Moreton Bay still in the balance:

Conservation input to the EPA planning process

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Executive summary

1. Comprehensive, Adequate and Representative (CAR) system of highly protected areas

- Apply the CAR principles to the rezoning process.
- Secure a minimum of 20 per cent of each habitat in highly protected areas to guide the rezoning, and in a number of instances we should strive for 50 per cent, such as dugong protection areas.
- Adopt the modeling program MARXAN to help define appropriate zoning options.
- Define habitat types and indicate what levels of protection are being offered to each in the draft Zoning Plan.
- Explicitly integrate the precautionary principle and principle of intergenerational equity in the decision-making framework for the rezoning.

2. Protecting iconic species and habitats – in addition to implementing the CAR system

The following iconic species and habitats require additional protection to that which should be afforded to them by applying the CAR system:

2.1 Corals

The following coral communities should be conserved in protection zones:

- Coral communities located around the south-east corner of Peel Island (*Platypus* wreck), eastern side of Green Island and Goat Island, being the locations of significant coral diversity and old age coral colonies;
- Relic reef and coral communities located along the Ormiston foreshore; and
- Deep-water coral communities, due to their significant ecological and scientific value.

2.2 Dugongs

- A new ‘go slow’ zone is required in the Southern Moreton Bay area.
- Major known dugong feeding sites require protection in protection zones.
- Western areas of Moreton Bay need stronger protection due to high dugong activity, Wynnum Creek and Ormiston, for example.

2.3 Sharks

- All known critical habitats of the grey nurse shark should be incorporated into protection zones, including:
    - Cherub's Cave (the area in a 1.2km radius of the point 27°07.67' south, 153°28.67'east);
    - Flat Rock (the area in a 1.2km radius of the point 27°23.41' south, 153°33.07' east);
    - Henderson Rock (the area in a 1.2km radius of the point 27°07.92' south, 153°28.71' east).
- Further assessment of possible grey nurse shark critical habitats should be undertaken and the resulting areas incorporated into protection zones.

- The Queensland shark control program should be removed from within Moreton Bay Marine Park as the program directly contravenes the primary objective of the park, that is, to conserve biodiversity.

2.4 Seagrass

- Key high value seagrass meadows, such as Amity and Moreton Banks, should be included in Protection Zones.

2.5 *Turtles*

- Seek to define critical habitat areas for turtles, and where these are defined, ensure a high level of protection for these areas.
- Establish a program to remove discarded and lost fishing gear, a program that should be funded by the commercial and recreational sectors.

2.6 *Migratory* wader birds

- All spring tide roost sites should be included in protection zones.
- All other feeding and roost sites should be incorporated into protection or conservation zones to better enable management of human impacts.
- Establish a network of artificial roost sites where needed to address inadequacies identified in the natural network of roost sites.

2.7 Mangroves and saltmarsh

- All mangrove communities not included in protection zones should be included in conservation zones.
- All remaining saltmarsh communities should be included in protection zones to increase their profile and assist with the management of impacts on them from terrestrial sources.

3. Fisheries

- Constrain fishing effort away from sensitive marine species and habitats.
- Remove fjshing methods from the Park that destroy or severely damage marine habitats and/or significantly impact on bycatch species, including threatened species.
- Provide structural adjustment assistance to industry where appropriate.
- Prohibit fin fish farms and other intensive aquaculture types which would add further pressure on the Park's ecological integrity.

4. Research and decision support tools

- Develop a comprehensive risk assessment framework to advise park management.
- Develop an ecosystem modeling framework to help inform park planning.
- Invest in an invertebrate research program in order to ascertain the nature of the Park's invertebrate populations and further develop decision support tools using invertebrate indicators.
- Urgently invest in research to understand the nitrogen, phosphorus and iron levels of dredge spoil and revise the dredge spoil management plan accordingly.

1.0 Introduction

1.1 Values

Moreton Bay Marine Park is internationally listed under the international RAMSAR convention for the value of its wetlands, and is one of Australia's most beautiful natural assets. The park is deserving of our special attention. Covering an area of 1523 km², it has a catchment of 21,220 km², representing a ratio of 14:1, which is a large catchment to support. The park supports significant biodiversity and economic values. At the same time it is a playground for the region's 2.7 million people and a significant number of interstate and international visitors. [1]

Moreton Bay is surrounded by and contains a diverse range of ecosystems, including forests, mangroves, mudflats, seagrass beds, bay islands, sand islands, coral and oceanic waters. These varied ecosystems support significant diversity helping make south-east Queensland second only to the Northern Wet Tropics with regard to biological diversity. Within Moreton Bay over 273 species of birds from 65 different families have been recorded[2], and it is also the home for over 60,000 migratory birds during our summer months.

