by mining with an annual GVP of $6,910 million, and minerals processing which has an annual GVP of $4,287 million.

Tourism data in Table 19 relate to commercial tourism for the catchment area, which includes land-based tourism occurring in the Marine Park catchment.

In Table 19 the relative importance of the main industries in the five statistical divisions within the GBR catchment is reported [these percentages do not relate to total economic activity]. Tourism is easily the most significant industry in the Far North region, representing almost 65% of the combined GVP of mining, agriculture, fishing and tourism. Fishing has less than 5% of the combined GVP [and less than 2.5% of GVP in each of the other regions]. In the Northern Region, mining is the principal economic activity, although tourism is also highly significant with 17% of GVP. Mining is also the dominant industry in the Fitzroy Region with over 80% of the combined GVP. Tourism and Mining have similar GVP in the Wide-Bay Burnett Region, with both industries having over 40% of the combined GVP.

These industry shares indicate that any collapse in the tourism sector would have far reaching effects in most of the statistical regions, but particularly in the Far North and Wide-Bay Burnett Regions. While the fishing sector is less important there are a number of coastal areas where its relative contribution is higher than indicated in the Table below.

[18] These projections were undertaken by ABARE for inclusion in the Productivity Commission [2003] research report into 'Industries, Land Use and Water Quality in the Great Barrier Reef Catchment'.

Table 19: Relative Importance [GVP] of Industries to the Economy of the Great Barrier Reef Catchment Area, 2001.

	Far North Region			Northern Region			Mackay Region			Fitzroy Region			Wide-Bay Region Burnett			GBR Catchment Total		
	2001 $ m	2020 $ m	Growth %	2001 $ m	2020 $ m	Growth %	2001 $ m	2020 $ m	Growth %	2001 $ m	2020 $ m	Growth %	2001 $ m	2020 $ m	Growth %	2001 $m	2020 $m	Growth %
Primary production																		
Sugar cane	183	254	39	177	276	56	150	241	61	0	0	0	107	113	5	617	884	43
Beef	138	174	25	131	164	25	154	193	25	544	683	25	285	358	25	1252	1572	26
Horticulture	291	406	40	224	304	36	19	25	34	35	47	35	224	296	32	793	1078	36
Commercial fishing	48	37	-23	19	16	-16	23	17	-23	28	23	-18	0	0	-24	118	93	-21
Aquaculture	17	94	472	12	65	448	6	36	500	0.2	2	1000	6	27	335	41	224	444
Mining	271	266	-2	755	741	-2	2871	2816	-2	2840	2785	-2	173	170	-2	6910	6778	-2
Processing																		
Mineral processing	33	43	30	1468	1936	32	22	29	32	2752	3791	38	12	15	25	4287	5814	36
Other																		
Recreational fishing	72	73	1	54	55	1	36	36	1	21	22	1	3	3	1	186	189	2
Tourism	1937	3490	80	579	724	25	658	868	32	475	568	20	579	718	24	4228	6368	51

Source: Productivity Commission [2003, p.330].

6.3 DEMOGRAPHIC STATISTICS FOR THE GREAT BARRIER REEF COASTAL COMMUNITY REGION

6.3.1 Population

The population of the GBR coastal communities, as at 30 June 2001, was estimated to be just fewer than 730,000 people which is around 20% of the total Queensland population The average annual increase in population for the GBR coastal communities for the period 1996 to 2001 was 1.3% which is slightly lower than the average rate of population growth for the State of Queensland of 1.7%. Population projections by the Queensland Department of Local Government and Planning indicate that population growth rates will average 1.5% over the next 20 years, and therefore the population of the GBR coastal communities is forecast to be 834,675 by 2010, and 968,674 by 2020. The most heavily populated areas of coast adjacent to the GBR are the major Queensland regional centres of the twin cities of Townsville-Thuringowa, Cairns, Mackay, Rockhampton and Gladstone. Taking into account land area, the most sparsely populated areas along the GBR coast are the Cook, Mareeba, Bowen, Broadsound and Livingstone Shires.

6.3.2 Indigenous Population

The total indigenous population residing in the GBR coastal communities, as at 30 June 2001, was estimated to be some 36,821 people, or 5% of the total population. The majority of the indigenous population lives in the Cook Shire [2549], Hinchinbrook Shire [2493], Mackay [2813], Townsville-Thuringowa [7404], Rockhampton [2868] and Cairns City [11062].

6.3.3 Demographic Statistics for Local Government Areas

An indication of the capacity of regional areas to withstand any opportunity costs following introduction of the RAP can be partly derived from demographic statistics. The table below shows the total population, indigenous population, ABS index of relative socio-economic disadvantage, and unemployment rate for each of the LGAs in the GBR catchment. From the table below it can be seen that all LGA regions within the GBR have a lower level of socio-economic wellbeing than the average [1000] except for Cairns, Douglas and Whitsunday.

Table 20: Demographic Statistics for GBR Catchment Local Government Areas, 2001*

Local Government Area	Total Population 2001	Indigenous Population	Mean Income 1999-00 [$]	ABS Index of Relative Disadvantage 1998	Unemployment 2001 [%]
Atherton	10,621	547	**29,790**	979	8.1
Bowen	13,698	748	**30,014**	**905**	7.3
Broadsound	6,601	131	51,474	999	2.8
Bundaberg	43,549	1,406	**28,515**	**932**	**12.6**
Burdekin	18,486	805	30,487	982	5.3
Burnett	23,598	324	**28,515**	**943**	**11.4**
Cairns	133,199	11,062	31,947	1012	7.8
Calliope	15,091	355	35,887	1005	7.7
Cardwell	11,443	716	**28,534**	967	4.6
Cook	9,700	2,851	35,522	**855**	6.5
Douglas	17,887	976	**28,756**	1012	4.7
Eacham	6,250	216	**28,840**	980	**9.9**
Fitzroy	9,553	328	32,228	975	7.0
Gladstone	26,835	952	36,022	976	**9.5**
Hinchinbrook	14,611	2,562	**29,956**	**933**	6.2
Johnstone	19,954	1,644	**29,570**	959	7.7
Livingstone	27,017	766	32,437	979	8.6
Mackay	75,020	2,813	33,741	980	8.5
Mareeba	18,096	2,099	29,284	954	8.9
Mirani	5,220	125	32,346	978	6.1
Miriam Vale	4,914	98	**27,541**	878	15.6
Rockhampton	58,382	3,006	32,336	966	**9.3**
Sarina	9,637	379	33,932	**942**	**9.4**
Thuringowa	51,140	2,851	32,859	996	8.0
Townsville	94,739	4,556	34,355	998	8.8
Whitsunday	20,990	251	**27,882**	1014	6.6

Source: ABS 2001 census data, Productivity Commission [2003].

* The numbers in bold are discussed in the text at 6.6

In the 2001 census the unemployment rate for Queensland census was 8.2%, and, in comparison, the unemployment rates for Bundaberg, Burnett, Gladstone, Eacham, Mareeba, Miriam Vale, Rockhampton, Sarina, and Townsville were all more than 0.5% higher than the state average. Conversely, the unemployment rates for Broadsound, Burdekin, Cardwell, Cook, Douglas, Fitzroy, Hinchinbrook, Mirani and Whitsunday were all more than 0.5% less than the Queensland State average.

