MANGALAGUN
CRAB CREEK MANAGEMENT PLAN

BROOME WESTERN AUSTRALIA

Roebuck Bay Working Group

MAY 2010

Roebuck Bay Working Group

Advancing and advocating integrated management planning to protect, restore and maintain the natural and cultural values of Roebuck Bay

Developed by
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Acacia Springs Environmental Pty. Ltd.

Cover photographs
People hunting/crab © Jan Van de Kam, The Netherlands; Birds © Adrian Boyle

Western Australian Planning Commission

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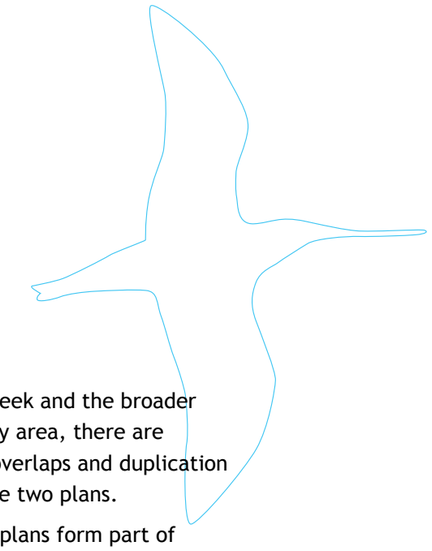


Readers please note:

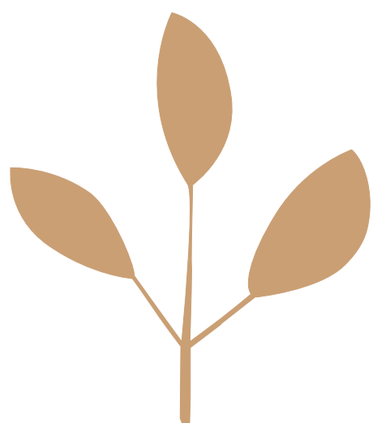
Mangalagun is the Yawuru name, the Aboriginal name, for the general area referred to in this plan. The area is more widely known as Crab Creek; therefore both names have been used interchangeably in this plan.

The Roebuck Bay Working Group is actively working to ensure a management plan for the whole of Roebuck Bay. In the interim, a plan for the Mangalagun (Crab Creek) area was prepared both as a pilot and as a lead up for the larger collaborative planning exercise, and to begin to address increasing pressures in the Crab Creek area.

Currently, a draft management plan for the Ramsar wetland site within Roebuck Bay is being prepared. As many of the issues for managing and conserving the natural and cultural values are common to both the Crab Creek and the broader Roebuck Bay area, there are inevitably overlaps and duplication between the two plans.

While both plans form part of an interactive whole, these overlaps have intentionally been retained. This recognises that both the Mangalagun (Crab Creek) and the *Roebuck Bay Ramsar site Management Plan* might be read separately. The ultimate objective is to have a nested set of management plans for not only Crab Creek and the Ramsar site but for the whole of Roebuck Bay.

The *Ecological Character Description for Roebuck Bay* (Bennelongia, 2008) provides the technical background needed for management planning for Roebuck Bay, and should therefore be considered in relation to this plan.



BACKGROUND: CONTEXT AND SETTING 1

The coastal country around Crab Creek (Mangalagun) on the north-eastern shores of Roebuck Bay in Broome, Western Australia, (see Figure 1.1), is a vital part of Australia's natural and cultural heritage and local economy.

The study area for the Mangalagun, Crab Creek Management Plan (CCMP) is roughly bounded by Crab Creek Road to the west, Broome Road to the north, and in an easterly direction to the creek itself and down to the tidal foreshore area of Roebuck Bay. The study area encompasses parts of Roebuck plains and Roebuck Bay, (see Figure 1.2) and includes part of a highly valued wetland in Roebuck Bay. The area is renowned worldwide for its natural assets largely due to its rich soft-bottomed intertidal mudflats that support very large numbers of migratory shorebirds, estimated at up to 300,000 annually. The wetland site was designated a 'Wetland of International Importance Especially as Waterfowl Habitat' in June 1990, under the Ramsar Convention (see Section 2.2).

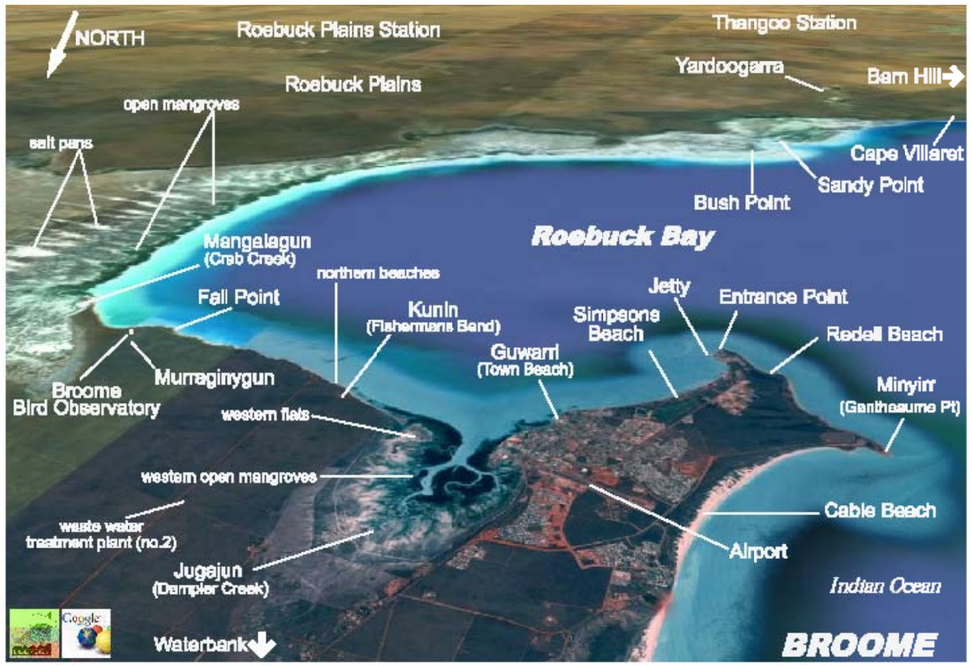


Figure 1.1 Key locations around Roebuck Bay,

In this plan, the term 'Crab Creek' refers to this broader area of land and sea. Crab Creek and the surrounding areas lie within the traditional estate of the Yawuru people. Here, Aboriginal people have lived for thousands of years around the coastal country, and during Buggarrigarre, (the Dreamtime), creator ancestors came and entrusted people with sacred law and culture. Generations have continuously maintained and practiced that law and culture and it continues to the present day.

Crab Creek and the adjacent Roebuck Bay, or Nalen Nalena, in the Yawuru language (ECD, 2008), is extremely important to both Indigenous and non-Indigenous communities for a wide range of cultural, economic, commercial and recreational pursuits.

It supports activities such as fishing, boating, hunting, bird watching and nature-based tourism. It is an important and increasingly popular recreation and tourism destination for local residents and overseas visitors.

Tourism, both domestic and international, around Broome generates significant income for the Kimberley region. In Broome visitors can enjoy everything from five star accommodation and fine dining, to fishing from the foreshore and escaping to deserted and remote beaches, as well as the usual sight-seeing, scenic tours and camel rides along Cable Beach. Around Crab Creek, bird watching based around the Broome Bird Observatory (BBO) and hovercraft tours to the Crab Creek foreshore are also important activities.

Figure 1.2 Location of the study area

Dashed red line incates the study area

The Crab Creek area is one of the best places in the world for viewing shorebirds, because of its accessibility, being close to town, and for the variety of shorebirds that it attracts (estimated to be 22 species, 20 of which migrate to the northern hemisphere each year).

Community Solutions (2004) identified the most utilised recreational sites around northern Roebuck Bay to be:

- Crab Creek: fishing, crabbing and other activities;
- Dampier Creek: fishing, water skiing and other boating activities (hovercraft at low tide), eco-tourism;
- Fishermen's Bend (Kunin), and other places on the northern beaches – bird-watching, walking, fishing and general enjoyment of the area and its scenery;
- Bush Point: bird research, eco-tourism.

From an aesthetic point of view, Crab Creek is one of the most scenic places in Australia. The milky blue sea, dark green mangroves, bright blue sky, and scarlet red pindan cliffs make a striking feature. The extraordinary sight of the full moon rising over the northern mudflats at low tide, forming a 'Staircase to the Moon', has become internationally famous.

A Values Mapping project (Community Solutions, 2004) described the importance of Roebuck Bay area to Indigenous people. Numerous middens along the northern coastline of the Bay testify that this has been so for hundreds of generations. The Crab Creek area holds a substantial number of Aboriginal heritage sites and remains a place of deep Aboriginal cultural, spiritual, social and economic significance. The Register of Aboriginal Sites has listed at least 65 heritage locations in the vicinity of the Ramsar site.

Not surprisingly, the areas with the highest environmental, cultural, and heritage values are also areas where there is strong demand for recreational access, and indeed tourist uses.

Crab Creek and the greater Roebuck Bay provide a number of important ecosystem services. Ecosystem services have been defined as 'benefits people receive from ecosystems' (Ramsar, 2005). This includes indirect benefits such as cooling breezes off the water and erosion protection from fringing vegetation. Four main categories of ecosystem services are defined by Ramsar. They are:

- Provisioning services — the products obtained from the ecosystem such as food, medicines, fuel and fresh water;
- Regulating services — the benefits obtained from the regulation of ecosystem processes such as climate regulation, water regulation and natural hazard regulation;
- Cultural services — the benefits people obtain through spiritual enrichment, recreation, education and aesthetics;
- Supporting services — the services necessary for the production of all other ecosystem services such as water cycling, nutrient cycling and habitat for biota.

While planning management for Crab Creek we have been mindful of these benefits. It is within the context of these four eco-system services that stressors on Crab Creek have been identified and the responses to those pressures have been formulated.

1.2 Influences on Crab Creek

The Crab Creek study area forms a small but important part of the greater Roebuck Bay, and as such is affected by the major influences on the environmental quality and cultural values associated with Roebuck Bay. These include natural stressors such as extreme weather events for example, cyclones and monsoonal rains, and human-induced impacts from the rapidly increasing resident and visitor populations, and the expansion of activities through the Port of Broome as a base for the North-West Shelf Gas exploration and supply.

The following activities and issues have been identified as potential pressures on Roebuck Bay. Many of these were previously summarised in Community Solutions (2006) and Bennelongia (2008):

- Agriculture including pastoral and horticulture;
- Spread of weeds;
- Increased erosion (leading to silting and turbidity in the Bay);
- Increased nutrient and contaminant runoff;
- Water use and groundwater abstraction;
- Reduced groundwater levels;
- Increased salinity of groundwater/saline intrusion;
- Changes to freshwater levels/availability for groundwater dependant fringing vegetation;
- Urban development;
- Wastewater contamination of environment;
- Contamination from drainage and land fill;
- Human and vehicular disturbances;
- Pollution of the Ramsar site by heavy metals, tributyl tin, hydrocarbons and toxicants from road run-off and urban drains;
- Contamination from pest control (e.g. mosquitoes and midgies);
- *Lyngbya* (blue green algae);
- Anaerobic impacts on mangroves;
- Reduced light levels to benthic plant communities e.g.seagrasses;
- Impacts on marine animals (e.g. fish, turtles, dugongs);
- Direct contact human health impacts;
- Commercial use and recreational fishing;
- Decline in fish stocks from over fishing (e.g. barramundi, threadfin salmon, mud crabs);
- Litter, plastic and other gross pollution;
- Recreation and tourism;
- Predicted increase in population and visitors;
- Increases in vehicle pressures;
- Fishing and boating activities;
- Land development pressures;
- Littering and waste;

- Increased lighting, noise and other disturbance (including that during infrastructure construction);
- Disturbance to feeding, breeding and roosting birds, intrusion and trampling of nests (both by people and dogs);
- Discarded fishing gear and other rubbish (e.g. plastic rings, cigarette butts & other debris);
- Growth in commercial and tourism industry;
- Climate change;
- Changes in temperature;
- Changes in rainfall patterns;
- Changes to atmospheric and oceanic circulation patterns.