Within Moreton Bay there are 61 species of cora: Flinders Reef, at the northern oceanic section of the bay, has 119 coral species recorded. [3] Moreton Bay's corals are biogeographically distinct from those of the rest of the Indo-West Pacific region, as the particular group of species present in Moreton Bay are unlike any other reported. [4] Of the 4000 species of fish found in Australian marine and estuarine waters, 740 are found in Moreton Bay, as are all six species of sea turtles that can be found in Australian waters. Moreton Bay is also one of the only places in the world where you can find a major dugong population next to a major capital city. And of course, no one can deny the economic, social, and environmental benefit of securing the health of the Park's turtles, dugongs, and dolphins.

1.2 Threats

Unfortunately, many of the park's values are now under serious threat. Currently, species like dugongs, dolphins, whales and turtles have no real safe havens in Moreton Bay despite the park being designed in part for this purpose. South-east Queensland is the fastest growing region in Australia. Over 1.6 million people already live here and another 50,000 people arrive every year! An out of control population explosion means that Moreton Bay Marine Park is confronting pressure from booming coastal development, more pollution, more visitors, more tourism, more boat traffic, bigger boats and much more fishing.

Global warming also challenges the health of the park's ecosystems. Coral bleaching is the most immediate but not the only concern. At the current rate, many of the world's coral reefs could be dead in 40 years. Moreton Bay's corals are not immune from this impact and their health has already significantly declined in several important areas. We must ensure that the park's ecosystems are healthy and resilient so they are best able to combat climate change impacts.

It is sobering to note that Healthy Waterways has identified that if we don't change our ways, by 2026 we are putting the viability of our $10,500 million south-east Queensland tourist industry, $260 million recreational fishing industry and $60.1 million commercial fishing industry at risk. [5] These industries rely upon a healthy and vibrant ecosystem. Without them these industries will not exist.

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[1] EPA, Environmental Protection Agency. 1999. State of the Environment Report Queensland 1999.

[2] Queensland Museum. 1998. Wild Guide to Moreton Bay. Queensland Museum publication.

[3] Queensland Museum. 1998. Wild Guide to Moreton Bay. Queensland Museum publication.

[4] Johnson Peter. R & Neil. David. T. 1997. Corals in Brisbane's Backyard. in *Australian Marine Conservation Society Bulletin.* Winter 97 Vol. 20. No1 pp 20.

[5] Healthy Waterways (2006b) SEQ Healthy Waterways Strategy. Overview. June 2006.

2.0 Solutions

2.1 Comprehensive, Adequate and Representative System of highly protected areas

We note that the main purpose of the Marine Parks Act is to provide for conservation of the marine environment. Under a draft planning framework for marine protected areas in Queensland, [6] the development of marine park coverage to achieve comprehensive, representative and adequate representation of marine areas is envisaged. Further, under the Zoning Plan "ecologically sustainable" means within the park's capacity to sustain natural processes while – (a) maintaining the life support systems and biological diversity of nature; and (b) ensuring the benefit of use to present generations does not diminish the potential to meet the needs and aspirations of future generations.

Currently, less than 0.5 per cent of Moreton Bay Marine Park is fully protected, and within some of those areas commercial fishing is still practiced. Scientific recommendations suggest that we must set conservation targets which secure at minimum 20 per cent and where necessary 50 per cent of all marine habitat types in highly protected areas to ensure that we maintain healthy and productivity marine ecosystems (see Appendix A).

We strongly encourage the use of conservation targets in association with the use of the program MARXAN to create zoning options. The MARXAN software can consider both biodiversity and socio-economic data and devise a least-cost reserve system that meets a set of preset conservation targets. We understand that MARXAN is being used to develop marine park systems and proposals for marine park systems in over 80 countries, by 1300+ users and thus we strongly encourage its adoption here.

We also would expect that the habitat types defined during the process, as well as the levels of protection that are being recommended, are clearly presented in the draft Zoning Plan. Appendix B outlines suggested habitat classifications and how this information may be presented. This approach is consistent with that applied by the NSW Marine Park Authority.

The review of Moreton Bay Marine Park is also an opportunity to protect the park's intrinsic values in perpetuity, and with precaution, so that the next generation can reap the benefits of our foresight and planning.

Recommendations:

- Apply the CAR principles to the rezoning process.
- Secure 20 –50 per cent of each habitat in highly protected areas to guide the rezoning.
- Adopt the modeling program MARXAN to help define appropriate zoning options.
- Define habitat types and indicate what levels of protection are being offered to each in the draft zoning plan.
- Explicitly integrate the precautionary principle and principle of intergenerational equity in the decision-making framework for the rezoning.

3.0 Protecting Iconic Species and Habitats

In reviewing Moreton Bay Marine Park, we must consider the need to protect iconic species and habitats above and beyond the level that a CAR approach may deliver.

3.1 Corals

Within Moreton Bay there are 61 species of coral [7]: Flinders Reef, at the northern oceanic section of the bay, supports 119 coral species (Queensland Museum, 1998). Moreton Bay's corals are

[6] EPA 2000, *Marine Protected Areas in Queensland A Draft Planning Framework*, Environmental Protection Agency, Brisbane.