6.3.4 Economic Impact on Regional Communities

The total economic impact on regional economies from GBR industries [i.e. tourism, fishing and non-extractive recreation] include not only the direct impact of sectors that use the Marine Park, but also the economic flow-on effects, or 'indirect' economic effects realised by other sectors. These indirect effects include benefits received by businesses that supply goods and services to operators in those sectors using the Marine Park, as well as businesses which process the outputs produced by direct users of the Marine Park [eg fish processors].

While changes in economic flow-ons are potentially very important for regional communities, any change in economic flow-ons does not represent an equivalent benefit or cost for the broader Australian economy. This is largely because an economic-flow on for regional economies is a gross effect, and does not take account of the returns that capital and labour could receive if utilised in other regions or sectors.

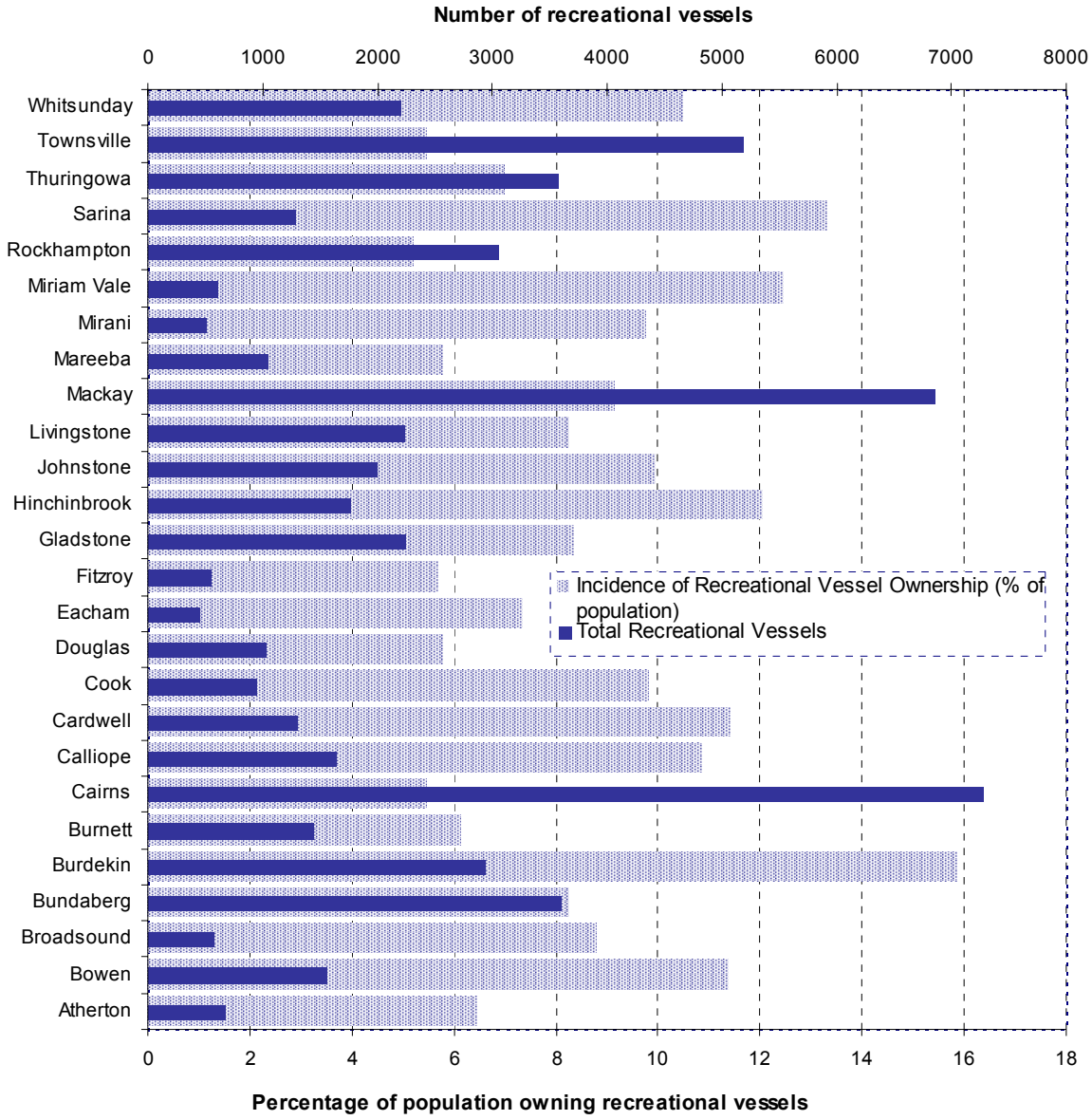
It is therefore important that economic flow-ons are not evaluated in the same light as direct impacts. That is, economic flow-on effects, or multipliers, should not be added to the direct effects. Instead, they should be reported as 'regional economic impacts'. It is recognised, however, that economic flow-on effects can be an important consideration in evaluating policies impacting regional areas if the Government has regional development objectives or if an area is identified as being in need of some level of assistance to offset its low socio-economic ranking [i.e. high unemployment, low levels of education/skills and the like].

For each of the main GBR industries the regional economic impact is estimated in Section 6.4 below.

6.3.5 Importance of Recreation Fishing to Local Economies

Information about the importance of recreational fishing to regional communities and economies is not incorporated in Table 19. But the location of registered vessels is a good indicator of the importance of recreational fishing to regional economies. From Figure 3 below, it can be seen that there is a broad spread of vessel ownership across the 26 Local Government Areas, with Townsville, Thuringowa, Mackay, Cairns, and Bundaberg being the areas with the highest level of boat ownership each having more than 3500 registered vessels. The percentage of the population owning boats varies from 5% to around 16%, and the localities where the incidence of boat ownership is greater than 10% includes Whitsunday, Sarina, Miriam Vale, Hinchinbrook, Cardwell, Calliope, Burdekin and Bowen.

Figure 3: Number of Recreational Vessels in Local Government Areas within the GBR Catchment



Source: QLD Department of Transport, ABS 2001 Census data.

6.4 ECONOMIC FLOW-ON EFFECTS

Using input-output tables it is possible to model economic flow-on effects, and the estimates of economic flow on effects are typically reported as 'multipliers'. A multiplier of, say, 2, indicates that for every dollar of direct economic impact, there is an additional dollar in output generated for other businesses in the regional economy. Various studies have estimated multipliers for the main GBR industries, including an estimated output multiplier of:

- 1.9 for the tourism industry [KPMG 2000];
- 1.6 for the commercial fishing industry [KPMG 2000];

- 1.57 for the marine tourism industry [AEC 1998]; and
- 2.1 for the recreational boating and fishing sector [KPMG 2000].

In addition to the Great Barrier Reef Industries, there is significant economic stimulus to the Townsville region due to the presence of the Australian Institute of Marine Science, GBRMPA, and CRC reef, which are all located in Townsville as a direct consequence of the Marine Park. Research budgets for these organisations [except GBRMPA] total some $25 million per year. In addition the GBRMPA budget is around $30 million per annum. The economic flow-on effects for all of these research/management organisations has been estimated assuming a multiplier of 1.5 [This conservative assumption has been made as no research has been conducted in relation to the economic multiplier for GBR research/management].