It has been stated in the Ecological Character Description (Bennelongia, 2008) that these stressors are thought to be exerting a relatively small influence on Roebuck Bay at this point in time, and we believe this is likely to be the case at Crab Creek. Furthermore they say that the Pindanland Subregion has been considered to be in 'good condition' ; referring to the fact that recovery to a relatively un-impacted state could occur in the short term and with minimum intervention.

The national estuary audit considered Roebuck Bay to be 'near pristine' with sections 'largely unmodified' (Bennelongia, 2008, p.84). Unfortunately this situation may not remain as evidence is already accumulating that significant changes are taking place as a result of combinations of many of the pressures listed above. For example, the annual occurrence of potentially harmful blue green algae, Lyngbya adjacent to Town Beach since 2005 is an indication that the Bay may be already impacted.

Due to the influences and pressures on Crab Creek, and the stakeholder belief that the area is worthy of protection, the Roebuck Bay Working Group (RBWG) identified Crab Creek as the first precinct to have a management plan developed as part of a greater aim; that of developing a management effort for Roebuck Bay.

Aboriginal Rangers installing signs at Mangalagun


Fishing is enjoyed at the mouth of Crab Creek

1.3 Aim of the Crab Creek Management Plan

The Roebuck Bay Working Group (RBWG) has been involved in a management planning process for Roebuck Bay since 2004, using a series of small grants to undertake a staged values-based planning process. This Plan is an initial endeavour to plan the management of one significant area around Roebuck Bay, within the available funds, and Mangalagun (Crab Creek) was selected as a priority for management. The aim is to

> *Define appropriate management measures to maintain the ecological, cultural and amenity values of Crab Creek.*

The Plan is aimed to guide the community and the RBWG in management of the land and sea, so that 'the natural systems, the people and their activities co-exist in a healthy, productive and sustainable way'. (www.GeoCatch 2009)

To date, the RBWG has worked well in a collaborative way to progress a plan of management for Roebuck Bay. Crab Creek is the first area being piloted under this aim. Over the last decade or so, the coastal management works around Broome have been addressed by a coordinated effort from land managers like Rubibi (representing Traditional Owners), and the Shire of Broome and by using a wide variety of volunteers and community groups such as the Broome Bird Observatory (BBO), Conservation Volunteers Australia (CVA), Greencorps, Work for the Dole and Community Development Employment Program (CDEP) participants, and in recent years Minyirr Park Indigenous Rangers. In the current political and economic climate we envisage that this reliance on volunteers and local 'grass-roots' labour and skills will continue.

It was important therefore that the Management Plan meets the needs of this target group. Our aim is that this Plan will be understandable and usable 'on the ground'.

The broad goals and objectives stated below arose from the community consultation and values mapping undertaken by Elix and Lambert, Community Solutions (2004) and are referred to in Bennelongia (2008).

Goals

- Habitats are maintained and protected;
- Plant communities and animal populations are protected;
- Biodiversity is protected;
- Foreshores are protected;
- Water quality is maintained;
- Important food sources are managed sustainably.

Objectives

- Impacts from developments are managed and minimised;
- Built infrastructure near the foreshore is protected;
- Protect shorebird roosting and feeding areas;
- Resilience, quality and extent of habitats maintained and protected;
- No unacceptable alteration of hydrological regimes;
- Biodiversity of fringing communities is protected;

- Impacts from Lyngbya (blue-green algae) are managed;
- Ensure recreational and commercial fishing effort does not exceed the sustainable yield for key local species (e.g. Barramundi, threadfin salmon);
- Climate change impacts are managed and emissions are within accepted limits.

1.4 Methodology for the CCMP

The management planning process has built on the collaborative work established by the RBWG. The group's membership (stakeholders) represents a significant array of government and non-government organisations, agencies and community groups with information, technical advice and practical experience relevant to the planning of Crab Creek (see Appendix 1). We actively encouraged stakeholders' involvement throughout the process, facilitated by three planning workshops, individual consultation and group meetings during the consultation phase.

Information provided by the stakeholders and their contact details is available in Griffiths (2008).

This Plan follows a rigorous process to establish what the stressors are on Crab Creek, and what might be possible on a local level, to reduce the negative impacts from these. It follows on from work previously undertaken for the RBWG resulting in the mapping of values, the identification of issues, and the development of Interim Management Guidelines (IMG) for Roebuck Bay. The IMG work undertaken by Community Solutions, (consultants Lambert and Elix), included significant community consultation and outlined a number IMGs that Bennelongia in 2008, endorsed and to which they added additional guidelines.

The Crab Creek management planning process is presented in a diagram at Figure 1.3.

We began by considering the RBWG's previous reports on Roebuck Bay's values, Issues Paper and the IMGs in the context of Crab Creek. Using a process of stakeholder consultation and interactive workshops with RBWG members we then developed the following logical order:

- Assessed and documented local, regional, global stressors; Defined the nature of key issues, trends and linkages and defined key management themes for Crab Creek;
- Developed a Ramsar compliant framework to tease out the interactions and intervention opportunities within main themes;
- Undertook a consistent assessment across main themes (Drivers and Levers: Bennelongia, 2008);
- Documented the scales of manageability for each of the management themes (see Griffiths 2008);
- Engaged the Roebuck Bay Working Group (RBWG) and a range of other stakeholders through workshops and consultations, in an appropriate dialogue on management needs;
- Developed a range of implementation options to explore governance opportunities for future requirements (see Appendix 4);

- Developed implementation actions directly applicable to Crab Creek;
- Developed actions applicable at the scale wider than CC (i.e. lobbying, information and education aimed at Broome, the Kimberley region, nationally and globally); and
- Recommended implementation targets, timelines and roles for the management response and actions.

Importantly, the planning process involved working with Traditional Owners (TOs) and consultation was undertaken by Neil McKenzie, himself a local Traditional Owner. Dave Deeley and Sharon Griffiths undertook a series of site visits and meetings with Neil McKenzie and Frank Sebastian along with issuing invitations and submitting ongoing information to Rubibi members, consultation with TOs and their legal advisors and Registered Native Title Body, the Kimberley Land Council, and more recently discussion at the newly incorporated Yawuru Native Title Holders Aboriginal Corporation.

In line with the requirements of the project brief, we have in the main relied on information and advice provided by the RBWG stakeholders and more recently the Ecological Character Description (ECD) for Roebuck Bay (Bennelongia, 2008). Maps were provided by RBWG members.

For information on the physical features around Crab Creek and adjacent areas refer to the Section 9 references. Expanded information will be available in the companion *Roebuck Bay Information* (Griffiths, 2008), a loose-leaf folder of information relating to management planning, and also in the *Roebuck Bay Ramsar site Management Plan* being developed for the RBWG.

Figure 1.3 The methodology used to develop the Managalagun Crab Creek Management Plan

KEY ISSUES FOR CRAB CREEK 2

A number of key factors and issues that need careful consideration in the management planning of Crab Creek were identified through consultation and from information gathered previously by the Roebuck Bay Working Group (RBWG). These included:

1. Cultural
2. Environmental
3. Economic
4. Tenure and Governance

Many of these key issues were outlined previously in four posters produced for the collaborative planning workshops. They are the:

- *Environmental characteristics of Roebuck Bay*;
- *Land use considerations for Broome and northern Roebuck Bay*;
- *Cultural resources and tenure for Crab Creek*; and
- *Potential threats and impacts for Crab Creek*.

These posters can be found in *Roebuck Bay Background Information* Griffiths (2008).

2.1 Cultural

Cultural uses (Indigenous)

Crab Creek forms part of a valuable and rich cultural landscape that surrounds Broome and is connected through song-cycle systems to many other parts of Australia. Around the Kimberley there is believed to have been extensive trading between Indigenous people on the coast and inland groups dating back many thousands of years. Extensive trade routes connected the east and west Kimberley which followed these song-cycle systems.

Indigenous people have always lived around the coast and have used, managed and relied on the coastal country (both land and sea) for aeons. It is the basis of cultural, spiritual, social and economic life for many of Broome's people. The Crab Creek area abounds in middens comprised of thousands of cockle shells and other evidence of centuries of sustainable living and dependence on natural resources.

Cultural heritage sites and areas of significance abound near the Crab Creek coast and in adjacent areas around natural water sources like creeks, springs and wetlands and in the vicinity of significant flora or fauna habitats. Most of these are in areas where visitors also like to go, and therefore, sites and cultural assets are at risk of damage or destruction.

During consultation and from previous work, i.e. values mapping, Traditional Owners and those people closely associated with country around Crab Creek often talked about their culture and lifestyle and the social and economic aspects of living close to this area. Aboriginal people need access to affordable food and to be close to the coast for passing on their customs, practices and knowledge e.g.through hunting and fishing, gathering bush tucker and medicines, storytelling and undertaking their responsibilities in caring for country which includes cultural transmission, as well as for recreational use.

Aboriginal residents and Traditional Owners clearly wish to retain their culture and have their lifestyle protected. This naturally includes the protection and sustainable use of the coastal areas and environmental assets.

Cultural uses (general)

Broome's unique history is centred on the sea around Broome and Roebuck Bay. Its development as a 'Town by the Bay' (Pigram Brothers) and as a multi-cultural hub has flowed from the pearling industry that became established in Broome in the 1880s. This love of the coastal fringes and dependency on the sea was reported in a Broome cultural planning study (Smith 1996).

Crab Creek is part of that appeal and offers a scenic, quiet and relaxing place nearby for people to escape the rigours of town life and is an important lifestyle asset. It offers opportunities for fishing, crabbing, boating, swimming, picnics, bush and beach walks, bird-watching, camping, cultural transmission and nature appreciation. It also hosts opportunities for research and education.

Being a free and readily-available recreational area encourages peoples use, and fosters physical activity and general exercise. These places play a vital role in the mental and physical health of the community who use them. With an increasing population of people with lifestyle diseases such as obesity, diabetes, heart problems, etc. freely available attractive natural areas that encourage people to 'get up and go' are vital.

This appeal will continue to draw people in greater numbers and will be further accentuated as other coastal areas become less accessible or more controlled, particularly as the pressure on Cable Beach may lead to closure of vehicle entry onto the beach.

Broome was recently termed 'a town for vehicles' in an ABC 1 TV series entitled *Two Men in a Boat*. This they said followed from residents' dependency on vehicle travel and the remote and hot tropical environment. We consider also (based on ABS 2006 information on income levels and population demographics), that there is an increase in residents who have the financial capacity to buy, fuel and maintain off-road vehicles. Coupled with the lack of facilities in the remote areas they visit and the consequent need to take all requirements with people in their vehicles, this has increased the use of 4WDs accessing natural areas throughout the study area. With the likelihood in future years that Crab Creek Road could be upgraded this too will encourage more two-wheel drivers to go out to Crab Creek to recreate. If upgraded to an all-weather road, then accessibility during the Wet season will be possible and is likely to substantially increase visitation.

Marine and nature appreciation is common to people living in Broome and visitors to the Kimberley, with many people enjoying ready access to the great outdoors and recreational pursuits like fishing, boating, bird watching, swimming, bush walking, picnics and general socialising. This and other lifestyle and cultural uses has been reported in the values-mapping undertaken by Community Solutions (2004). Predicted increases in tourism will inevitably lead to more people in and around Roebuck Bay, the Ramsar site generally and Crab Creek specifically.

2.2 Environmental

The Crab Creek area has an international reputation as a readily-accessible bird watching area, known extensively for its natural habitat that supports large numbers of migrating shorebirds. The very fact that so many of these birds fly 25,000 kms each year to get to and from Roebuck Bay, suggests that the area has much to offer, particularly an abundant supply of food and warm weather so birds do not lose energy trying to stay warm. (SCP signage p193). It is a feeding and resting area for migratory shorebirds during the non-breeding time of their life cycle, when birds are not on migration or in their northern hemisphere breeding grounds. The high biomass (population of small spineless animals e.g. starfish, snails, molluscs, and other mud-dwelling benthic invertebrates) around Crab Creek and the Bay is a key to the importance of this habitat that is estimated to support about 500 species of benthic invertebrates. This rich food source attracts peak numbers of 130,000 shorebirds.