[7] Ida Fellegara. Ecophysiology of the corals of Moreton Bay.

biogeographically distinct from those of the rest of the Indo-West Pacific region, as the particular group of species present in Moreton Bay is unlike any other reported (Johnson & Neil, 1997). At present there has been no loss of coral but they are subject to continual pressure derived from sediment load and in some instances anchor damage. In recent times (2002) a new coral community has been discovered in Moreton that includes the *Cycloseris cyclolites* found in deep water (8m) with seagrass on the eastern side of Moreton Bay. This species has a symbiotic alga within its cells, which requires light to photosynthesize, therefore, continuation of good water clarity within eastern Moreton Bay is essential for this species survival.

Significant and diverse coral communities are located at Goat Island, the south-east corner of Peel Island and very aged significant coral communities exist east of Green Island. These communities deserve full protection from human disturbances.

It is noted that coral is also suffering from anchor damage, bommies are being rolled over with consequent impacts upon growth and in a number of instances resulting in killing the coral.

The relic reef found along the Ormiston foreshore is also of significant geological interest and ecological importance, representing a significant fringing reef that existed 3000–6000 years ago and a site of developing coral systems. The area is also noted for its intensive dugong feeding activity, particularly from Empire Point to the mouth of Hilliards Creek.

Recommendations:

The following coral communities should be conserved in protection zones:

- Coral communities located around the south-east corner of Peel Island (*Platypus* wreck), eastern side of Green Island and Goat Island, being the locations of significant coral diversity and old age coral colonies;
- Relic reef and coral communities located along the Ormiston foreshore; and
- Deep water coral communities, due to their significant ecological and scientific value.

3.2 Dugongs

Moreton Bay is home to a large population of dugongs *(Dugong dugon).* These fascinating marine mammals feed nearly exclusively on seagrasses. Globally and along the eastern seaboard of Queensland this species is declining in numbers.

Dugongs reach breeding age at 6 to 17 years. They have long pregnancies (14 months) producing one young every 2.5–5 yrs, which is dependent upon its mother until 1–2 years of age. Consequently, the dugong population growth rate it quite low resulting in slow recovery rates.

It is important to note that the majority of the dugong stranding and mortalities records for Queensland for 2004 (46 per cent) came from the Moreton Bay Marine Park, this being an increase of 8 from 2003 for the same area. Thankfully, for 2005 it dropped to 25 per cent but the overall loss for Queensland is relatively unchanged. It should be noted that Moreton Bay is unique, having a dugong population on the doorstep of a major capital city. Nowhere else in the world does this occur. We are very lucky considering we hunted dugongs for oil up until 1910.

Our knowledge of dugongs continues to expand with recent research showing dugongs regularly dive to between 15–20m and remain at these depths for 3 minutes (Tangalooma & UQ, 2002). This indicates that recently discovered deep-water seagrass in eastern Moreton Bay is a food source for dugongs.

While knowledge is improving we are finding certain areas of the western side of Moreton Bay are important feeding sites for dugongs. Such areas include seagrass meadows off Wynnum Creek, Thornlands and one area noted for intensive dugong feeding activity is the area from Empire Point to the mouth of Hilliards Creek. Further, recent research does show some dugongs do utilise the northern sections of Moreton Bay, such as work by Chilvers et al., (2005).

It is noted there are no safe havens in Moreton Bay for dugongs, current go slow zones do not provide adequate protection for dugongs from human disturbance.

Recommendations:

- A new ‘go slow’ zone is required in the southern Moreton Bay area.

- Major known dugong feeding sites require protection in protection zones.
- Western areas of Moreton Bay need stronger protection due to high dugong activity, Wynnum Creek and Ormiston, for example.

3.3 Sharks

Sharks and rays are more like whales and dolphins than other fish. They live long lives, produce few young, have relatively long gestation periods and are very vulnerable to human impacts.

Moreton Bay's diverse environments are home to 45 species of sharks and rays. Unfortunately 12 of these species are listed internationally as vulnerable or endangered. Many of the locally declared species are also listed internationally by the International Union for the Conservation of Nature. Therefore threatened species of sharks and rays should be given similar levels of protection as marine mammals, and not included as a target species in the Queensland east coast fin fish fishery. With as few as 300–500 individual grey nurse sharks off the east coast of Australia, this shark is one of Australia's most critically endangered marine species and in need of special attention as part of this review.

The National Recovery Plan for the grey nurse shark also lists the Queensland and NSW Shark Control Programs as 'a major threat' to the recovery of this species. Further, over 100 countries have coastlines inhabited by sharks and rays but do not apply policies like Queensland's shark control program. Unfortunately Queensland and New South Wales, along with South Africa, are the only 3 places in the world apply culling programs to alleviate a social phobia of shark attack. These programs result in the killing of whales, dolphins, dugongs, turtles, rays and sharks. Interestingly, shark nets do not fully enclose any surf beach swimming areas. Sharks can still swim up to the beach - clearly evident when chasing small fish.