On the basis of these estimated multiplier effects, the total economic flow on effect from GBR industries, and research/management organisations located in the GBR catchment area, is estimated to be some $760 million per annum.

Table 21: Economic flow-on effects from GBR industries

GBR Industry	Direct GVP $ Million[a]	Multiplier	Indirect GVP $ Million
Commercial fishing	130.1	1.6	78.06
Charter & Game fishing	50	1.57	28.5
Tourism	589.4	1.57	336.0
Recreational fishing	201	2.1	221.1
GBR research[b]	25	1.5	12.5
GBR management[b]	30	1.5	15
Fish processing[c]	na	na	68.6
Total			759.7

a) see Table 14 for details of direct-use GVP.
b) Only management and research in the GBR catchment area included in these estimates, excludes GBR-related management and research occurring in other regions.
c) Estimates for GBR fish processing GVP are derived in Section 3.3.11.

6.4.1 Use of multipliers for estimating economic flow-on effects

Use of multipliers is generally considered to provide an upper bound estimate of economic flow-on effects as they do not take account of the capacity for capital and labour to be diverted into other industries following any contraction of the businesses in which they are currently employed. Multipliers have an additional weakness in that other important economic linkages are not taken into account.[19] [20]

[19] An example of an important economic linkage that is not reflected in multipliers is the impact of lowering prices for inputs to production after a contraction in a given industry, which may provide a positive stimulus for other industries.
[20] A modelling technique known as 'general equilibrium modelling' is typically preferred by economists as it takes account of the alternative uses of capital and labour and other key economic linkages.

6.5 DEPENDENCE OF REGIONS ON GBR INDUSTRIES

Even though data for fisheries GVP and tourism GVP at the LGA are available it is not possible to provide estimates of the proportion of total economic activity that can be attributed to these industries in GBR communities. This is because there are no data available on the total value of all goods and services produced in each LGA.

6.6 DEMOGRAPHIC OVERVIEW

Average income, the unemployment rate and the ABS index of relative social disadvantage, for each of the selected LGAs in the GBR-catchment, are reported in Table 20 above. The numbers in bold are discussed here.

The mean income in Queensland for the 1999-00 financial year was $33,196, and from the Table 20 it can be seen that income was lower than the State average in all except four of the above LGAs. Mean income in nine LGAs was less than $30,000 for 1999-00.

At the time of the 2001 ABS Census, unemployment rates in eight of the selected LGAs were higher than the rate for Queensland, which was 8.2%. The unemployment rates in Bundaberg, Burnett, Eacham, Gladstone, Miriam Vale, Rockhampton and Sarina all exceeded 9%.

An indication of the capacity of regional areas to withstand any adverse change following introduction of the RAP can also be gleaned from the ABS index of relative disadvantage, which is an index that encompasses a range of measure including mean income, education levels, and the unemployment rate for a region. Table 20 also shows that all LGA regions within the GBR have a lower level of socio-economic wellbeing than the average for Australia [1000] except for Cairns, Calliope, Douglas and Whitsunday. The LGAs with the lowest index of relative disadvantage ratings [i.e. < 950] include Bowen, Bundaberg, Burnett, Cook, Hinchinbrook, and Sarina.

6.7 IMPACT OF THE ZONING PLAN ON REGIONAL ECONOMIES

If implemented, the Zoning Plan will have a range of impacts on regional economies. Most opportunity costs for regional economies relate to potential reductions in economic flow-on benefits from fisheries that may contract as a result of the Zoning Plan. However, there are expected to be positive impacts flowing from the Zoning Plan for some commercial fisheries [through safeguarding fish stocks and habitats and stock enhancement effects], recreational fisheries, charter fishing and for tourism that, in turn, will deliver positive economic flow-on benefits for regional economies. Naturally, it is important that all impacts of the Zoning Plan, both positive and negative, are assessed in determining the overall impact of the Zoning Plan on regional economies. Research currently being undertaken by the Bureau of Rural Sciences and Bureau of Tourism Research will contribute to describing regional impacts of the rezoning of the Marine Park.

6.8 FLOW-ON BENEFITS ARISING FROM ENHANCEMENT OR PROTECTION OF GBR-TOURISM

It is anticipated that the Zoning Plan would provide a positive stimulus for the tourism industry. Furthermore, tourism values would be more secure as the Zoning Plan would help protect the environmental amenity tourists are visiting. Consequently, economic flow-on benefits for regional communities related to the tourism industry would be enhanced by the Zoning Plan.

Some of the areas expected to experience a reduction in economic flow-on benefits as a result of any contraction in the fishing industry following implementation of the Zoning Plan, are also likely to experience offsetting gains as a result of the positive stimulus the Zoning Plan is likely to have for the tourism industry.

6.9 RISK MANAGEMENT – BENEFITS FOR REGIONAL ECONOMIES

The risk-management benefits of the RAP have important implications for regional economies. By providing insurance for the reef against potential damage, economic flow-on benefits for communities in the GBR catchment are protected. This section has shown that the dependence of regional economies on GBR use industries is very high, with economic flow-on benefits for regional economies from GBR-use industries estimated at some $760 million per annum in output [in addition to direct annual GVP for GBR use industries of an estimated $891.5 million]. Conversely, the potential cost to communities in the GBR catchment could be extremely high in the event that the RAP is not implemented and GBR-use values, and therefore economic flow-on benefits for regional economies, decline severely following damage to the reef and broader Marine Park.

SECTION 7: RISK MANAGEMENT ASSESSMENT

Given the immense value of the reef and the potential irreversibility of some kinds of damage, appropriate risk management is arguably the highest priority for management of the Marine Park. Australia is signatory to the World Heritage Convention [1972] for protection of the GBR World Heritage Area and to the Convention on Biological Diversity [1992], and a range of other national and international strategies relating to protection of biodiversity; this also adds weight to the need for effective risk management.

Furthermore, a risk management role is conferred upon the GBRMPA under its enabling legislation that specifies that in preparing a zoning plan regard shall be given to the following [s 32[7]]:

- The conservation of the Great Barrier Reef;
- The regulation of the use of the Marine Park so as to protect the Great Barrier Reef while allowing the reasonable use of the Great Barrier Reef Region;
- The regulation of activities that exploit the resources of the Great Barrier Reef Region so as to minimize the effect of those activities on the Great Barrier Reef;
- The reservation of some areas of the Great Barrier Reef for its appreciation and enjoyment by the public; and
- The preservation of some areas of the Great Barrier Reef in its natural state undisturbed by man except for the purposes of scientific research.

One of the objectives of the RAP is to 'provide an ecological safety margin against human induced disasters' – i.e. the RAP incorporates risk management objectives. The purpose of this section is to firstly provide an overview of how the RAP, and therefore the Zoning Plan, works to provide risk management benefits by increasing the resilience of the GBR. Secondly, the economic significance of increasing resilience of the GBR is demonstrated using an illustrative example of the recovery in tourism values following a serious coral bleaching event under both 'with Zoning Plan' and 'without Zoning Plan' scenarios.