Ramsar-listed wetland

Within the Ramsar site (ECD, 2009), 84 species of waterbirds have been recorded; of which 22 species occur in numbers greater than 1% of the global populations. Shorebirds are represented by 35 species. Many of these are attracted by the high availability of bivalves present in the intertidal zone (Piersma et al., 2006). Around Roebuck Bay, at low tide 17,500 hectares of exposed mud flats become the feeding grounds for the shorebirds. At high tide, the birds form large flocks and roost on the shores particularly around Crab Creek.

Relaxing at Mangalagun

After a great day on the Bay

The waters around Crab Creek contain a huge variety of sea creatures, including protected marine species like turtles, dugong, dolphins and sawfish. (DPI, 2008). Flatback turtles, *Natator depressus* (nationally vulnerable), Loggerhead Turtles *Caretta caretta* (nationally endangered) and Green Turtles *Chelonia mydas* (nationally vulnerable) regularly use the Ramsar site as a seasonal feeding area and as a transit area on migration.

Detailed information on the key environmental features of Roebuck Bay including the ecology, values, and criteria applicable to the designation of the Ramsar site can be found in The Department of Environment, Water, Heritage and the Arts. (2003), *Information Sheet of Ramsar Wetlands (RIS) — Roebuck Bay, Western Australia-33*.

Apart from the commonly-known rich tidal mudflats around Crab Creek where a diversity of life is revealed; such as worms, urchins, sea slugs, shellfish, anemones, crabs, snails and starfish, there exists other dependent ecosystems. The mangrove community around Roebuck Bay has very high ecological values: for example in acting as a fish and crustacean nursery, trapping silt and buffering the coastline from cyclone impacts.

During high tides, water from the Bay flows through these fringing mangroves. On the highest tides and during storm events the water flows into the salt marsh shrub community of samphires and the clay pans beyond. Also included are the saline grasslands of Roebuck Plains that are dominated by extensive areas of Saltwater Couch, a grass highly valued by the cattle industry. The tidal inundation of these habitats has profound effects on the ecology of Crab Creek and indeed the Bay. Detail on the vegetation within the Crab Creek study area is provided in the folder Roebuck Bay Information (Griffiths 2008), in the article written by Tim Willing in 2008, entitled *Vegetation Communities*.

In the book *Life along land's edge: Wildlife on the shores of Roebuck Bay, Broome*. Rogers and his colleagues (2003) pose the question and answer. 'Why don't pindan soils surround all of Roebuck Bay? And why, for that matter, is there a bay at all? The answer lies 200 kilometres away, where the mighty Fitzroy River flows into King Sound near Derby. For many millions of years it flowed into what is now Roebuck Bay, and it left behind both the structural layout of the bay, and an extensive plain of fine alluvial and estuarine sediments — Roebuck Plains, a region of magnificent natural grasslands that abuts eastern Roebuck Bay.'

Roebuck Plains after rainfall

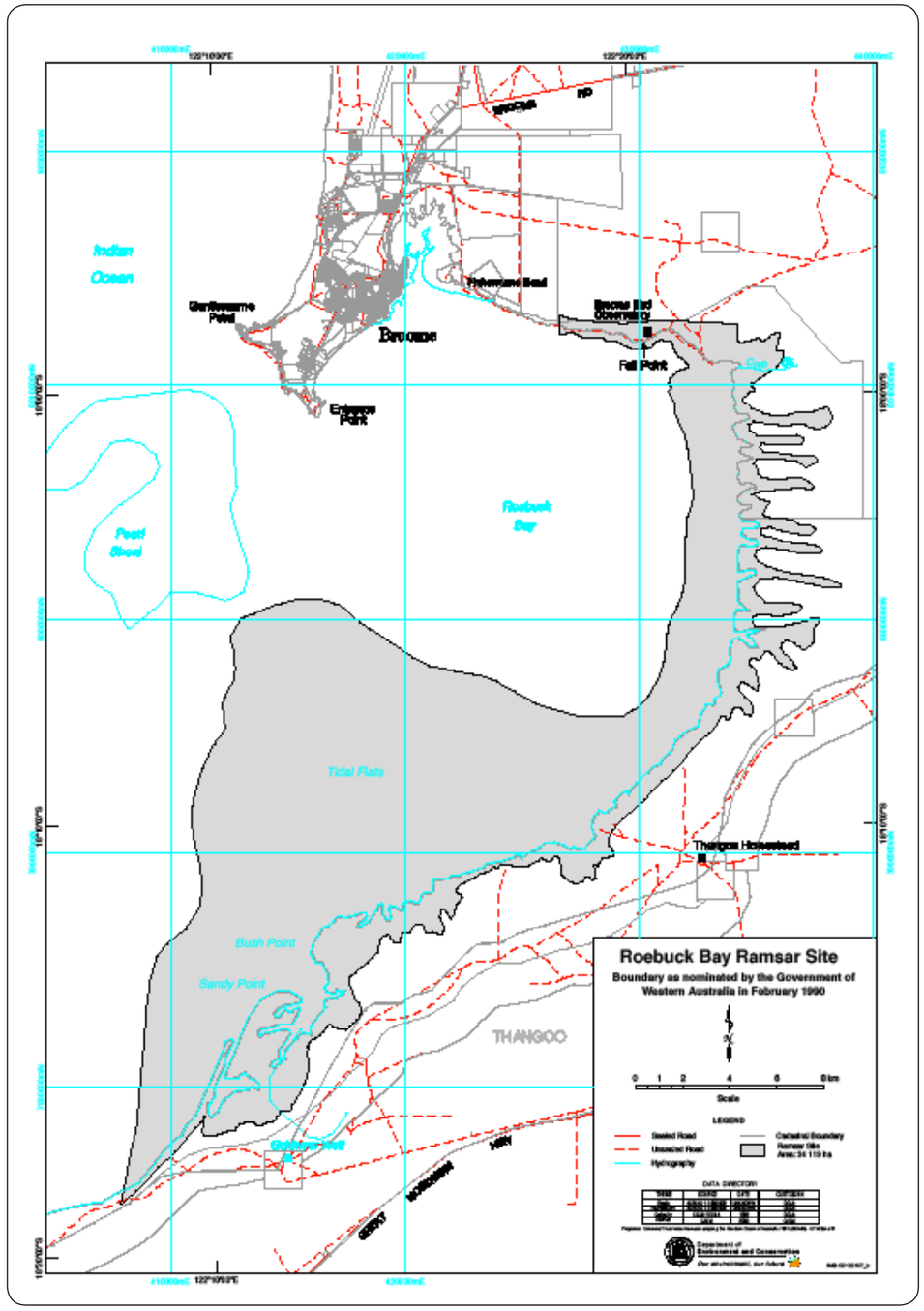


Figure 2.2 Ramsar site Roebuck Bay, Broome Western Australia.

developed walk-trails, interpretive displays, and planning has commenced for a dedicated Visitor Centre.

The fact that the Crab Creek area has such a diversity of habitats in close association with each other is the primary determinant for its richness and biodiversity.

2.3 Economic Issues

Crab Creek offers the opportunity for people to supplement their diet with fresh foods such as sea foods and bush tucker, and this has a significant non-cash value to the local economy. (LGDP 1996).

Currently, the study area is almost free of commercial development with just the Broome Bird Observatory offering information, a small camp ground and limited basic accommodation, mainly used by researchers and volunteers. Other commercial tourism operators who use Crab Creek are in the main bird-watching enterprises, and the hovercraft that brings visitors from the Port across the Bay to the beach.

With the area of Crab Creek holding many natural and cultural values, it presents significant opportunity for developing tourism, preferably guided cultural and nature-based tourism, and also eco-friendly tourism. These opportunities have been tested through local indigenous organisations, and through the Broome Bird Observatory and a couple of commercial tour enterprises. For example, Mamabulanjin Aboriginal Corporation operated guided tours around Crab Creek, and others have provided consultancy, cultural advice and cross cultural awareness raising services for people working around the Bay including tour operators and charter boat operators. The economic opportunities arising from tourism, research and education could well be exploited further, and become a useful and cost-effective strategy to reduce human pressures, and raise visitor awareness. The establishment of Cultural Rangers for the coastal areas could have significant benefits such as a cost effective management strategy and value-adding to tourism.

2.4 Tenure and governance

Tenure and the rights and responsibilities associated with the management of the Crab Creek area, has confused stakeholders for many years. The information presented below is a summary gathered from the key stakeholders. While attempts have been made to ensure the information is correct, it should not be relied upon in making decisions or undertaking management. Stakeholders are advised to seek their own professional legal advice.

The area around Crab Creek has numerous tenures over reserves and land ranging from leasehold, freehold, unallocated Crown Land (UCL) and a mining tenement area to the north-west. A cattle station Roebuck Plains Station, owned for the past 10 years by the Indigenous Land Corporation, and considered to be a 'jewel in the Kimberley pastoral industry', is soon to be handed back to Yawuru people, the traditional owners, though the management control of the station is reportedly contentious according to Shirley McPherson quoted in *The Australian* newspaper of 19 May 2009.

The Broome Bird Observatory (BBO) is located 25 kilometres east of Broome, on two hectares of land near Fall Point at Crab Creek. Whilst a small development,it has basic facilities for visitors and staff, combines as a research facility and offers shorebird courses and tours. The BBO has developed walk-trails, interpretive displays, and planning has commenced for a dedicated Visitor Centre.

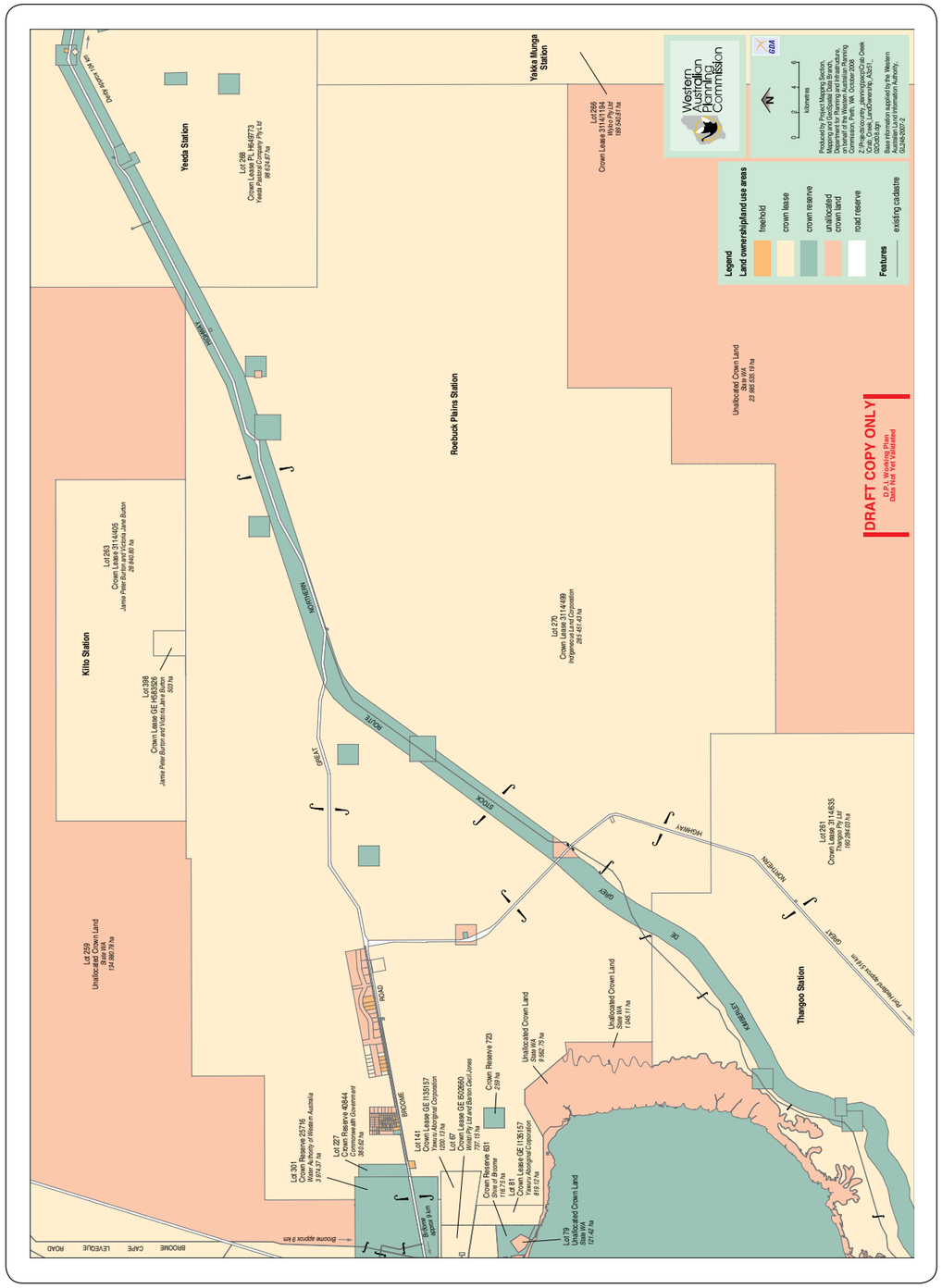


Figure 2.4 Land Tenure (draft for RBWG purposes only)

In a *Report of the Marine Parks and Reserves Selection Working Group in 1994*, Roebuck Bay had been considered for reservation as a Marine Park or for public recreation and protection of flora and fauna.