The QDPI (2006) analysis of trends over the last 10 years along the Queensland coastline shows a disturbing future for sharks. While the total catch of all species of fin fish has increased, sharks are the species which account for the majority of the increase, while other species which consumers prefer may be in decline. [8]

Of concern, is that the annual commercial catch of sharks (and rays) in Queensland, of about 750 tonnes is similar to the total for clusters of what many consumers may prefer (i) bream, whiting and flathead (~750 tonnes) or (ii) barramundi, threadfin, salmon or trevally (~750 tonnes). This is clearly unsustainable as the populations of these long living fish species recover much slower to human induced or natural impacts than do short life species.

Also of concern is the annual estimated recreational catch of sharks (and rays), of about 200 tonnes.

Moreton Bay Marine Park should be a safe haven for sharks, Sharks deserve specific mention as iconic species at the top of their food chains and increasingly believed to be more valuable economically, as well as environmentally, alive and helping maintain healthy ecosystems, than dead and providing a diminishing source of seafood products. Most species of shark pose absolutely no threat to humans at all. They are our living dinosaurs and are a great mystery and endless source of fascination to our children. Sharks are complex organisms with complex life histories, low reproductive rates and very high vulnerability to fishing pressure. Some species of shark also have very localized home ranges and so removing their habitat or the species itself will result in lost biodiversity and localised extinctions. Its time we had a heart for sharks and consider what we can do to assist their survival as part of this review.

Recommendation:

- All known critical habitats of the grey nurse shark should be incorporated into protection zones, including:
    - Cherub's Cave (the area in a 1.2km radius of the point 27°07.67' south, 153°28.67'east);
    - Flat Rock (the area in a 1.2km radius of the point 27°23.41' south, 153°33.07' east);
    - Henderson Rock (the area in a 1.2km radius of the point 27°07.92' south, 153°28.71' east).

[8] *Queensland East Coast Inshore Fin Fish Fishery, Queensland Department of Primary Industries Discussion Paper (2006).*

- Further assessment of possible grey nurse shark critical habitats should be undertaken and the resulting areas incorporated into protection zones.
- The Queensland shark control program should be removed from within Moreton Bay Marine Park as the program directly contravenes the primary objective of the park, that is, to conserve biodiversity.

3.4 Seagrass

Moreton Bay supports 24,000 \ha of seagrass. The good news is currently seagrass meadows in Moreton Bay, based on Moreton Bay Community Seagrass Watch data, are relatively stable. However, prior to 2000 the situation was quite different. There has been extensive loss of seagrass particularly on the western side of Moreton Bay. Seagrass loss from southern Moreton Bay is documented to have occurred between 1987 and 1992, southern Deception Bay in 1996 and Bramble Bay most likely in the 1980s (Healthy Waterways, 1999). This loss would exceed 1000ha and much of the loss would appear to be related to excess nutrient load and re-suspended sediments, with 70 per cent of this sediment coming from 30 per cent of the SEQ catchment, that is, 80 per cent of this sediment is coming from the Brisbane and Logan rivers. When examining the Brisbane and Logan catchments it is found that 75±20 per cent of the sediments originates from subsoil (channel) erosion while the remaining 25 per cent comes from cultivated surface soils (Healthy Waterways, 2001). It should be noted that urban areas are not guilt free, urban areas contribute far more silt and nutrients when compared against a similar size area of agricultural land.

It becomes frightening when one realises that if future growth continues, a further 60,000ha (equal almost half the area of Moreton Bay) will be required by 2026 for urban development in SEQ (Healthy Waterways, 2006a). The consequence of this population growth is a 27 per cent increase in nitrogen and phosphorous and 23 per cent increase in sediment entering Moreton Bay (Healthy Waterways, 2006b). The greatest increase in diffuse pollution will come from the urban environment but it is the rural environment that contributes the greatest volumes of nitrogen and sediment into Moreton Bay. Approximately 250,000 tonnes (80 per cent) of the sediment load comes from the rural areas (Healthy Waterways, 2006a).

The importance of seagrass is highlighted by the East Coast commercial catch of tiger, endeavour and red spot prawns for 1995 totally 3,500 tonnes valued at $50 million and dependent on seagrass meadows (DPI, 1998). This importance is made evident by the loss of 80 per cent of offshore tiger prawn catch when 20 per cent of the Gulf of Carpentaria seagrass was lost due to cyclone disturbance.

Seagrass, while providing a valuable habitat is also very productive, primary productivity estimated at 2–11g carbon m^{-2} day^{-1} (Moriarty and Boon, 1989). Put in simpler terms, Moreton Bay seagrass is estimated to produce 105 tonnes of carbon per day (Queensland Museum, 1998).

Other values of seagrass include sediment retention and nutrient cycling. It is known that nitrogen-fixing microbial communities have a symbiotic relationship with seagrass roots (bacteria receive carbon from the seagrass and the seagrasses gain N from the bacteria). Higher organic content of seagrass sediment leads to higher rates of microbial decomposition (increasing N and P availability).