The key features of the RAP that enhance resilience of reef and non-reef bioregions include:

- By having at least 20% of each bioregion in protected areas under the RAP, the chances of loss in biodiversity following damage to a proportion of any given bioregion are much lower;
- Following damage to a reef or non-reef bioregion, the chance that there will be a loss of connectivity of species between regions will be much lower; and
- By reducing the incidence of over-exploitation of particular species or of animals within a functional group[21] and by reducing habitat damage, the RAP provides for reduced impact on biodiversity following damage caused by any of the identified risk factors, and improved resilience of the ecosystem.

[21] A functional group is group of plants or animals that play a specific role in the ecosystem.

It is difficult to include risk management benefits when assessing proposed government policy using a standard cost-benefit analysis framework, as it would involve identifying probability weightings for the pessimistic outcomes and there is insufficient information to do this in relation to the Marine Park. Incorporating risk management in a cost-benefit analysis would also involve estimating parameters describing the community's overall level of aversion to risks relating to potential damage to the Marine Park.[22]

To overcome these problems in estimating risk-management benefits of the RAP, the value of risk management is illustrated by using an indicative case study example of the change in tourism benefits following a major coral bleaching event for both the 'with Zoning Plan' and 'without Zoning Plan' cases. While this represents a highly illustrative example it is an effective way of demonstrating that the RAP could provide very significant benefits by limiting the extent and duration of damage to GBR ecosystems.

7.1 IMPROVING RESILIENCE OF THE GBR

It is inevitable that the Marine Park ecosystem as a whole will be subject to increased pressure over time as a result of:

- Easier access to more areas of the Marine Park;
- Increasing numbers of potential park users due to growth in population and visitation numbers;
- Climate change including coral bleaching;
- Increasing number of kinds of uses;
- Improved technology, including fishing technology which will amplify fishing impacts;
- Increasing competition for use, including extractive and non-extractive use, of the Marine Park;
- Increased pollution from an expansion of onshore activities and shipping; and
- Increased traffic through the Marine Park.

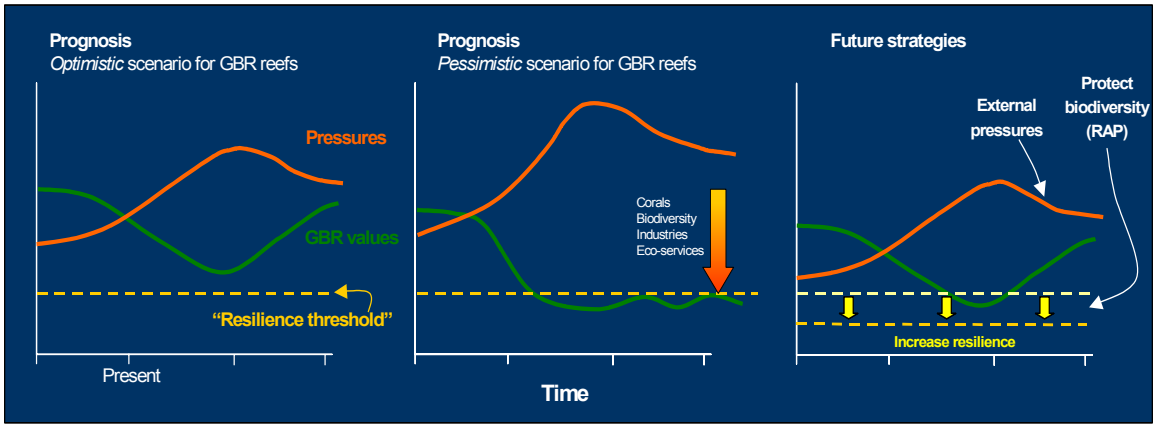
Consequently, there is a range of threats to the health of the Marine Park, the cumulative effect of which could potentially be devastating for biodiversity and GBR ecosystems over time, without sufficient protection mechanisms. Recent work indicates not only that the threats exist but they have already manifested in a 30% degradation of the Great Barrier Reef ecosystem [Pandolfi et al. 2003]. For example, in 1995, the Queensland State Government began developing Management Plans for each of its fisheries. There are now Management Plans in place for three of the 17 fisheries in the GBRMP. All other Queensland fisheries are managed by Regulation. There are limits on levels of take [i.e. output controls] in five fisheries [mainly the dive-based 'harvest' fisheries]. Management of fisheries has, historically, been undertaken on the basis of 'maximum sustainable yield'. This has proven to be an

[22] If people are 'risk neutral' as opposed to 'risk averse' then only expected costs and expected benefits are relevant in cost benefit analyses, reflecting the zero value attached to risk management. However the reason people are prepared to pay for insurance and adopt risk management strategies is because they are risk averse. i.e. People generally place a high value on avoidance of pessimistic outcomes and do not just consider expected values in their decision-making processes. It is reasonable to assume that the Australian community would, collectively, be highly risk averse about potential damage to the GBRMP, because of its uniqueness, its high value, and the irreversibility of any damage to the reef and non-reef bioregions.

inappropriate approach, as it does not adequately account for the ecosystem effects of fishing pressure. As a result, critical relationships between target species, other key species, and the reef in general, have not been addressed adequately in fisheries management strategies or practice to date. The management of each species has generally ignored the fact that they are part of an integrated ecosystem. This is indefensible ecologically.

The RAP aims to offer some of the protection required to counter the range of threats. The threats to the GBR system and the importance of maintaining its resilience make the maintenance of food webs and ecosystems extremely important. Protecting a comprehensive and representative network of areas of the Marine Park free from the impacts of extractive activities is required if the GBR ecosystem is to remain intact. It will be less vulnerable to other natural and human disturbances such as over-exploitation of resources, reduction in water quality, storm effects, disease and mortality from coral bleaching due to global climate change [See Figure 4].

Figure 4: Impact of the RAP on Resilience of the Marine Park



Copyright: Research and Monitoring, GBRMPA

The above figure illustrates the relationship between GBR values and pressures on the Marine Park. Under the optimistic scenario [Panel 1], pressures outside GBRMPA control [e.g. climate change, population pressures] continue to increase but then stabilise. The increased pressures have a significant impact on GBR values, but the relatively moderate the level of increase in pressure allows the system to stay above the 'resilience threshold'.

This threshold indicates the point at which the system loses its ability to readily recover, or 'bounce back', from the effects of disturbances or pressures. If the resilience threshold is crossed due to a greater and unsustainable increase in pressures, as depicted under the pessimistic scenario [Panel 2], serious and protracted impacts can result. Under this scenario, the system has been pushed beyond its resilience, severely compromising recovery potential and depressing key attributes of the system [such as coral diversity and abundance, biodiversity, economic health of dependent industries and ecosystem services] for an extended period.

The GBRMPA actively works on two fronts to avoid irreversible losses to GBR values [Panel 3]. The first is to raise awareness about the impacts of unsustainable increases in pressures and advocate for their reduction. The second is to support the natural resilience of the reef ecosystem through active management initiatives, including the proposed RAP, to protect biodiversity, including key functional species, maintain intact food webs and preserve connectivity among habitats. Supporting the resilience of the ecosystem will serve as a critical insurance policy against unpredictable or unmanageable stresses, such as climate change and coral bleaching.