The land and waters here have been subject to Native Title claims, Native Title determinations in the Federal Court, and in recent years negotiations relating to Native Title rights. The delay in the resolution of Native Title issues in some areas, and the uncertainty on the process and outcomes has created instability, insecurity and reluctance by some stakeholders to make decisions required to effectively manage Crab Creek. However in 2006 a native title determination was brought down after Yawuru people were able to demonstrate continuous and unbroken connection to the area and established their legal rights as native title holders.

Currently much of the area forms part of the negotiations being undertaken by land owners and managers e.g. government at all levels, and the Traditional Owners (TOs). Recently, in-principle agreements between the State Government of WA and Yawuru Native Title Holders Aboriginal Corporation (the TOs), have been announced. The recent agreement is said to include joint management and collaborative initiatives such as Indigenous Land Use Agreements (ILUA), in some coastal areas, with key stakeholders such as the Shire of Broome, and the WA Department of Environment and Conservation. Crab Creek will be subject to this agreement we understand.

In regards to future decisions on tenure in and around Crab Creek, one aspect that should be considered is that by declaring or reserving areas, (and thus promoting the area) this will attract greater visitation (Community Solutions, 2006).

Whether in areas where Native Title exists or not, it is important to note that Aboriginal sites of significance, are still afforded the same level of protection in legislation, under the provisions of the Aboriginal Heritage Act (1972) (WA).

On Unallocated Crown Land (UCL), the State is usually responsible for carrying the responsibility for management and liability for the public. The Department of Planning and Infrastructure (DPI) has ultimate management responsibility for UCL, but the Department of Environment and Conservation (DEC) is responsible for management of the Ramsar site and has control over flora and fauna (Bennelongia, ECD p31).

On reserved lands where there is a management order, for example where the Shire has the care, control and management of a road or recreation reserve or the Water Corporation for a water reserve, the body that holds the management order normally carries the ultimate responsibility for management. There are other situations where those that have a lease, have the power under the management order, to 'sub' lease land to others e.g. the Aboriginal Lands Trust (ALT) who may exercise their power and sub lease to a local Aboriginal corporation.

Commonly known locations within the study area, and the leases and tenure details are:

- Wattle Downs: east of Crab Creek Road. Leasehold to Yawuru Aboriginal Corporation. This is currently on a 6 month rolling lease, until the results of the Global negotiations are known (pers. comm. David Lanegan).
- Gubanyana: A section 91 licence exists over one area (a camping licence) at Gubanyana. The State is the leasor.
- Broome Bird Observatory: a small reserve (#41066) on 2.8 hectares of land near Fall Point, and gazetted for the purpose of a Broome Bird Observatory. It was leased in 2004, from DEC and is operated by Birds Australia. (Bennelongia, ECD p41).
- Roebuck Plains Station, (#3114/049) covers an area of 283,459 hectares. It is owned and operated as a pastoral station, by the Indigenous Land Corporation.

The Government of Western Australia has control over marine areas of the Ramsar site. The Department of Fisheries is responsible for areas below the low tide mark and for ensuring sustainable recreational and commercial harvesting of fish populations.

The intertidal zone is the confusing area of the law. Technically the area between the high and low water mark is the property and legislative responsibility of the State, although there is a constant tension with the Commonwealth, especially when it comes to determining who has jurisdiction over any resources found in the area.

Residents enjoy fishing and playing

Broome Bird Observatory plays an important role at Crab Creek

PRESSURES ON CRAB CREEK 3

What are the pressures or stressors on Crab Creek? Where do they come from? This section responds to these key questions.

Factors operating at all scales, global, regional and local, have the capacity to adversely impact on Crab Creek (CC). These include:

- Climate change and rising sea levels;
- Invasive pests, weeds and ballast organisms;
- Impacts from introduced or feral animals;
- Disturbance from recreational and business activities;
- Development and land clearing;
- Wildfires or inappropriate fire regimes;
- Socio-economic circumstances of the population.

The world economy and market for natural resources has brought with it a number of significant resource proposals for the Kimberley region such as bauxite mining, natural gas mining and processing, the introduction of genetically modified (GM) crops, and the expansion of irrigated agriculture on the Ord River.

It is anticipated that pressures from the industrial development of the Kimberley would flow to Broome, Roebuck Bay and as a result may impact on Crab Creek.

Global issues may have a much more profound impact than local pressures in some instances. Habitat and food sources for migratory shorebirds are disappearing particularly in rapidly developing nations of East Asia. Coastal development is claiming feeding grounds that sustain birds during their long migration. This is believed to be having an adverse impact on migratory bird populations in the Australasian/East Asian flyway well in excess of the pressure from local visitor disturbance on migratory shorebirds at Crab Creek.

In this plan, there is a recognition that the primary focus needs to be on the local pressures and the Crab Creek management effort and responsibilities; tackling the management with on-ground actions such as controlling visitor impacts and reducing foreshore erosion. While other larger scale pressures that have the capacity to profoundly influence CC are outside the jurisdiction of the CC management effort (eg. climate change), they cannot be ignored. In the CC plan we have dealt with this through recommending strategies such as leveraging (lobbying and awareness-raising), and the provision of appropriate information to those who have the primary responsibility for managing these responsibilities.

It should be noted that some pressures identified by stakeholders are known facts and their impacts reasonably well understood (e.g. uncontrolled pedestrian access). Others pressures identified may as yet be untested perceptions, such as water quality.

Section 5.2 Scales of manageability presents a conceptual model for determining the issues that need to be addressed through the CCMP as a primary responsibility and those that need to be managed through other means.

3.1 Global stressors

It has been observed (Bennelongia, 2008) that factors remote from Roebuck Bay, have the capacity to profoundly influence population dynamics and recruitment (the renewal of populations) within the Roebuck Bay ecosystem. This is particularly true for shorebirds reliant on foreign governments to protect important habitats along the global flyways, but also the number of species, and the numbers within species, of the rich food sources (benthic invertebrate) within the extensive intertidal mudflats around Crab Creek. These organisms are reliant on ocean currents for recruitment, particularly after extreme cyclonic events when massive disruption to benthic communities (the plant and animal communities dwelling on the bottom of the Bay) has occurred. Detecting changes and longer term trends in the inter-tidal communities around Roebuck Bay is extremely difficult, given the unpredictability and uncertainty of these external global influences.

There is another range of more recent global stressors that have the potential to further confound our understanding of the results from the management effort for Crab Creek. These factors such as climate change, oil futures (including the cost of fuel and energy), disease and invasive organisms, independently, have the capacity to further mystify our understanding of population dynamics. Potential interactions between these factors, combined with natural global stressors, significantly add to the complexity and uncertainty. This complexity has the capacity to make it more difficult to measure the success of, or refine our local Crab Creek management effort.

3.1.1 Climate change

Global climate change has the potential to impact on animal and plant communities around the Bay in unpredictable ways. Critical factors associated with climate change are envisaged to include:

- increases in temperature, both average temperatures, but more importantly peak summer temperatures;
- changes in patterns of precipitation (with reductions in total rainfall in the south west and increases in rainfall in the north of the state);
- increases in the frequency and severity of extreme weather events (cyclones, fires, floods and droughts), although the increases in extreme events are predicted to impact the north east of Australia more than the north west;
- reduced productivity of agricultural and pastoral regions, although some crops and regions may even benefit;
- sea level rise and increasing coastal vulnerability.

Of concern with climate change, are predicted interactions between the various factors. For example, increased cyclone severity when combined with high tides and a sea level rise, has the capacity to increase the penetration of storm surge into fringing ecosystems, delivering saline water further inland. Coastal erosion in areas where there are soft sediments is also predicted to increase significantly under the combination of these factors.

For Crab Creek, and Roebuck Bay specifically, climate change has the capacity to stress ecological systems in a number of ways.

Rainfall patterns, stormwater runoff and ground water flows into fringing and inter-tidal areas, may have a strong influence on ecosystem form and function through a range of processes, including changes in the transport of materials both dissolved and particles, changes in nutrient regimes, the supply of carbon, salinity and the impacts of water as an erosion and transport medium (Bennelongia, 2008).

In conclusion, climate change is predicted to increase the uncertainty and variability associated with ecosystem dynamics. The Roebuck Bay ecosystem is naturally highly variable, with distinct seasonality in rainfall, wind patterns, tidal ranges and in the life cycles of animal and plant communities. Fauna and flora in and around Broome have evolved to cope with the prevailing seasonal patterns overlain by the current cyclonic regime.

Delayed effects, uncertainties and indirect impacts potentially associated with these changes, could act to confound our attempts to develop baseline population targets, to set the limits of acceptable change (LAC) required under the 2002 Ramsar Convention.

3.1.2 Oil — world markets and demand

Oil futures and the impact of world energy costs, and the dependency on fossil fuel flows from a global scale down to a local community level with implications for Crab Creek and the people who depend on it. The cost of fuel and energy in remote regions is a critical factor.

For remote regions there is a heavy reliance on fuel oil to move goods and people the large distances required, both on land and at sea. The viability of many industries is therefore highly dependent on the price of oil and fuel, such as agricultural production, the transport of foods to the region and the tourism industry.

Results on Broome from an oil spill in 2009

Impacts from Cyclone Rosita in 2000

Economic growth and production are strongly related to the price of energy. Reserves of fossil fuels and other sources of energy are finite, and for oil supply the trend is downwards, while demand is trending upwards. The effect of these trends is a significant increase in price in the future. Businesses may become less profitable, leading to a reduction in tourism and agricultural production, and increases in the cost of transported and imported foods and other goods in and out of the Kimberley region.

Increased costs of oil and energy may have a complex range of impacts on the Roebuck Bay ecosystem (and therefore Crab Creek), some positive, some negative. For example, possible adverse impacts of increased fuel costs on the Roebuck Bay ecosystem and consequently Crab Creek could include:

- Further financial disadvantage for Indigenous communities and consequently a greater reliance on and (possibly unsustainable) harvesting of important food stocks (e.g. fish cockles, turtle, crabs, dugong, and bush foods);
- Reduced tourist activity and consequent income spin-off for management, protection and development works;
- Increased costs of works to control erosion, and capital works such as building roads, developing public amenities and infrastructure.

Possible positive impacts of future oil shortages and increased fuel costs on the local (Roebuck Bay) ecosystem could include:

- Reduction in tourist visitations to Crab Creek, and consequent reduced threats to cultural and natural heritage;
- because of increased rainfall compared to southern Australia, increased horticultural development in the Kimberley may result in greater economic activity and thus resources potentially available for coastal management.

Possible development of alternative energy supplies in the north of Australia such as tidal and wind power.

As with climate change, the impacts of oil and fuel costs on natural and human communities associated with the Broome area are complex, multi-scale, and difficult to predict, monitor and evaluate.

3.1.3 Diseases and invasive organisms

Many diseases of humans and wildlife present in countries to our north are currently absent from northern Australia. There have been however, changes observed in Australian biota such as frogs, birds and mammals, possibly attributable to infectious diseases (Garnett et al., 2008). Japanese encephalitis has been spreading east through Indonesia, and is now endemic in New Guinea and the Torres Strait Islands. It has been predicted that there is a high probability that it will enter the feral pig population in northern Australia and find its way to other native animals. Were that to happen, it would be impossible to eradicate (Garnett et al., 2008). Marine invasive (ballast) organisms are of concern for example the black-lipped mussel that impacts on the pearling industry.