Seagrass meadows are known to be the sole food source for dugongs and green turtles yet there is not one seagrass meadow under full protection. Important seagrass meadows, such as Amity and Moreton Banks, provide much of the food source for dugongs in Moreton Bay and yet are provided no protection. These areas likely contribute substantially to the well being of the local fishing industry.

Recommendation:

- Key high value seagrass meadows, such as Amity and Moreton Banks, should be included in protection zones.

3.5 Turtles

Conservationists remain deeply concerned about the lack of protection and recovery of the park's marine turtles. Marine turtle mortality due to boat strike has been identified as an issue in Queensland waters,

principally in Moreton Bay and Hervey Bay. [9] In the East Coast Otter Trawl Fishery, 80 per cent of turtle captures are derived from three components of the fishery: Moreton Bay (52.9 per cent), tiger prawn (15.6 per cent) and the banana prawn (11.4 per cent). [10] More recent data has not been made available to us and may shed more light on this topic, particularly in terms of the impact of Turtle Excluder Devises (TEDs) on the trawl boats. However, conservationists remain concerned about the impact of commercial and recreational fishing on turtle populations, as well as the impact of lost or discarded gear. Continued boat strike on turtles is also extremely concerning.

Recommendations:

- Seek to define critical habitat areas for turtles, and where these are defined, ensure a high level of protection for these areas.
- Establish a program to remove discarded and lost fishing gear, a program which should be funded by the commercial and recreational sectors.

3.6 Migratory wader birds

In Moreton Bay over 273 species of birds from 65 different families have been recorded (Queensland Museum, 1998), and it is also home to over 60,000 migratory birds during our summer months. Of particular note is the grey-tailed tattler (*Tringa brevipes*), of which 22,000 of the estimated total flyway population of 48,000 birds are found in Moreton Bay during migration. In addition 10 percent (2200 birds) of the eastern curlew (*Numenius madagascariensis*) population were found in Moreton Bay.

It is estimated that 75 per cent of Queensland's shorebird population clusters around three coastal locations: south-east Gulf of Carpentaria (Kurumba); Hervey Bay/Great Sandy Strait; and Moreton Bay (MCCN, 2005). Unfortunately, in SEQ many important feeding and roosting sites for migratory waders have been lost, the most notable recent loss was Raby Bay in the Redland Shire. Of the 112 identified roost sites in Moreton Bay only 15 are available during times of spring tides. A number of these areas are under threat from residential and canal development or encroachment by same.

Recent examples of encroachment upon significant wader roost sites are found in the Thornlands area of Redland Shire. Some attempts have been made to address this loss. The Port of Brisbane Corporation has created a 12ha permanent artificial roost site at the Port of Brisbane and a smaller roost site was created at Empire Point Ormiston in the Redland Shire. The former roost site is likely to be successful given its isolation from human disturbances but the Empire Point site, given its proximity to urban settlement, is subject to repeated disturbances by humans, such as people walking their dogs.

Recommendations:

- All spring tide roost sites should be included in Protection Zones.
- All other feeding and roost sites should be incorporated into Protection or Conservation Zones to better enable management of human impacts.
- Establish a network of artificial roost sites where needed to address inadequacies identified in the natural network of roost sites.

3.7 Mangroves and saltmarsh communities

In December 1997 there were estimated to be 144km² of mangroves and 50km² of saltmarsh/claypan between Caloundra and Southport (Hyland and Butler, 1989). It is estimated between 1974 and 1987 that 8.4 per cent of SEQ mangroves and 10.5 per cent of its saltmarsh/claypan communities had been lost (Hyland and Butler, 1989). Within Moreton Bay this loss is estimated to be 20 per cent since European settlement, 1240ha being destroyed within Moreton Bay between 1974 and 1989. The past

[9] Recovery Plan for Marine Turtles in Australia. Marine Species Section Approvals and Wildlife Division, Environment Australia in consultation with the Marine Turtle Recovery Team. July 2003.

[10] Recovery Plan for Marine Turtles in Australia**.** Marine Species Section Approvals and Wildlife Division, Environment Australia in consultation with the Marine Turtle Recovery Team. July 2003.

airport expansion was responsible for a loss of 850ha of mangroves between 1977 and 1980, representing 12.5 per cent of mangrove loss in SEQ (Coastal CRC, 2003; BAD, 1979). There appears to have been little if any mitigation undertaken to reduce the loss of mangroves. The future expansion of the Brisbane Airport will see a further 94ha lost. It should also be noted Gold Coast canal estates are responsible for the loss of 3 per cent of Moreton Bay's mangroves. These losses are not always due to humans. In November 1997, 280ha in southern Moreton Bay died due to a hailstorm, resulting in loss of bark, branches and pneumatophores.