7.2 EXPERIENCE FROM THE 2002 CORAL BLEACHING EVENT

The 2002 coral bleaching event represents a recent example of damage that can occur in the Marine Park. North Queensland had unusually hot and still weather during the summer of 2001-02, which resulted in increased sea temperatures and stress to the GBR. Wilkinson [2002] reported on the impact of this coral bleaching event:

> 'A mass bleaching event followed similar in scale to the 1998 event, but this one affected a much larger area than in 1998, and the inshore reefs were once again the most severely affected.
>
> The first aerial reports showed that the coral bleaching affected almost 60% of the total GBR reef area. The inshore reefs were most severely affected by bleaching [similar to 1998], however, many more offshore reefs were affected in 2002, than in 1998. … There was extensive mortality on a few inshore reefs, with up to 90% of coral reefs dead at the worst affected sites, however, it now appears that the majority of reefs will survive the bleaching event with only minimal coral mortality….
>
> The area affected by bleaching in 2002, combined with the potential for mass coral death at the worst affected sites, provides a vivid warning of the potential for widespread and severe ecological damage should warm weather events increase in severity, duration or frequency in the future.'

Wilkinson et al. [1999] and Cesar [1999] estimate that the economic cost of the worldwide 1998 mass bleaching event might range anywhere from $US700 million to in excess of $US8 billion over the next 20 years. The bulk of these losses are a result of decline in fisheries [between $US260 million and $US1.3 billion], tourism [between $US332 million and $US3.4 billion] and coastal protection [up to $US2.1 billion depending on the extent of reef framework collapse].

Data presented in Westmacott et al. [2000] suggest that for the Indian Ocean, the cumulative losses over a 20-year time period in net present value terms are between $US600 million [optimistic scenario] and $8,000 million [pessimistic scenario]. Under the pessimistic scenario, the total damages over a 20 year time period are primarily from coastal erosion [$US2.2 billion], tourism losses [$US3.3 billion] and fishery losses $US1.4 billion. In the optimistic scenario, the losses are still considerable stemming mainly from tourism losses [$US0.5 billion].

7.3 ECONOMIC COST ON TOURISM – WITH AND WITHOUT RAP

This highly illustrative case study focuses on the potential impact of a single threat – i.e. global warming which can lead to serious coral bleaching events, and the benefits for the tourism industry associated with managing this risk

The true benefits for the TEV of the Marine Park of adopting suitable risk management strategies would be much greater because it would encapsulate benefits from mitigating other potential damaging impacts and it would also incorporate the range of benefits for other GBR use industries and the cumulative environmental benefits linked to improved risk-management.

Cesar [2000] estimate the cost of coral bleaching in the Philippines island of Palawan is $US90.90 in loss in GVP per tourist per annum. This equates to a loss of an estimated $US36.36 in value-added per tourist, or $55.94 [AUD]. For the Marine Park with 1.8 million annual visitors the cost, assuming the loss in tourism values applied per visitor were equal to the losses estimated by Cesar, would be $100.7 million per annum, with a lump-sum equivalent of around $3.4 billion. Building resilience, for example through implementing RAP, would mean that the GBR ecosystem is more likely to resist the impact of, or recover from, coral bleaching and the commensurate loss in tourism values would be less.

This represents an illustrative example of the potential economic impact of coral bleaching events only. A forthcoming report by Hoegh-Guldberg and Hoegh-Guldberg for WWF Australia, '*Climate Change, Coral Bleaching and the Future of the Great Barrier Reef*', contains a comprehensive review of the issues.

7.4 SUMMARY

The benefit of risk management in respect of a single threat to the reef – i.e. coral bleaching – is estimated by taking the difference between the lump-sum of the tourism losses for the scenario whereby the reef does not recover and the scenario whereby, due to improved resilience provided by the RAP, the reef condition improves. On the basis of the above estimates, the risk management benefit could be in excess of $3.0 billion in respect of a single threat – coral bleaching - and in relation to loss in economic benefits for the tourism sector alone.

Given the range of other threats to the Marine Park and other GBR-use sectors, and other use and non-use values associated with the reef, the risk management benefits are potentially much higher than indicated by the above illustrative example.

It can therefore be concluded that the potential risk management benefits associated with the RAP are of a very high order of magnitude and clearly represent one of the principal benefits associated with the RAP.

ATTACHMENT 1
STUDY APPROACH

A1.1 INTRODUCTION

The approach adopted in this report is largely a function of the available data, but it is also shaped by the nature of the Zoning Plan and the broad range of potential impacts. Ideally, the overall focus would be on the comparison of the total economic value [TEV] of the Marine Park under the 'with Zoning Plan' and 'without Zoning Plan'. The main complicating factors in conducting such an assessment, include the inability [within the constraints of this project] to place dollar values on many of the important values, and also the uncertainty about condition of the Marine Park under both scenarios i.e. 'with the Zoning Plan' and 'without the Zoning Plan'. Hence, economic values are used in this study as important reference points, but no attempt is made to quantitatively estimate the change in TEV attributable to the RAP.

A1.2 OVERVIEW OF APPROACH

In general terms, the conceptual framework used to assess the Zoning Plan in this report is described using the following equation.

The Zoning Plan will provide net benefits to the Australian community if….

Benefits associated with safeguarding & enhancing Marine Park values by increasing the protected area.

>

Extractive and non-extractive use benefits associated with the Marine Park forgone as a result of increasing the protected area.
[+] Increment in management costs.
[+] Increment in compliance/enforcement costs.

The above equation reflects the core trade-off between investment in the future health of the Marine Park and the level of certain types of Marine Park usage that are permitted. All affected components of what is known as TEV of the Marine Park should be taken into account when applying this framework.[23] A large number of different values associated with the Marine Park have been identified, and this study includes an evaluation of how many of these values are likely to be impacted by the Zoning Plan. While it is not meaningful [or possible] to attempt to apply the above equation[24] directly in relation to each of the 35 different components of the TEV, it still represents an important analytical tool as it helps clarify the relevant tradeoffs to be considered in evaluating the Zoning Plan.

In view of the difficulty in quantifying the impact of the Zoning Plan, the approach adopted in this report is to identify each of the main Marine Park values, and identify which values are likely to be safeguarded and enhanced as a result of the Zoning Plan, and which are likely to fall. However, where possible, quantitative indicators [monetary and other measurement units] of Marine Park values, as well as qualitative indicators of the impact of the Zoning Plan are utilised.