Cane toads and other feral animal pests also have the potential to further damage agricultural and natural ecosystems. Weed species also have the potential to increase in the future through greater trade and following

the establishment of more favourable conditions associated with climate change. There are a number of weed species already well established in the Kimberley and locally around Broome and additional weed species are likely to damage agriculture and natural vegetation communities through direct competition and/or altered fuel loads, potentially increasing the risk of fires.

As with climate change and the future of oil, diseases and invasive organisms have the capacity to interact in unpredictable ways and potentially impact on the local ecology in adverse ways. Again tracking management efforts become more difficult due to the complexity of stressor factors and the remote conditions in which most pests and vectors (disease-transmitting organisms) are located. PHOTO

3.2 Regional (Kimberley) stressors

Economic growth and the increasing number of the people residing and visiting the Kimberley, impact across the region, including potentially, the Crab Creek area. Pressures include:

- Population growth;
- Exploration and mining;
- Agriculture, including pastoral and horticulture;
- Fishing;
- Aquaculture (including pearling);
- Tourism.

3.2.1 Population

Human impacts are a growing pressure on coastal locations around Australia. The Kimberley region has the second fastest growing regional population in Western Australia with an estimated resident population in 2007 of 34,270 and it is expected to grow to 70,400 by the year 2031. (KDC, 2009)

In the Kimberley, the population demographics are unique, with a generally younger population than elsewhere in WA and Australia, (a median age of 30), and a high proportion of Indigenous people (47.7% in 2006) who form the majority of longer-term residents. According to the Kimberley Development Commission (KDC) the median age of the Kimberley Indigenous population in 2001 was 21 years, while the median age of the region's non-Indigenous population was 40 years.

The region also has a significant population of young, non-Indigenous people among whom many are either itinerant or short-term residents, according to the KDC 2006 Economic Perspective. Furthermore a disparity often exists between these Indigenous and non-indigenous peoples' needs and priorities (e.g. in the use of natural areas). (See 3.3 Local Pressures).

KDC (2006) says '*The Indigenous component of the region's labour force tends to be more stable and less mobile than the non-Indigenous population. During the peak tourism period employment prospects attract non-Indigenous workers from other regions and states, altering the population mix for the duration of the season. In addition, the median age of the resident population at the 2001 Census for the Kimberley was 28 years compared to 34 years for the State as a whole.*'

Population mobility is a significant demographic feature in the Kimberley, particularly among the non-Indigenous workforce. The majority of Indigenous residents tend to be represented in the stable resident population. Indigenous people are not only a part of the demographics; they are a vital part of the social and cultural backbone of the Kimberley region and its economic viability.

A third major demographic feature is the large number of short-term visitors (particularly during the popular tourist period between May and October), estimated to 346,600 annually (KDC, 2009).

The continuing trends across the Kimberley suggest increased visitation and strong population growth, in particular indigenous population growth. With a characteristically large, young population of child-bearing age, and the high numbers of people with a low socio-economic status, the challenge will be to meet the population's needs that include health, recreation, education, employment and the retention of culture.

3.2.2 The Economy

The Kimberley region has a diverse regional economy: mining, retail, tourism, construction, pearling, agriculture including pastoral and horticultural, manufacturing (e.g. steel fabrication, diamond and pearl jewellery), and services are major industries that contribute to the region's economic output.

Natural Resources: Exploration and mining

The Kimberley is renowned for its wealth of natural resources (e.g. minerals, gas and petroleum). A significant amount of industrial activity comes from off-shore areas or other places in the Kimberley. Broome is the established regional service hub for many of the industries and the Port of Broome, on the edge of Roebuck Bay, operates as the off-shore supply base and the port for shipping and transportation.

With many of the proposals now being considered, it could be assumed that this will create increased activity around the Port of Broome as it responds to the requirements of regional development, and this may have subsequent impacts on Roebuck Bay and Crab Creek.

Agriculture: pastoral and horticultural

Beef cattle are the Kimberley region's traditional pastoral industry and over 50% of the area is still held under pastoral lease. The Department of Agriculture and Food reports that there are an estimated 100 pastoral stations in the region.

The Kimberley herd of beef cattle is estimated at about 600,000 representing around 30 per cent of the total WA herd. The value of cattle disposals from the region was estimated to be between $60 to $70 million in 2004/05. The cattle are carried by road trains to Broome, held in paddocks close to the Port and then transported out by ship, as live export trade. In 2007 more than 90,000 cattle were exported to South East Asian markets and the live cattle exports are expected to grow according to trends.

Kimberley crop production is dominated by the region's largest irrigated agricultural project, the Ord River Irrigation Area, located near Kununurra. Currently forestry (Indian Sandalwood in particular), utilises the largest tracts of land. The second stage of the Ord River development has recently commenced.

There are also horticultural activities undertaken in the West Kimberley, near Broome and Derby (e.g. mango, melon, and banana), and some bush food production (such as Gubinge).

Fishing

KDC (2006), tells us the fishing industry in the Kimberley includes catches of wild stocks and an aquaculture industry dominated by pearling. The principal fisheries in the region focus on finfish, particularly the high-value emperor, snapper and cod varieties. The region has a limited number of trawl fisheries for prawns. There are also significant fisheries for Spanish mackerel, barramundi, threadfin salmon and shark.

Considerable gaps exist in understanding fish populations across the Kimberley (DoF, 2009). Research needs to be undertaken to understand the bigger picture on sustainable management of coastal food stocks across northern waters and the role of Roebuck Bay and the Crab Creek area as a nursery for this industry.

Aquaculture (Pearling)

Pearling is a highly lucrative industry with pearls being farmed throughout Kimberley waters.

The pearling industry needs clean waters and some concerns have been expressed about possible contamination of the Kimberley's clean waters by the development and growth of industry in coastal locations.

Other forms of aquaculture are being trialled across the Kimberley. An integrated plan for aquaculture in the Kimberley has recently been prepared by the Department of Fisheries (DoF, 2009).

The Port of Broome is also the regional port for servicing the pearling industry.

Pressure from pastoral activities

Fishing and tourism are important components of the local economy

Tourism

The lure of the outdoor lifestyle, unspoilt environment, wide open spaces, freedom of independent travel, clean waterways, amazing array of animals and environment, an ancient culture and the prospect of adventure and excitement 'in the wilds' draws people to travel the Kimberley region. Nature based and cultural tourism opportunities are key attractions that draw significant numbers of visitors from around the world.

Visitation to the region is largely seasonal, mainly between April and October, due to the reliably fine warm weather. Apart from recorded arrivals, thousands travel independently or in organised guided tours e.g. coach tours, fly in private aircraft, sail in yachts or cruise the coast, and these independent visitors are often not calculated in tourism numbers. During this 'Dry' season there is a large influx of visitors (often elderly and often on restricted budgets, locally known as 'grey nomads', who travel independently in vehicles. Their travel is often for longer periods and for some has become an annually adopted lifestyle. Characteristically many wish to camp free and enjoy the natural areas, and to exploit the natural resources such as fish, crabs, fresh water and timber. The secluded areas sought out are often culturally significant, though many travellers are unaware of this.

In the Values Mapping Report (Community Solutions 2004) Elix and Lambert note that 'with the increasing demand for nature based tourism, identification and declaration of National Parks and natural areas now acts as a magnet for tourists, who are attracted by the very selection of those areas and the fact that the areas are made open to public access. The act of dedication thus creates its own demands (Preece et al., 1995).

Much tourism across the Kimberley is unmanaged and most of the utilised areas are in natural or culturally significant areas, often in remote locations, both on land and sea. These factors apply equally to tourism in the coastal areas around Broome, including at Crab Creek.

3.3 Local Stressors (Broome, Roebuck Bay and Crab Creek)

The Shire of Broome is the region's largest population centre with more than 40% of the Kimberley population.

In order to identify the pressures on Crab Creek it is important to consider the nearby impacts from Broome and Roebuck Bay. These include:

- Population growth and human uses;
- Increased tourism;
- Development of the townsite;
- Infestation of Lyngbya (blue green algae); and
- The growth in Port activities.

In workshops held during the planning process, RBWG members and stakeholders identified the pressures on Crab Creek and rated their priority for management. This included a review of those impacts identified previously during the RB Issues process. (Community Solutions 2004 and 2006).

3.3.1 Population growth and human uses

Human impacts have been identified clearly as exerting the most pressure on the Crab Creek area, though Roebuck Bay is currently considered to be 'largely pristine' (Bennelongia, 2008). Therefore, growth of the resident and visitor population is a key consideration in planning to manage coastal areas around Broome, as is the socio-economic status of its residents.

With the town's rapid growth, urban development and diminishing access to natural areas of public open space, people seek places to get away from the stresses in their life. Historically people have headed to the cool and shady places close to the coast to find peace and quiet and to 'recharge their batteries'. People continue to be drawn to these free areas close to water as they provide accessible places to recreate and they have a strong place in the physical and mental well-being of the Broome population.

More Indigenous people from outlying communities are moving into Broome. This is likely to have been prompted by the withdrawal of the Community Development Employment Programme (CDEP), in order to meet Government stipulations for education, training and employment requirements. It also results from Broome being developed as the regional centre for service delivery e.g. health, welfare and education.

In the 10 years between 1995 and 2005, Broome's population increased by 55 per cent. (Preliminary estimate based on the 2006 Census of Population and Housing. Source: Australian Bureau of Statistics). In 2007 it was estimated that the Broome Shire supported 14,984 permanent residents, (KDC, 2009).

Furthermore human pressures increase considerably during the peak tourist season, with up to 237,000 visitors annually. (Tourism Western Australia, 2008). The projections are that by 2028 Broome's resident population will double in number (WAPC, 2008).

Often those residents on the lowest incomes, (and therefore with the greatest need to readily access coastal resources to feed families), have less money for fuel or are less likely to have a vehicle to transport them beyond the immediate coastal fringes of Broome (LGDP, 1998).

Well equipped recreational fishers

Catching 'a feed' from the shore

The relatively poor socio-economic status of Indigenous people has been well documented. According to 2006 census data, government pensions and allowances were the main income source for the majority of Indigenous people, and they have lower employment rates with two out of five working age people not engaged in the workforce. (ABS 2008). Furthermore Indigenous people in remote areas have increased disadvantage including limited access to services and labour markets. This has important implications for Indigenous people living in Broome, and impacts on their health and other life outcomes.

While the data confirmed that Indigenous household income had increased in recent years, the gap is widening between Indigenous and non-Indigenous incomes. It further supports the notion that along with the increased population is a subsequent increase in people in higher income brackets. This correlates with an observable number of people with sophisticated recreational resources: boats often equipped with GPS, fish finders, radios, satellite phones, refrigeration, (pers. comm. Peter Westgate, DPI, 12/3/09), well equipped off-road vehicles, motor cycles, off-road campers and all-terrain vehicles (ATVs).

Issues arising from the lower socio-economic profile of the local population are likely to increase with the widening income gap. A significant group of people are already feeling excluded from the benefits of the local boom and the economy, (pers. comm. Cr Elsta Foy 30/3/09).

The population characteristics of the region have important ramifications for Crab Creek and the Broome area: e.g. meeting the needs of a young (see Section 3.2.1) and relatively poor population that require more readily accessible and freely available opportunities for recreation, exercise and sustenance. The coast, natural areas and public open space are vital components to meet these needs (BSC, 2009). PHOTO

It is in the coastal havens which Indigenous people have traditionally used for centuries that a feeling of encroachment from the outside world is often sensed. Often the popular areas for visitors are the same areas that are customarily highly valued for fishing stocks, cultural practices etc. The influx of more people, often with different and conflicting values, has brought many changes, for example, increased competition for reduced coastal resources (e.g. fish and crabs), the introduction of laws, legislation and controls that may have impinged on Indigenous customary practices, and more development of the townsite towards, or on, the foreshore thus reducing access.

The use of the Crab Creek foreshore for activities such as recreational fishing is growing along with access to the area by boats and vehicles. This brings additional pressures, for example, anecdotal evidence suggests some fishers may be over-exploiting coastal resources like crabs and fish, and reports suggest this is more common in unmanaged areas that are visibly free of an enforcement presence.