While natural events cause significant damage, losses in SEQ are primarily due to human activities and unfortunately new sinister impacts are starting to emerge. These include genetic damage to *Avicennia marina* and *Rhizophora sp* caused by hydrocarbons found within the sediment derived from stormwater. The damage manifests itself in the form of mutation seen as 'albino' propagules attached to parent trees (Duke et al, 2001). The affected propagules lack chlorophyll and normal green coloration, leaving them yellow or red. If they do establish and grow leaves they soon die once the seedlings reserves are depleted (Duke et al, 2001). Lota Creek, Bulwer Island, Cleveland and Eprapah Creek, Victoria Point are some of the areas where this genetic damage has been observed. There is also growing concern about the health of Mangrove forests around Moreton Bay, areas such as Fisherman Island and Whyte Island are the site of declining mangrove health. Up to 13 per cent of mangroves at Fisherman Island were recorded as dead and about 47 per cent in poor or fair condition. On Whyte Island 27 per cent of mangroves were dead and 40 per cent in poor or fair condition.

The exact cause of the diminishing health of these mangrove forests is still unclear and subject to continued research. While there have been many losses in the past there have been some gains, between 1944 and 1983 the mangroves at Oyster Point Bay, south Cleveland doubled in area. However, we note losses far exceed gains. Current losses of mangroves due to permits appear relatively small with permits issued in 1996 allowing 4.09 ha of marine plants to be cleared, of which 2.20ha were for mangroves. However, clearing of mangroves due to permits is likely to significantly increase due to the airport expansion; clearly new information on such permits is required. Illegal clearing of mangroves continues albeit on a small scale but is widespread and the sum total of the loss indicates there is a problem.

Mangroves provide habitat, food, coastal protection and trap silt and nutrients and like seagrass they are very productive. The United Nations Food and Agriculture Organisation (FAO) estimates in 1985 the average global fishery yield from about 82,000km² of mangrove waters is 9 tonnes of fish, crabs and shrimp and 2 tonnes of snails and bivalves per square kilometre (Czuczor, 1998). We know production of fishery resources in mangrove communities is affected by geographic and climatic conditions and community structure. Moreton Bay mangrove communities appear very productive. *Avicennia* mangrove communities in the Brisbane River were estimated to produce 2.3–3.5 g dry weight m^2 day^{-1} (DPI, 1998). We know there is high biomass and density of fishes using subtropical *Avicennia* forest, however, there is a possibility of diversity, density and biomass declining with distance inside such forests. This does not detract from their importance as small fishes do use inland mangroves to avoid large predatory fishes, subtropical mangroves being noted to support intermediate carnivorous fishes, which also make up a high percentage of commercial and recreational catch. For example, *Avicennia marina* (subtropical) forest in Moreton Bay support 42 species of fish at a density of 0.27 ± 0.14 fish m^{-2}, 75 per cent of economic value and 25.3 ± 20.4 g m^{-2}, 94 per cent of economic value.

While mangroves are protected under the Fisheries Act they are not protected from human disturbances and bait and shellfish collectors and consequently the biodiversity within mangrove forests are not effectively protected. A variety of migratory waders use mangroves for roosting. Neither, Coastal protection legislation nor the Fisheries Act has effectively prevented the continued loss or declining health of mangroves in Moreton Bay or prevented human disturbances of the species that utilize them.

Recommendations:

- All mangrove communities not included in Protection Zones should be included in Conservation Zones.
- All remaining saltmarsh communities should be included in Protection Zones to increase their profile and assist with the management of impacts on them from terrestrial sources.

4.0 Fisheries

Some 740 species of fish are found in Moreton Bay Marine Park: 1200 species in the greater SEQ region. This is amazing diversity and points to the complexity, and perhaps fragility, of the park's marine ecosystems. Excessive fishing effort and inappropriate fishing technologies threaten the viability of these complex ecosystems. Fishing effort is increasing and this is deeply concerning. Turtles and dugongs continue to drown in crab pots and gillnets and bycatch and seabed disturbance by prawn trawlers is unacceptable and needs addressing.

The rezoning of the park can play a role in helping secure the health and productivity of the region's fish communities and the opportunities the rezoning process provides this should be considered by EPA in collaboration with DPI as part of this review.

An effective rezoning process is likely to have some short-term impacts on the nature of fishing in Moreton Bay Marine Park. It is important that effort is not simply shifted by the zonings and that it is effectively removed where possible.

We emphasise marine aquaculture activities, such as fin fish farms must be prohibited due to their highly polluting nature and ability to increase the occurrence of disease and parasites, all well documented in Australia and overseas. This industry employs very few people yet threatens the wellbeing of marine environments and the valuable work of nearly 300 groups within Moreton Bay's catchment, who work to improve water quality and the protection of Moreton Bay's biodiversity. Australia's eminent scientific researchers on marine mammals of Moreton Bay articulated in the internationally published *Biodiversity Conservation* [11] the effects of the previous sea cage proposal in 2004. These included a decline in water quality and potential loss of habitat for Moreton Bay's bottlenose dolphin population and upon important seagrass meadows for dugongs, which are listed as vulnerable under the Nature Conservation Act.