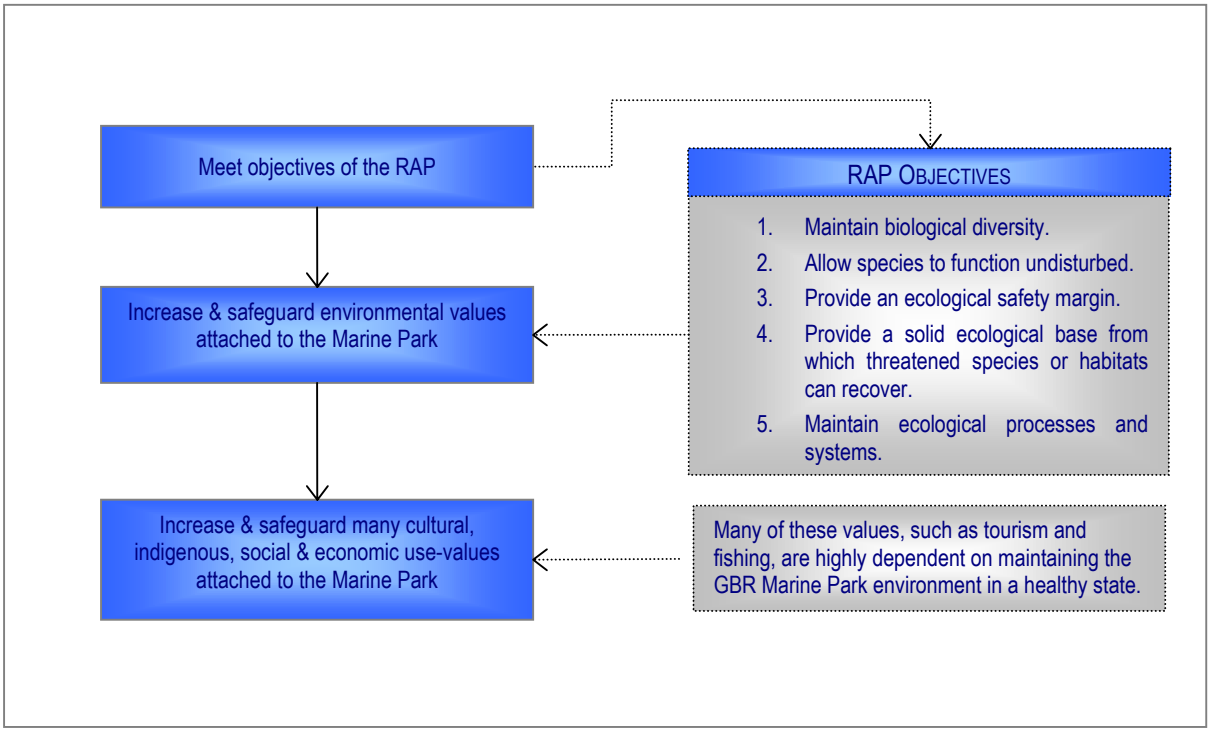
[23] If the above equation is positive, then this would indicate the TEV of the Marine Park would be enhanced as a result of the Zoning Plan. To apply the above equation it is necessary to examine the impact of the Zoning Plan on all relevant environmental, economic, social, cultural, and indigenous values associated with the Marine Park.

[24] Due to uncertainty about the Marine Park values under both 'with Zoning Plan' and 'without Zoning Plan' scenarios, and the difficulty in expressing many Marine Park values in monetary terms

A1.3 LINKAGE BETWEEN THE RAP AND MARINE PARK VALUES

A strong linkage can be drawn between the objectives of the RAP and the environmental benefits from the RAP/Zoning Plan. This is because there is currently a very small amount of environmental protection provided under the existing zoning arrangements for the Marine Park compared with the minimum environmental protection, recommended by the SSC in its biophysical operational principles, required to meet the RAP objectives. It is therefore reasonable to interpret the environmental benefits of the Zoning Plan in terms of the environmental benefits flowing from meeting the objectives of the RAP. In the figure below the direct link between RAP objectives and environmental values is depicted, and the additional dependence of cultural, indigenous, social and economic-use values on maintaining the Marine Park environment in a healthy state is also represented.

Figure 5: Link Between RAP Objectives and Environmental Values.



By meeting the RAP objectives through implementation of the Zoning Plan, all of the environmental values [e.g. existence values, option values and ecosystem services] attached to the Marine Park will be enhanced and safeguarded. While there is expected to be at least some trade-off between conservation and certain economic use activities – e.g. commercial fishing activity - there is also a high degree of complementarity between conservation and continued enjoyment of those same economic benefits from use of the GBR Marine Park. This is because, as illustrated in the figure above, meeting the objectives of the RAP, will help safeguard/enhance environmental values attached to the RAP, which, in turn, will help increase and safeguard a range of cultural, indigenous, social and economic use values attached to the Marine Park.

Hence, the linkages between maintaining the GBR Marine Park in a healthy state and safeguarding and enhancing economic-use values through implementation of the RAP, represent a key consideration in assessing the RAP.

In fact, most of the use values [commercial and recreational fishing, marine-based tourism, fishing and hunting by indigenous groups, and recreation] that are dependent on the continued protection of biodiversity in the Marine Park will be safeguarded [e.g. reduced risk of fishery collapses, and reduced risk of collapse in marine-based tourism following serious damage to the Marine Park] as a result of the RAP. Moreover, many would also be enhanced following implementation of the RAP [e.g. greater level of tourism benefits in the Marine Park if habitat is better protected and there is more abundant marine life].

A1.4 WEIGHTING DIFFERENT MARINE PARK VALUES

In conducting a policy evaluation, whenever it is impossible to place all values into the same measurement units [i.e. into monetary terms], an element of subjectivity is introduced into the decision making process. This is because weightings for different values are required in decided whether the policy is likely to deliver net benefits to the community. However, the evaluation of costs and benefits of the Zoning Plan is not considered to be an entirely subjective process despite values being placed in different units. This is because a strong indication of the relativity of different values impacted by the Zoning Plan can be ascertained through a general process of review of the relevant environmental, social, cultural, indigenous and economic-use values and how these values are likely to be impacted by the Zoning Plan.

In this report all values are presented in their original units, and a description of some of the factors affecting society's values is provided [e.g. environmental scarcity values]. Where possible monetary values are also reported but, as mentioned, for many Marine Park values this is not possible. The next step is to evaluate the likely impact of the RAP on these values. Finally, the most significant expected impacts of the Zoning Plan are identified to enable evaluation of the key tradeoffs arising from introduction of the Zoning Plan.

This approach is considered more meaningful than placing arbitrary weightings on the various values through the use of some form of multi-criteria decision support model.