Transient visitors are said to be less likely to develop a sense of ongoing stewardship for specific coastal areas, as compared with permanent populations frequenting the area (according to workshop participants at the 2001 Coastcare Conference in Esperance WA).

Results from a 2003 study (undertaken for Traditional Owners [Rubibi] by Elodie Comte and Melise Willmot from Montpellier University), on visitor awareness of the cultural and natural values and user impacts on Cable Beach, indicated that most visitors to the coast did not understand Indigenous cultural values or practices or the impact of vehicle use on beaches.

3.3.2 Tourism

Broome is a high profile internationally recognised tourist destination with ever-increasing numbers of visitors flocking to the surrounding coastal country. With natural attractions right on its doorstep, Broome provides an array of recreational opportunities such as fishing, boating, camping, swimming or simply a place to enjoy spectacular colours and scenery e.g. beach sunsets. Some of the world's best reef and game fishing is known to be in the surrounding waters, and Broome has become a hub for enthusiasts. The numerous tidal creeks are ideal for boating and provide access to fishing, crabbing and for bird watching. From July to October, whale watching has evolved as a product in recent times.

During the 'Dry' season, at the peak of the tourist season during the months from June to August, Broome's population swells to over 45,000 per month (Broome Visitors' Centre [BVC] website, 10 March 2009). Even during the 'Wet', the off-season for tourism, visitor numbers have increased sharply, with reportedly more than 10,000 additional people having passed through the Broome Visitors' Centre during the 08-09 'Wet' season compared to the same period in the previous year.(ABC Local Radio 11am news report on 3 April 2009).

Visitors are keen to know more of the local culture and natural environment and there is a greater tendency for self-drive discovery travel around Broome's coastal areas, and a growth in commercial tourism operations supporting this demand. Activities such as guiding tourists around Crab Creek bring additional pressures on the physical environment, however, there are also benefits flowing on an economic, social and cultural level. In the main, guided tour groups are better managed and put less stress on the area than uncontrolled visitation.

The townsite on Roebuck Bay

Inappropriate foreshore development on Roebuck Bay

3.3.3 Townsite development

Strong growth in the planning and development of Broome reflects the demands from a rapidly-growing population and the increasing numbers of visitors.

The requirements to meet the needs of an increasing human population be it resident or visitors, include essential service provisions such as water, power, sewerage, and shelter. This demand creates increased stressors from groundwater drawdown and altered surface drainage patterns. This is in part due to the construction of roads and the sealing of surfaces, which reduces the penetrability of surface areas, (for example, from expansive built environments like shopping centres, car parks, airport runways, housing estates, resorts and the proliferation of residential and public paved areas).

This also leads to the concentration and redirection of stormwater run-off away from dependent habitats toward vulnerable ecosystems (e.g. coastal foreshores), and causes increased peak run-off velocities potentially leading to significant increases in erosion.

A new wastewater treatment plant is being established within the Crab Creek study area. The plant is on a 200 ha site at Lot 67 Crab Creek Road and is scheduled to start development in late 2009. This will involve major earthworks and excavation. People have expressed some concern during the CCMP consultation about the proximity of the treated effluent irrigation system, both for the treatment sites and the on-site irrigation field planned for the area.

Land use planning and changes to purposes and uses have a strong influence on and exert pressure upon the coastal fringes around Roebuck Bay. Areas that have historically provided somewhat of a buffer between the township and the Bay continue to be developed and this has had flow-on effects to Crab Creek. For example, Traditional Owners, represented by Rubibi (Shire of Broome/Rubibi 1997) have previously expressed concern about pollution entering the Bay from a caravan park's septic system, from changed drainage regimes after the extension and development of the Broome airport runway, and the development of a shopping centre over wetland areas in Chinatown.

A plan for the future development of Broome, Waterbank Structure Plan (DOLA, 2000), was prepared for an area adjacent to the townsite and the Crab Creek study area. The area, previously a pastoral station, is known as Waterbank Station, and is part of an area subject to a Native Title claim. Proposals for future development on Waterbank and along the Broome Road corridor (see Griffiths (2008) *Impacts and Prevention*) includes sites for an international airport, heavy industry, commercial operations, wastewater treatment, horticultural projects, residential subdivisions, and areas for tourism development, all of which are likely to have a range of impacts on the Crab Creek area.

Significant residential and tourism development is planned for Broome. Planning has commenced for the provision of up to 2500 blocks of land over the next five to seven years to somewhat alleviate the current housing pressure, that is expected to increase along with the growth

of Broome and flowing from the industrialisation of the Kimberley. Residential development is planned to the north of the existing townsite (closer to Crab Creek) at Bilingurr, where a yield of 900 plus dwellings is expected (WAPC, 2008). Essential service provisions for water, power and sewer services and drainage will bring additional pressures.

3.3.4 Lyngbya (blue green algae)

Lyngbya was considered a local stressor of concern to numerous stakeholders throughout the planning process. It has the potential to adversely impact on animals (e.g. dugong and turtles) and local fishers have found that Threadfin Salmon move out of Lyngbya infested areas. Lyngbya has been found to smother sea grasses and mangrove communities. In Queensland it has been found on occasions to be highly toxic with significant risk to public health through direct contact. There are also concerns that consumption of contaminated sea food could harm humans. There is little understanding of the triggering mechanisms for Lyngbya despite considerable research into the topic undertaken in other areas of Australia. PHOTO

3.3.5 Growth in port activities

The Port of Broome plays a key role in supporting global, regional and local markets. Apart from the transport function, it is the supply base for off-shore activities such as oil/gas research and development and mining.

It is also the deep-water port and jetty from where more localised stressors that impact on Crab Creek either directly or indirectly, originate. For example, the hovercraft vessels are based at the Port, transporting tourists to the shores of Crab Creek each day. Resource development has meant that areas of land are increasingly cleared for lay down areas for the associated storage needs within the port and the adjacent areas and the number of shipping movements has increased. With this comes more ancillary vehicle movements, cargo, need for sewage disposal (sewage discharge is not permitted in the Port area), bilge, facilities for boat maintenance (e.g. anti-fouling and sand blasting). Stakeholders at CCMP workshops and in community consultations raised concerns about the future growth in Port activities and the flow-on effects to the Crab Creek area.

Lyngbya on Roebuck foreshore

Increasing shipping activity

The further expansion of Broome as a base for the Browse Basin exploration and mining and providing some support for shipping for the North West Shelf, will lead to an expansion of Broome port facilities (Capt Vic Justice pers. comm., Community Solutions, 2004). It was stated during consultation that exploration permits for petroleum are held over the wetland area of the Bay. Pressure to develop petroleum reserves within the Bay, and increased shipping activity all increase the risk for shorebirds of a globally catastrophic oil spill (ANCA, 1996). Fortunately, the Broome Port Authority takes this issue very seriously and maintains international best practice in oil and chemical spill containment and contingencies. Port contingency plans for severe weather events and spills are vital and up-to-date from the information available to us.

3.4 Pressures on Crab Creek

For Crab Creek, pressures arising from population growth, increases in local and tourist visitation, and uncontrolled access to the foreshores have led to negative impacts on significant cultural sites and natural habitats, disturbance to migratory shorebirds, as well as resulting in less availability of important coastal resources like food and medicine.

Stressors most commonly identified by stakeholders include:

- Uncontrolled vehicle and pedestrian access;
- Invasive weeds;
- damage to cultural sites;
- Lack of public amenities (i.e. shade, water, directional signage, parking areas);
- Inappropriate and unmanaged camping;
- Insufficient tourist information;
- Lack of enforcement;
- Inappropriate fire regimes and wildfires;
- Foreshore erosion;
- Litter;
- Over-exploitation of coastal resources e.g. fish and crabs.

Pressures arise on cultural sites, (e.g. middens) and important food and medicine stocks sourced from both land and sea. Uncontrolled camping and vehicle access causes erosion on cliffs, vegetation destruction, the unsustainable collection of firewood, and the proliferation of litter. Boating activities like high speed and rapid maneuvers disturb and harm wildlife (DPI, 2008). PHOTO midden

Visitor impact is one of the key management challenges at Crab Creek. Suitably organised and accredited tourism operations can help control and manage large numbers of people and aid in the raising of awareness and protection of sensitive cultural and natural areas, as well as provide employment and economic opportunities.

Increased visitation will mean more vehicles, humans, boats, dogs and litter. However by educating and raising visitor awareness and promoting codes of conduct in the use of Crab Creek, for example the sustainable take of coastal resources; the seasonality and abundance of food (e.g. the fat and skinny times of fish, crabs, birds and reptiles), and the scarcity specific to species and breeding cycles. This may help to reduce pressure on important food stocks.

Fishing is a highly valued customary practice and popular recreational activity. Species such as barramundi, tropical emperor, sea perch, mangrove jacks, trevally, sooty grunter, threadfin salmon, cod and mud crabs are locally sought out by fishers in the creek systems, mangroves, and other coastal areas. However fishing and utilising coastal resources are a vital part of the non-cash economy and subsistence for many people, particularly Indigenous people.

Commercial fishing was identified as a local stressor on Crab Creek by participants at the RBWG workshops however the Department of Fisheries W.A. (DoF, 2009) manages fish stocks/licences on a regional basis. Some respondents stated that further consideration needs to be given to determine where and how sustainable commercial fishing can operate in particular to ensure that dietary and cultural needs of local residents are protected into the future. Gaps in knowledge about fish stocks are acknowledged by DoF (2009).

The particular focus of the Crab Creek Management Plan is to examine the pressures exerted locally and to identify management strategies that may be undertaken on a local level to reduce negative impacts.

Shell midden site at Mangalagun

Uncontrolled vehicle access to cliffs around Crab Creek

Fire threatening the country around Crab Creek

MANAGEMENT THEMES: TRENDS AND LINKAGES 4

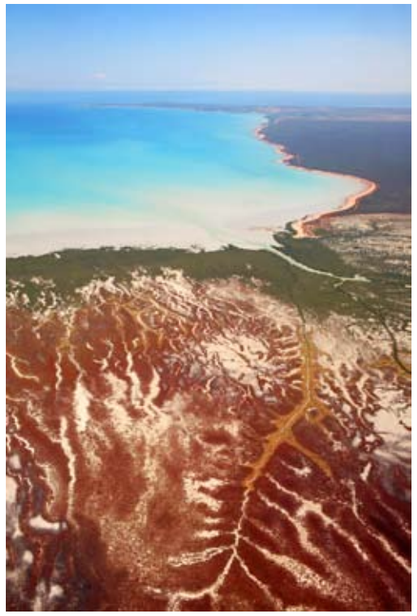
Following the identification of the stressors impacting on Crab Creek, this section develops our findings into management themes (or dimensions of management). These 13 themes incorporate the main stressors (both natural and human pressures), and include some proposed responses (e.g. rangers).

In table 4.1, examples relevant to Crab Creek provide an aid to understanding.

The management themes, have been categorised as arising from a natural process, a 'driver', or due to human influence termed 'anthropogenic' factors: a 'lever', (Bennelongia, 2008), or the theme is considered to be a management response.

The scale of application relates to where the management effort needs to be applied. This concept is further developed in Scales of Manageability in Section 6.