Recommendations:

- Constrain fishing effort away from sensitive marine species and habitats.
- Remove fjshing methods from the park that destroy or severely damage marine habitats and/or significantly impact on bycatch species, including threatened species.
- Provide structural adjustment assistance to industry where appropriate.
- Prohibit fin fish farms and other intensive aquaculture types that would add further pressure on the Park's ecological integrity.

5.0 Investment in research and decision support tools

We have clearly undervalued the benefits of Moreton Bay Marine Park to the people and businesses of south-east Queensland and have failed to adequately invest in securing a healthy future for this valuable resource. Economic data, if collected, would clearly show that the current expenditure on research and decision support tools for management of the park is embarrassingly low compared to the economic returns the park brings to Queensland.

5.1 Risk assessments and ecosystem modelling

Moreton Bay Marine Park lacks an integrated risk assessment framework for assessing individual and cumulative sources of impact on the park's health and productivity. The park also lacks an ecosystem modelling framework to help further our understanding of the functionality of the park's ecosystems and to guide management decisions. Clearly investment in these areas is needed for us to begin grappling with questions such as 'What will the impact of Climate Change be on the Park?', 'What is the carrying capacity of the Park?', 'How much fishing is enough?', 'How many recreational boats, and of what size, can particular areas of the park cope with ecologically?'

[11] *Moreton Bay, Queensland, Australia: An example of the significant marine mammal populations and large-scale coastal development, B.L. Chilvers, I.R. Lawler, F.Macknight, H.Marsh, M.Noad, R. Paterson (2004).*

Recommendations:

- Develop a comprehensive risk assessment framework to advise park management.
- Develop an ecosystem modeling framework to help inform park planning.

5.2 Understanding invertebrates

There is also a particular lack of investment in understanding invertebrate communities and their critical role in the Park's food chains. There are 355 species of invertebrates living in Moreton Bay. Many if not all form the foundations of the food chain in Moreton Bay and play a critical role in the maintenance of the health of Moreton Bay yet we understand little about them. The vast majority requires stable habitat conditions. Several are target species for the seafood industry and require urgent attention beyond the few being used as water quality indicator species.

Recommendation:

- Invest in an invertebrate research program in order to ascertain the nature of the Park's invertebrate populations and further develop decision support tools using invertebrate indicators.

5.3 Quantifying the impacts of dredge spoil

Significant investment is also required to quantify the impact that dredge spoil dumping is having on the Park. It is estimated that 20 million cubic metres of sand will be taken from Moreton Bay for SEQ infrastructure and another 10 million cubic metres of sand for the building industry over the next 20 years. A draft sand extraction strategy is proposed for comment later in 2007, *Nitrogen, phosphorous and available iron*. Recent research, provided to us through the Healthy Waterways Partnership, indicates these elements when found in marine sediment are a major contributor to Lyngbya blooms: Yet, we continue to dump dredge spoil into the Park with no assessment or understanding of its impact with respect to *Lyngbya* blooms.

Recommendation:

- Urgently invest in research to understand the nitrogen, phosphorus and iron levels of dredge spoil material and revise the dredge spoil management plan accordingly.

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Appendix A

Scientific support for protecting between 20 - 50 per cent of each habitat in highly protected areas

Townsville Declaration, International Symposium on Coral Reef Biodiversity - 2002

"*As insurance for sustainability, 30-50 per cent of reefs should be set aside as no-take (no-fishing) zones, for long-term protection, not just of fish, but of entire reef ecosystems*."

Source - International Forum on Threats to Coral Reefs Centre for Coral Reef Biodiversity, Townsville October 14-19, 2002.

United Nations Development Program, Worlds Parks Congress Declaration - 2003

The World Parks Congress 2003 (WPC) recommended a global target of establishing national networks of marine 'no-take areas' (i.e. Marine National Parks) which encompass 20-30 per cent of each marine habitat type by the year 2012.

Source – http://www.iucn.org/themes/wcpa/wpc2003/english/about/intro.htm

Scientific Steering Committee - Great Barrier Reef Representative Areas Program - 2003

In the GBR Representative Area Program, the Scientific Steering Committee set 20 per cent as a minimum required habitat target for Marine National Parks and 50 per cent for all high priority dugong habitats.