A1.5 RISK MANAGEMENT WITH RESPECT TO AVOIDING EXCESSIVE DAMAGE TO THE MARINE PARK UNDER A PESSIMISTIC SCENARIO

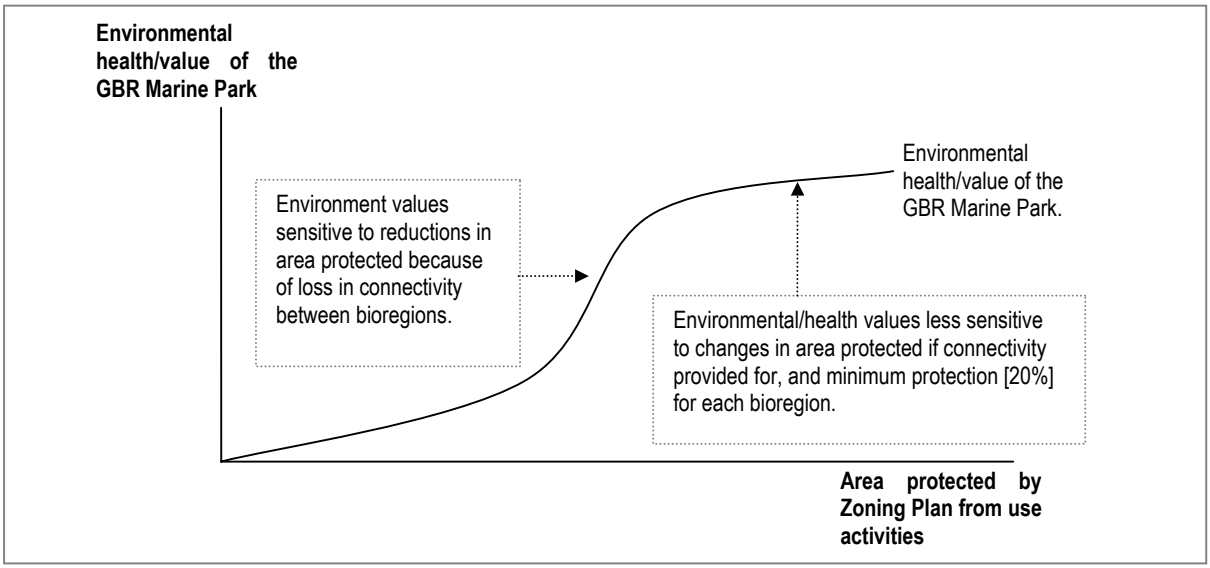
One of the key intentions of the RAP is to increase the resilience of reef and non-reef bioregions in the event that there is serous damage, due to external factors, to any aspects of the Reef and non-reef habitats, plants and animals. The principal potential threats to the reef and broader Marine Park include coral bleaching due to global warming, oil spills from shipping accidents, overfishing, pollution and damage to marine ecosystems from nutrient runoff. Risk management benefits are assessed in Section 7 of this report.

A1.6 ECOLOGICAL LINKAGES & IMPLICATIONS FOR BENEFIT FUNCTION

The terms of reference for this study do not extend to considering the social and economic impacts of potential zoning plan options that would provide for greater or lesser amounts of protection for the Marine Park than those implied by the Zoning Plan. It is important, nonetheless, to note that there is likely to be a sharp drop in environmental benefits associated with the zoning plan, if the level of protection falls below a level sufficient to provide for ecological connectivity.

The biophysical operational principles developed by the independent SSC, which are satisfied by the design of the Zoning Plan, are based on ecological connectivity. The SSC considers that the biophysical operational principles, which were used to develop the Zoning Plan, are best estimates of the requirements to provide *minimum* protection through declaration of no-take areas. This is based on their assessment that important ecological linkages, processes, or species would be at risk if any less than 20% of each of the 70 identified reef and non-reef bioregions were protected.

Figure 6: The Relationship Between Environmental Health and Values of the Reef and the Area Protected from Extractive Use Activities.



As can be seen from the above figure, the benefits of the RAP are not likely to be proportional to the area protected, but, rather, are likely to fall in a knife-edge fashion if protection falls below a critical level, reflecting the loss in connectivity between regions. This factor needs to be borne in mind in considering any potential adjustments to the Zoning Plan.

A1.7 REGIONAL IMPACTS

Regional economic flow-on effects attributable to the RAP are assessed with respect to the flow-on effects from the following GBR industries:

- Tourism;
- Commercial fishing;
- Recreational fishing;
- Marine Park based research; and
- Marine Park management.

In this study, multipliers are used to assess regional impacts [See Section 6.4].

While highly important to the assessment of the Zoning Plan, regional economic impacts should not be added together with estimates of the monetary value of impacts of the Zoning Plan on direct-use activities such as fishing and tourism. Queensland Treasury [2000] recommends that regional economic impacts be reported as 'social impacts' and reported separately to other items in cost benefit analyses. This approach reflects the fact that any contraction in economic activity at the regional level may be offset by expansionary impacts elsewhere in the economy.[25]

However, it should be recognised that the broader Australian community may have empathy for regional impacts, and, as such, they may experience some intrinsic [non monetary] costs/benefits following any contraction/expansion at the regional level. However, these benefits and costs are unlikely to be equal to the size of the regional impact.

A1.8 SUPPLY-SIDE MEASURES OF ECONOMIC VALUE OF GBR INDUSTRIES

The value of GBR-use industries can be expressed in a number of ways. Most people are accustomed to comparing industries on the basis of the value of output, or *gross value of production*, and for this reason GVP measures are presented in this report, thus providing people with a measure of industry value that they are familiar with.

However, *value-added* is a better measure of the economic contribution of industries, which is also reported, as it takes account of the cost of inputs used in production. Value-added includes wage and salary income, proprietor's income, rents, profits, and indirect business taxes, and is a common measure of the net contribution of an industry or region to production [net of costs of the non-labour inputs].

While the contribution of industries to the economy is measured using value-added, an alternative question could be 'what is the additional value of production specifically attributable to access to the Marine Park for GBR-use industries.' In the short- to medium- term, this value, which is known as the '*resource rent*' can be approximated by the value-added measure. But value-added is not the true value of access to the Marine Park in the long-term because it includes returns to labour and capital that could be earned elsewhere in the economy following a structural adjustment period.

Resource rent, which is equal to revenues less all input costs [including capital costs and labour costs], is the appropriate measure of the value of access to natural resources in the longer term. Resource rent represents the surplus return on inputs used attributable to access to the Marine Park. While it is beyond the scope of this report to estimate resource rent for GBR-use industries, it is important to recognise that value-added will over-state the long-term value of access to the Marine Park.

A1.9 DEMAND-SIDE MEASURES OF ECONOMIC VALUE OF GBR INDUSTRIES

Economic value for consumers is represented by the additional value they derive from consumption *above* the price paid. This is known as consumer surplus [see Section A1.11 and Figure 7 for a graphical description of consumer surplus]. A common error is to interpret expenditure as the economic value derived by consumers, but this is not the appropriate approach, a point that was stressed by the

[25] For example, a town with high level of dependence on recreational fishing could be affected adversely if the Zoning Plan imposes restrictions on recreational fishing in the area. However, there is likely to be a shift in recreational fishing to other parts of the coast in such situations, which, in turn, will lead to an offsetting increase in business activity in the towns adjoining the coastal areas to which recreational fishing is diverted. Hence the overall economic impact may be small, despite locally significant impacts.

South Australian Centre for Economic Studies [1999] with respect to recreational fishing:

> 'Just as the value of production [output] has been the most common form of misconception over the commercial economic value of fisheries, then the amount spent by recreational fishers to catch fish has also been a commonly misused concept. Some recreational fishers argue that because they spend a large amount [e.g. incorporating bait, travel cost/time, tackle, petrol, boat hire] for the purpose of catching a certain species, then they therefore place a higher economic value on the species and correspondingly should be allowed a greater share of the rights to harvest the resource [by distributing some of the share away from commercial quotas]. However, [just] as [the] commercial economic value of fish is not its gross production value [nor the amount spent by commercial fishermen catching the fish], neither is the cost associated with fishing the recreational economic value.'