Vehicle pressure on cliffs and vegetation at Mirda (One Tree)



Crab Creek joins Roebuck Bay

Table 4.1 Management Themes for Crab Creek

No	Management theme	Example	Category[a]	Scale of Application[b]
1	Education, awareness raising & decision making	Uniqueness of local animals & plants, Indigenous culture	Response	Crab Creek, Broome, Roebuck Bay for Global
2	Human use pressures on cultural & natural resources	Destruction of middens, increased fire & illegal camping	Lever	Crab Creek
3	Coastal vulnerability	Cyclones, storm surge, sea level rise	Driver	Crab Creek, Broome
4	Rangers	Monitoring, information, enforcement	Response	Crab Creek, Broome, Kimberley,
5	Public amenities	Shade structures, bird hides, signage, toilets, water	Response	Crab Creek
6	Crab Creek foreshore erosion	Eroded sediment smothering mangroves, erosion gullies	Lever	Crab Creek
7	Water quality & quantity of inflows to RB	Sewerage spills, reduced groundwater flows	Lever	Crab Creek, Broome, Roebuck Bay
8	Habitat disturbance & species loss	—Migratory shorebird disturbance, —seagrass loss —Loss of habitat for dolphins, dugongs, turtles.	Lever	Crab Creek, Broome, Roebuck Bay
9	Impacts from development	Tourist operations, industry, horticulture	Lever	Crab Creek, Broome, Roebuck Bay
10	Lyngbya	Potential human health impacts from algal toxins	Lever	Broome, Roebuck Bay
11	Important coastal food stocks (eg fish) & resources	Fish, crabs, cockles, bush tucker, medicines	Lever	Crab Creek, Broome, Roebuck Bay, Kimberley
12	Invasive species	—Weeds, —ballast organisms —cane toads	Lever	Crab Creek RB, Broome Western Australia
13	Climate change	—Alteration of ocean currents, —increase in sea level —loss of habitat —increased temperatures	Driver	Crab Creek, Australia

Category[a] = .Categorising according to (Bennelongia, 2008)

Application[b] = The scale of application as it applies to the Crab Creek management effort.

The trends and linkages associated with the management themes

For each of the 10 themes that is a lever or driver, the trends and linkages have been addressed along with the key issues. Issues were identified from previous works undertaken for RBWG in planning the management of the greater Roebuck Bay, and from stakeholder input through consultation and workshops. Each theme incorporates a description of how the stressors may be changing over time (the trends), and how the stressors relate together, (the linkages).

The three themes identified as responses, Rangers, Public Amenities, and Education and awareness-raising and decision making, are discussed in Section 5.

Theme 4.1 Human use pressures on culture and natural resources

Trends

- Visitor numbers to Broome are increasing; this means more people share a finite stock of coastal resources including sea foods, bush tucker and medicines. More pressure on precious and diminishing cultural and natural resources including firewood (fuel), water, shade, shelter and habitat.
- It is a common sentiment expressed by local residents that with the increasing numbers of 'outsiders' coming onto land and sea, particularly where Aboriginal people have lived and roamed, that pressure is experienced (ill-ease, and a reduction in privacy) in the use of places that were traditionally fished, camped upon and frequented to undertake customary practices including law business.
- Population pressures mean more housing, more sewerage, more clearing of natural vegetation, more lawns and water-thirsty gardens, more hardened surfaces impacting upon drainage patterns and stormwater runoff and nutrient load into the Bay.
- Increasing development of natural areas and the associated clearing of land that is customarily used for the collection of bush foods and materials, for hunting and for cultural transmission.
- More people living in town, with increased numbers of low income people with a greater need and less ability to access alternative areas and secure food stocks.

Certain people are getting further out, with ease, into natural areas of both land and sea.

People with disposable incomes and desire for greater recreational experiences often have the ability (through 4WDs, boats, ATVs and sophisticated equipment and technology) to find places and comfortably access to more remote areas. Often they have the advantage, ability and equipment to exploit the coastal resources. (Freezers, GPS, radio, fish finders, booklets and web sites that identify (by GPS) where prime resources or spots are) This greater mobility has been associated with the dispersal of introduced weeds through inadvertent transport on car tyres, shoes, carried on pets, and pests for example in bilge water on boats.

Linkages

- Lack of policing and being scrutinised, often means some people will exploit the conditions or resources (linking to need for rangers and education).
- Need to funnel people; direct them to areas of less sensitivity away from sensitive areas.
- Awareness needs to be raised and understanding of the need to share resources equitably and practice responsible and sustainable attitudes.
- By giving people somewhere appropriate to go (i.e. with public amenities to divert them), we reduce the human impacts on more vulnerable areas.
- People are making their way into previously inaccessible areas; resulting in habitats increasingly being disturbed.

Theme 4.2 Coastal vulnerability (storms, sea level rise)

Undertaking vulnerability assessments of the coastal zone identifies which areas are susceptible to damage in the future through the increased likelihood of catastrophic climate-related events. Early identification of vulnerable areas and risks to people and property is essential, to allow sufficient time to budget for, and implement contingency responses.

Trends

- Increasingly people want to reside or recreate on the coast; and consequently more infrastructure and development is occurring in potentially vulnerable areas;
- Predicted increases in severe weather events with an increased sea level compound the risk to people and property and natural and cultural resources in and around Broome.

Increasing coastal vulnerability and duty of care obligations have meant that local authorities in some Australian cities have bought back coastal developments or freehold land in order to reduce their future financial exposure and legal liability, for example by Warringah Shire Council at Collaroy Beach in NSW.

Linkages

Interactions between rapid regional growth particularly in the energy sector, increased port visitations and increased risk of extreme weather-related events could combine to increase the risk of catastrophic oil or chemical spillage which could severely damage the ecology of the Bay. PHOTOS

Theme 4.3 Foreshore erosion

Trends

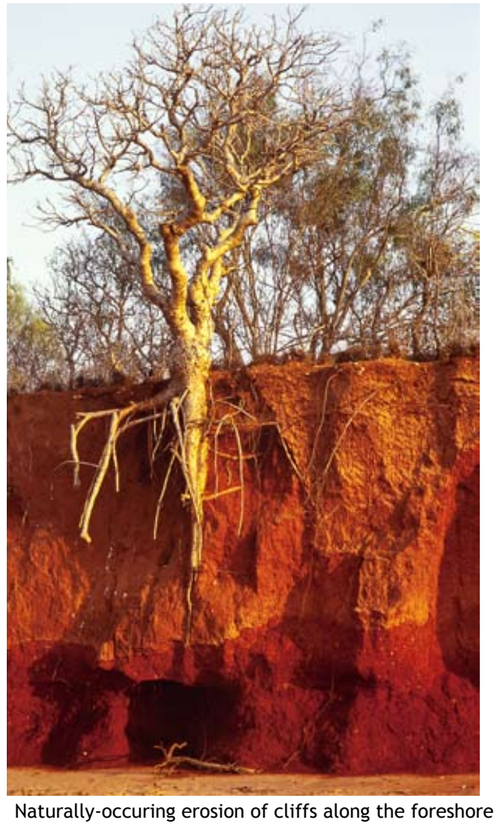
- Creation of tracks by unmanaged vehicles and pedestrians, destabilises coastal cliffs, disturbing habitats, and introduces weeds. Once erosion commences and large erosion gullies are formed, their adverse impact increases;
- More and more visitors:
- Improved understanding and management practices of cattle in adjoining pastoral station minimising coastal erosion from grazing animals;

- Natural trends relating to severe weather events, such as cyclones and flood, are increasingly being considered by relevant agencies (e.g. FESA and Shire) in their strategic planning and emergency response plans.

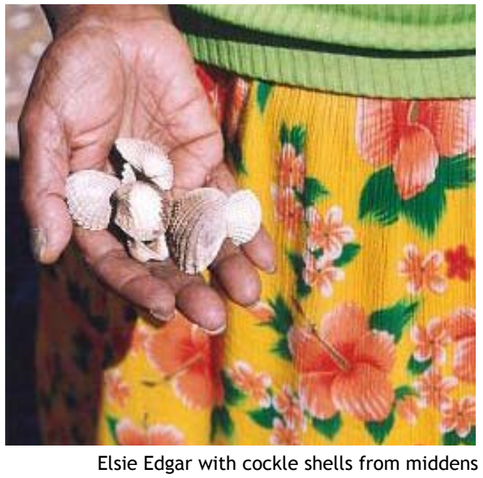
Linkages

- With no designated car parks, walking trails or beach access except near the BBO, increases the likelihood of inappropriate access.
- Foreshore erosion is increased when protective vegetation is degraded or disturbed by human impacts, particularly on cliff edges.
  The salt marshes around the Bay bind the soil during periods of flood and also help reduce wind erosion along the coastline. (ECD, 2008 p60).
- It is believed that mangroves are being adversely affected by the eroding pindan sediment from unmanaged vehicle access along the foreshore.

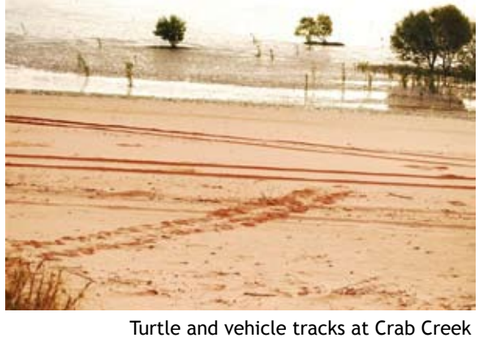
In 2008 a pilot investigation indicated that eroding pindan sediments from unmanaged vehicle access along the Crab Creek foreshore may be adversely impacting on the structure (as measured by its penetrability) of the inter-tidal sediments, thus reducing the availability of phosphorus to marine plants. It has been speculated that accelerated foreshore erosion into the fragile intertidal areas may be adversely impacting on the recruitment of mangroves and on molluscs, where benthic microalgae that the molluscs feed upon have been reduced in abundance.



Naturally-occuring erosion of cliffs along the foreshore



Elsie Edgar with cockle shells from middens



Turtle and vehicle tracks at Crab Creek

- The numbers of large grazing molluscs may be reduced, where it is possible that benthic micro-algal assemblages on which they feed have been reduced as a consequence of the reduction in available phosphorus in surface sediments impacted by the eroding pindan.
- By grading Crab Creek Road the road is getting deeper and collects more runoff resulting in higher peak velocities into the Bay.
  Both cockle numbers and their size has diminished, and water/sediment inputs have been mentioned as a causative factor. (Anecdotal evidence during consultation with Indigenous people).
- Foreshore development closer to Broome and high usage by power boats in creeks and foreshore areas are reputed to create erosive forces impacting on the coastal fringes. Photo erosion

Theme 4.4 Water: the quality and quantity of inflows

Most of the stormwater entering Roebuck Bay is currently untreated. There are few detention or retention structures and few litter traps. This means that there is the potential for nutrients, sediments and gross pollutants to be delivered to the Bay in stormwater without any form of attenuation. Fortunately for Broome, the high phosphorous-binding capacity of the pindan soils and the relatively low levels of fertilisation of street plantings means that there is relatively low levels of soluble nutrients available for transport by stormwater.

The rapid growth of Broome and an increasing emphasis on exotic vegetation and wide expanses of fertilized turf along streetscapes, means that background levels of nutrients available for movement into the Bay are increasing significantly. This is, of course, acceptable so long as appropriate stormwater detention and treatment structures are also being incorporated into drainage systems. However, this does not appear to be the case in many new development areas. Greater levels of nutrient and pesticide application to public and private landscapes and horticultural areas also increase the risk of elevated pollutant levels in groundwater leading to the Bay and to Crab Creek.

Waters around Crab Creek are the habitat for the Australian Snubfin dolphin

Introduced species e.g. Neem trees destroy native species

Trends

Rapid growth in resident and visitor populations for Broome has produced a rapid increase in new accommodation sites. Many of these promise a tropical paradise with wide green landscape vistas.

Increases in impervious surfaces, irrigation, nutrient and pesticide applications mean that authorities must redouble their efforts to ensure proper stormwater attenuation systems are put in place during developments to minimise the risk of pollutant inputs to the Bay.

Linkages

- Possible loss of fringing vegetation through a lowering of groundwater tables through abstraction.
- More extreme rainfall from climate change brings greater probability of catastrophic sewage pond failure, as occurred in January 1997, when 415mm of rain fell in 5 hours.

Theme 4.5 Habitat disturbance and species decline

From the stressors identified there is a range of negative impacts arising or likely to arise at Crab Creek. These include threats to biodiversity, such as habitat disturbance and fragmentation and the decline of species. Both on land and sea (and in the air) animals and plants are being injured and disturbed. Stakeholders identified these trends.