Appendix B - Suggested Habitat Communities of Moreton Bay Marine Park

The following is a proposed classification system to guide the rezoning of the marine park against CAR principles:

	Generic Community Type	Communities considered
1	**Coral reef**	i. limestone reefs – island / cays ii. limestone reefs – fringing iii. inshore rocky reefs iv. artificial reefs
2	**Rocky reef**	i. Oceanic sub-tidal rocky reef *e.g. Flat Rock, Shag etc* ii. Fringing rocky reef/coffee rock
3	**Seagrass**	i. River estuaries ii. coastal – muddy shores iii. coastal – sandy shores iv. deep water v. reef
4	**Mangroves** **(note: there are at least 13 mangrove communities that can be identified in Moreton Bay as per DPI www.chrisweb.dpi.qld.gov.au)**	i. Riverine mangroves ii. Western bay fringing mangroves iii. Eastern bay fringing mangroves iv. Southern park island mangroves v. Moreton Bay island mangroves vi. Pumistone Passage mangroves
5	**Subtidal sands**	i. Northern dune fields ii. Deepwater sandy plains oceanic iii. Deepwater sandy plains bayside iv. Eastern sandy banks
6	**Beaches**	i. Oceanic sandy beaches ii. Protected sandy beaches (bayside)
7	**Mudflats**	i. Southern mudflats ii. Northern mudflats
8	**Saltmarsh**	i. All saltmarsh

How this would present in the draft Zoning Plan with the percentage of the total known habitat represented in each category:

	Community type	per cent Protection Zone	per cent Buffer Zone	per cent Conservation Zone	per cent Habitat Zone	per cent General Use Zone
1	**Coral reef**					
2	**Rocky reef**					
3	**Seagrass**					
4	**Mangroves**					
5	**Subtidal sands**					
6	**Beaches**					
7	**Mudflats**					
8	**Saltmarsh**					

Appendix C – Species residency in MBMP

An argument has been proposed that suggests Fished species in Moreton Bay are all migratory and therefore marine protected areas are of no benefit for conserving these species. Listed below is a summary of information about the habits of several significant fishery species that are caught commercially/recreationally in Moreton Bay Marine Park:

Blue swimmer crabs

Blue swimmer crab movement in Moreton Bay has been shown to be localized and associated with changes in salinity, while mature flathead don't move far with research showing fish are recaptured close to where they were tagged. DPI (2002).

Tailor

Large quantities of tailor are caught by recreational and commercial fishers in coastal waters off Queensland. A tagging programme, involving State Government fisheries biologists and amateur fishing clubs, was established in 1986 to examine the movement, growth rate and fisheries exploitation of juvenile tailor (<270 mm fork length) in Moreton Bay. Of 2173 juvenile tailor tagged in Moreton Bay during February-July and December 1987, 237 were recaptured over a period of 30 months, representing a recapture rate of 11 per cent. This was a high recapture rate compared with those in similar finfish tagging studies carried out in Moreton Bay. The recaptured fish moved relatively short distances (mean±s.d., 10.2 ± 15.0 km; maximum distance, 85 km). Estuaries such as Moreton Bay function as nursery areas for tailor prior to their movement onto open surf beaches as adult fish (Morton et al, 1993).

School mullet

The mullet school (*Mugil cephalus* L.) has a real entity. The same fish remain associated in a group for a considerable period. Some emigration from (and inferentially immigration to) the school takes place. Some schools remain in one locality (within a river system) for some months. Others appear to move more or less continually. A sojourn in fresh water does not appear to be essential though many fish are found there. Fish of all age groups can be found at all times of year from fresh water to the lower saline estuaries. Some seasonal difference in the direction of movement is evident in Moreton Bay, Qld.; but this movement lacks the persistence of the seaward spawning migration of adult fish in late summer and autumn. There is some evidence to support the hypothesis that the majority of mature fish do not migrate every spawning season, but at greater intervals (Thomson, 1955)

Prawns

Apart from Greasyback prawn, all prawns follow the same pattern. Spawn in deep oceanic waters. Hatched larvae then move into sheltered parts of bay on currents and reside there until reach juvenile stage. After adult stage is completed they move back into oceanic waters. Partly migratory but do spend a large amount of time as juveniles in shallow water inlets therefore marine reserves do benefit them.

Greasyback prawns: strongly dependent on estuarine environments. As they grow majority migrate downstream. Mating inside rivers, although spawning is inside marine areas.Migratory and spend a large amount of time in the rivers

Mud crabs

Female mud crabs migrate 30 - 40 km offshore to release larvae. Larvae are then carried inshore by currents. Juvenile mud crabs are found in estuarine areas such as mangrove lined creeks, juvenile sand crabs are found associated with seagrass beds and 3 spot crabs are located in slightly oceanic waters. Migratory in adult spawning stage but spend time in various habitats as juveniles before they enter the fisheries.

Dr Suzan Pillans has clearly demonstrated the benefit of highly protected zones to mud crab size and productivity in Moreton Bay Marine Park – see her PhD thesis.

Moreton Bay bugs

Occur in water depths of 25-60 metres in sandy substrates. A tagging study has showed that most bugs are recaptured at the place they were released and therefore do not seem to be migratory. A low density with low fecundity makes this species vulnerable to exploitation.

Squid

Squid grow rapidly and have short life spans and spawn all eggs in one go. Eggs are attached to bottom making them vulnerable to trawling. Spawning grounds in Moreton Bay are unknown. Migration unknown.