Willingness to pay [or 'consumer surplus'] for the recreational fishing experience [or other consumptive use associated with the Marine Park] over and above the expenditure on fishing equipment and trips is a more appropriate measure of the value derived by recreational fishers from access to the Marine Park. This is because willingness to pay indicates the additional enjoyment the recreational fisher experiences over and above the next best alternative consumption option.

Despite not being an appropriate indicator of consumer value, expenditure data for recreational fishing and other GBR-recreation industries such as tourism, are reported in this study. This is because they are indicators of the relative importance of industries and they are also highly relevant in terms of examining the impacts of the Zoning Plan on suppliers reliant on tourism and recreational fishing expenditure.

A1.10 SENSITIVITY ANALYSIS

Economic values can be expressed either as annual values, or as capitalised or 'lump-sum' equivalents of the future stream of annual values. A discount rate is required in order to convert annual values into a lump-sum equivalent. Although environmental values are not discounted, and are only reported as annual values. This approach is in recognition of equal weighting given to future generation's enjoyment/valuation of the Marine Park.

Following the approach adopted in a recent study of the economic value of Hawaiian reefs by Cesar et al. [2002] a discount rate of 3% is used to convert annual economic-use values into lump-sum equivalents, or 'net present value' amounts. Sensitivity analysis is undertaken using a discount rate of 6%, which is Queensland Treasury's recommended discount rate for project appraisal.

Sensitivity analysis is also undertaken with respect to the main potential cost of the Zoning Plan, which may have an impact on commercial fisheries.

A 1.11 METHODOLOGY FOR ESTIMATING ECONOMIC VALUE OF FISHERIES

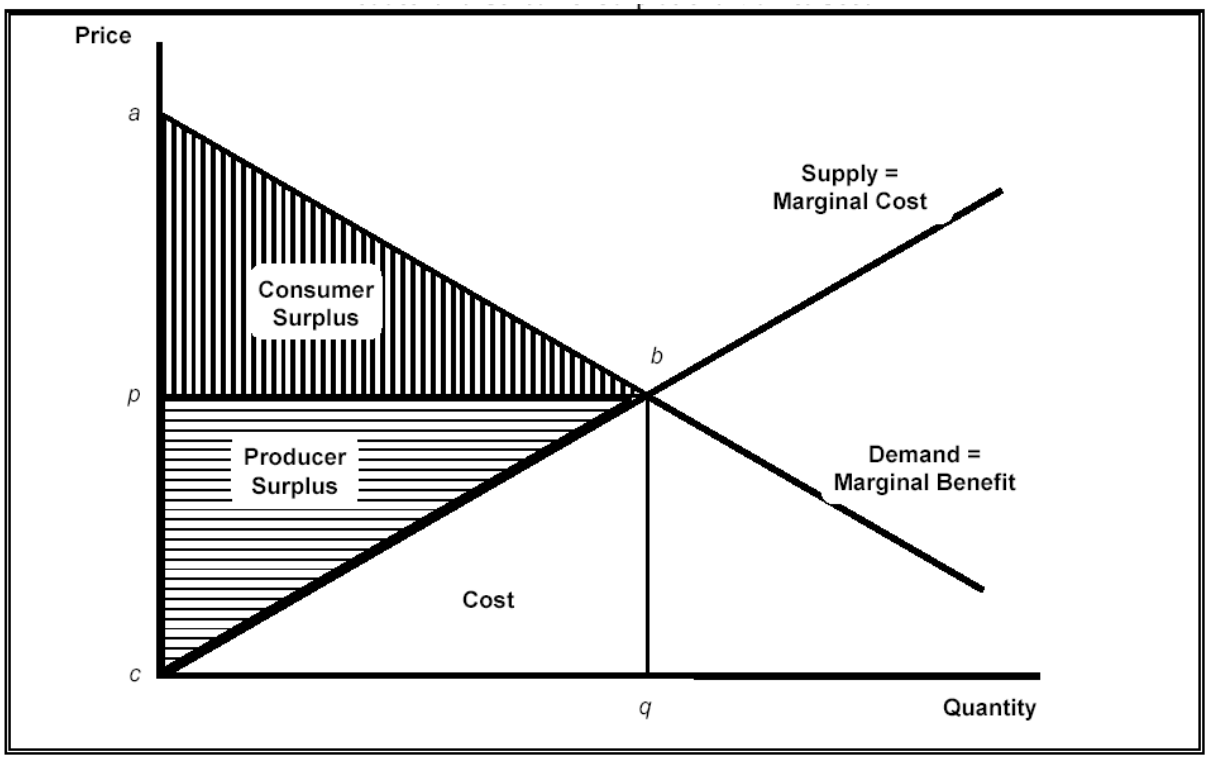
As economic values of fisheries resources have often not been correctly used or specified, there is a need to develop a theoretical framework to explain why certain concepts are employed for measuring economic value.

The figure below illustrates the difference between real economic value and what has popularly been considered to be economic value in fisheries, the value of gross production [the value of total output, i.e. the price received for the resource times the quantity produced].

Gross value of production is not the economic value of the resource. Economic value is the value to society of a resource. The above description of value of output does not take into account all the corresponding values to society from the consumption and production of the resource. As a simple illustration, consider Figure 7.

The maximum price that consumers are willing to pay for each unit is indicated by the demand curve. For a given output, q, the area cqba is the total amount consumers are willing to pay. This value does not take into account the resource cost of the output. This is given by the area under the supply curve, cqb.

Figure 7: Estimating Economic Value



Economic value [area abc] is the difference between the total amount consumers are willing to pay and the resource cost of the output. The economic value can be partitioned into two components: consumer surplus and producer surplus.

Consumer Surplus takes into consideration the price paid by consumers for resource [p], as against the amount that they would have been willing to pay [indicated by the Demand curve]. For some consumers, surplus funds are therefore left over after buying a good. In other words, it is the difference between the value of the product to the consumer and its price. In Figure 7, total consumer surplus is given by abp.

Producer Surplus is the difference between a producer's total revenue [cpbq] and the resource cost of the output [cbq]. In Figure 7, total producer surplus is given by cpb.

In contrast, the gross value of production, the term often confused with economic value, is cpbq [producers total revenue], an area that usually eclipses actual economic value. The above discussion has been based on a very simplified economic model, and for further discussion on this issue refer to Willig [1976].

ATTACHMENT 2

DATABASES USED IN DESIGNING THE ZONING PLAN

Databases used by GBRMPA to maximise complementarity, and minimise disruption to existing use activities, subject to meeting the objectives of the RAP, include:

- Existing GBRMPA zoning;
- Queensland Government Fisheries Closures;
- Queensland Government adjacent National Parks;
- Australian Maritime Safety Authority shipping lanes;
- Australian Maritime Safety Authority ship reports;
- Ports;
- Land use Characteristics;
- Coastal developments;
- Native Title claims;
- Boat ramps;
- Suntag – fish tagging data;
- Recreational fishing diaries and logbooks;
- Commercial crab-pot fishing;
- Commercial net fishing;
- Commercial reef-line;
- Commercial trawl;
- Commercial harvest;
- Commercial charter;
- Historic shipwrecks; and
- Submissions to GBRMPA on the rezoning process.

More information about the way in which these economic, social and cultural databases were used in forming the Zoning Plan can be found in GBRMPA's Basis for Zoning Decision's Report.

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