Trends

- Concerns expressed that seagrass meadows are under threat, from increased boating, fishing and commercial activity resulting in monitoring at limited sites.
- Anecdotal evidence suggests that fish stocks have diminished notably; threadfin salmon, barramundi, mud crabs and shell fish like cockles. (These are important food stocks for the local population and highly prized by many recreational fishers).
- More people are fishing and gathering without heeding the seasonal appropriateness of ‘takes’ traditionally observed by Indigenous people. (Sustainable fishing practices).
- No statistical data on recreational or customary fishing was available.
- Lyngbya is known to impact adversely on other natural eco-systems by smothering and shading.
- Wildfires and inappropriate fire regimes are changing the structural composition of vegetation, impacting on longer-lived trees and reducing native species. (Some species do not regenerate after fires).
- Fire favours colonising vegetation, opportunistic species, (both native and introduced) and fire-tolerant species.
- Communities such as vine thickets are particularly vulnerable to fire and presently suffer from shrouding by introduced vine species that increases the fuel load and fire hazard.
- Fire is implicated in the extinction of small mammals in the arid and semi arid areas of northern Australia.
- More human incursions into remoter areas and increased numbers of people driving on the beaches increases the risk of disturbance e.g. shorebirds and turtles.

- Direct injuries and mortality to marine wildlife from commercial and recreational boats.
- People are venturing further afield to source important food and cultural stocks and for recreation.
- Less populated beaches are sought for recreation e.g. to escape crowded Cable Beach.
- Increased numbers of people walking dogs at Crab Creek thus disturbing roosting birds.
- Rocks and shells are being removed around the coast, thus reducing habitat (LGDP, 1998).
- Introduced species are competing with native animals for hollows and habitats (e.g. European bees displacing native possums, parrots and bats).
- Diminished and fragmented areas of bush and other important refuges and habitats, prevents the movement of native animals along corridors.
- Introduced plant species and weeds have devastated, choked and infested valued vegetation communities such as monsoonal vine thickets and pindan woodland. For example Neem trees, South American passionfruit, Darwin Pea.
- Animals such as feral cats and foxes are more prolific in recent years. (pers. comm. Kingsley Miller DEC).
- Cattle may have had a degrading impact on both the flora and fauna and fresh water sources in and around Crab Creek due to previously poor management practices.
- Vegetation is increasingly being cleared in adjacent areas (e.g. roads, development and wastewater treatment plant, etc.) and this reduces the corridors and linkages for fauna movements, and prompts the relocation of fauna to the Crab Creek area forcing competition on existing species, habitat and food sources.

Linkages

- Areas have historically been devastated by natural events such as cyclones.
- Gaps in knowledge are evident; (DoF, 2009; Bennelongia, 2008) baseline information is needed to establish the true extent of species decline.
- Hovercraft movements have been cited as an unwanted and potential impact on Crab Creek. Conversely, awareness-raising commentary on board the vessel is said to bring visitors greater understanding of the values of Roebuck Bay (LGDP, 1998).
- Changes from disturbances and species decline flow to various levels of the food chain.
- Raising awareness and educating users can influence people to behave in ways that reduce negative impacts on the environment and biodiversity.
- Controlling vehicular access will minimise incursions to sensitive areas.
- Fire that reduces the diversity of species and habitats is a threat to the animals, insects, birds, etc. that depend on them.
- Injuries and disturbance to marine animals (e.g. snubfin dolphins) from boats can be reduced, by introducing speed limits and education.

Theme 4.6 Impacts from development

Rapid population growth in the Broome townsite brings with it a number of impacts on the Crab Creek area, many of which interact.

Trends

- More development in adjacent areas will mean increased pressures on Crab Creek e.g. drainage, visitors, domestic pets and vehicles.
- More people want to live close to the coast and developers have responded to this desire.
- As access to other recreational areas is restricted, more visitation to Roebuck Bay foreshores is likely.
- Clearance of vegetation leads to a reduction of habitats. This leads to the placement of more pressure upon the remaining (remnant) natural areas by fauna, and by those people collecting bush foods, timber for artefacts, and firewood.
- Increased amounts of stormwater are flowing into the Bay.
- People are planting exotic species that have the capacity to escape or become invasive species in bushland. These often require more water and fertiliser.
- Pollutants like fertilisers, nutrient load, etc. is getting into the waterways.

Linkages

- Previously removal of natural landforms to quarry gravel at Fatima (Quarry Beach) has been a destructive force on vegetation, created foreshore erosion and cliff instability.
- In considering applications for development, decision makers need to be aware of the flow on effects to coastal areas (e.g. changing drainage patterns, increased human and vehicular traffic on natural areas).
- Public facilities will draw more people to Crab Creek.
- Educating planners, governments and legislators and those responsible for making planning decisions to maintain coastal buffers and reduce the risk posed by severe weather events and impacts from global warming.
- It is suspected that numbers of Black and Whistling Kites, which are predators on other species, has increased, due to increased food around human settlements, garbage tips and roads.

High tidal range & townsite drainage pressures

Neil McKenzie and DIA staff at old gravel pit

Theme 4.7 Lyngbya (blue green algae)

A naturally-occurring marine blue green algae, *Lyngbya majuscula* has been observed in coastal waters around Australia. Since 2005, Lyngbya has been noted to increasingly occur in Roebuck Bay. The negative impacts of this species interact with other pressures.

Trends

Increasingly evident in Roebuck Bay:

- Community monitoring and rudimentary research being undertaken.
- Complex mechanisms controlling Lyngbya blooms are not yet fully understood despite considerable research elsewhere.

Linkages

- May destroy mangals and seagrass, and potentially kill or harm marine wildlife.
- Lyngbya contains toxins that turn some marine animals off their food and can also cause rashes, itches, burns, tingles, blistering and breathing problems in humans.(Deeley, 2009).
- Anecdotal information suggests that increases in Lyngbya is linked to erosion and pollutants entering the Bay.

Theme 4.8 Important food, medicinal and cultural resources

Food, medicinal and cultural stocks sourced in and around Crab Creek are vital to many Broome residents. These include marine resources such as fish, crabs, turtle, dugong, stingray, oysters, cockles and other shellfish. According to the Rubibi community (LGDP, 1998), many of the coastal resources are diminishing. On land other varieties of seasonally-available foods, such as reptiles, wallabies, birds, eggs, and bush fruits are threatened by a number of factors including shrinking areas of natural bushland and disturbance by increased human visitation.

Trends

- Diminishing availability of food stocks due to reduction in natural areas where bush food, medicines and timbers are gathered.
- Reduced access to foreshores makes getting food harder.
- Travel further afield for food supplies.
- People are relying more on supermarkets for food supplies.
- Health status has declined due to more sedentary lifestyle and diet.
- People with the lowest incomes depend more on coastal resources to supplement their diet.
- Competition for finite resources between those who are well equipped and those who are economically disadvantaged.
- The commercialisation of bush tucker (e.g. Gubinge) and demand by world markets has led to the use of detrimental practices in harvesting.

Linkages

- To ensure sustainable use of natural resources (e.g. fishing practices, bush tucker and timber collection, hunting), education and awareness raising is paramount.

- When natural areas are cleared, there are fewer resources available for customary use; access to natural resources are vital for cultural transmission.

Theme 4.9 Invasive species

Population growth and increased visitation to areas such as Crab Creek, increased shipping and boating activity at the port and Gantheuame Point , clearing of native vegetation and changed fire regimes all favour greater risks from introduced invasive species.

Trends

- Increasing incidence and diversity of weeds e.g. dominance of matting vines promoted by fire and soil disturbance.
- Greater recognition of invasive species due to awareness-raising by Shire, Environs Kimberley, and other community groups like SKIPS, and Kimberley Environmental Horticulture.
- More interest and appreciation of indigenous species particularly as water use comes under scrutiny, and the cost of water rises.
- Increased shipping and yachting from across the world brings potential for importing foreign pests into the local ecosystem (e.g. black lipped mussels that impact upon the pearling industry).
- Movement of cane toads toward the Kimberley.
- Shire of Broome is increasingly utilising native species in the parks and gardens (Use less water and require less maintenance).
- Greater availability of local indigenous species (local provenance) for sale.
- Increased numbers of feral animals such as domesticated pets and the fox, a major predator of mid-size and weight range marsupials.
- Increase of invasive, introduced plant species used within the establishment of new garden areas; resulting in an increasing proportion of introduced species in relation to natural species.
- Supported by increased human population and its waste, some native species populations (e.g. Ibis, Black Kites) have increased dramatically resulting in disproportionate numbers and species, thus threatening bio-diversity.

Shipping increases potential for importing marine pests

Declared weed Bellyache Bush found around Broome

Linkages

- Areas of native bush are being displaced by introduced woody weeds (e.g. Neem trees and Leucaena).
- Introduced weeds (vines) are smothering and burdening local shrubs and trees, reducing habitats and biodiversity.
- The spread and density of weeds are creating an increased fuel load as a fire hazard.
- More people are gaining greater awareness of the problems of invasive species via Weed Busters and pamphlets and posters.
- Rangers can have a monitoring role and be involved in weed reduction.
- Invasive species may threaten availably of food and cultural stocks (e.g. weeds replacing local plants, destruction of vital habitats).
- The possibility of introduced pests and invasive species increases with the growth in shipping activity at the Port, and this can have a detrimental impact on indigenous marine species.
- Marine invasive species may threaten coastal food stocks (e.g. shellfish), and the viability of industries.
- Lyngbya, though naturally occurring, threatens other species (e.g. mangroves and seagrass) and therefore their dependents (biota).

Theme 4.10 Climate change

In Section 3.1.1 we describe possible adverse impacts from climate change on the Kimberley region, which may also apply to Crab Creek. Specific climate change related events include potential increased storm surge and salt-water intrusion during extreme events, increased coastal erosion and damage to fringing vegetation communities.

Trends

Climate change impacts seem to be trending along the worst case scenarios with each new set of predictions.
Vulnerable areas of the Crab Creek foreshore should be identified. This means a coastal vulnerability assessment for Crab Creek should be undertaken as a matter of priority.

Linkages

- Increase in rain/water.
- Coastal vulnerability increased (e.g. reclamation of coastal fringes).
- Climate change may favour invasive species.
- Change in plants; may favour weeds.
- Some invasive species (e.g. toads and plants) may travel into the Bay via the catchment.

Invasive pest; the cane toad is linked to reduction in some native species

Access to coastal and cultural resources is vital

ASSESSMENT OF MANAGEMENT: THEMES AND NEEDS 5

We have considered the pressures (stressors) on Crab Creek, assessed their origins and whether certain factors may be affecting others, for example where one stressor may be aggravating or accelerating another pressure.

Table 5.1 question 20 in the assessment framework refers to the gaps identified in the Ecological Character Description for Roebuck Bay (ECD). We are aware of the significant gaps in knowledge and baseline information (Bennelongia, 2008 and DoF, 2009), and the changing political environment in which the RBWG and landowners and managers operate. For example, changes are imminent for the reservation of areas, governance arrangements and tenure.

From our 'reading' of the known factors and possible impacts on Crab Creek, and given our understanding of the current trends and linkages, we have presented management objectives that we believe are achievable.

In this section we identify aspects to which we can effectively apply management, mindful of the priorities identified by stakeholders during CCMP workshops. On this basis we are making some recommendation for management objectives that we believe are realistic in terms of time, effort and achievability.

5.1 Assessment framework

Crab Creek forms part of the Ramsar listed site in Roebuck Bay, and as such, this Management Plan must provide a framework for evaluating the management themes, that conforms to the Ramsar requirements (Ramsar Convention, 2002). The assessment framework used has been adapted from Ramsar guidelines combined with the work on supporting sustainable management systems by Prof. Stephen Dovers of ANU (2001). We have undertaken a consistent evaluation of each of the management themes (for Drivers and Levers, Bennelongia, 2008) using the following framework as a tool. The results are available in Griffiths (2008) *Roebuck Bay Information*.

Table 5.1 Framework for assessing Crab Creek management themes

No	Topic	Description	Response
1	Goal	What are the management goals for each main Crab Creek theme?	
2	Theme	Which management theme?	
3	Objective	What are the management objectives for various subcomponents of each theme?	
4	Issue/impact	How do the issues associated with each management theme or its components play out and what is the nature of any impacts arising?	
5	Causes of impacts/ threats	What are the causes of the impacts so far as they are known?	
6	How could things cause this to change over time?	Is it going to stay the same, get better or worse if we don't do anything?	
7	Spatial scale of cause or effect	Is this something that is only occurring locally or is it occurring globally?	(Local [Crab Creek] • proximal [Broome/Roebuck Bay] • distal [Kimberley] • National • Global)
8	Temporal scale of possible impacts - Timing	Is the impact observed immediately, or is there a time delay?	(Immediate [minutes, hours] • short term [days, weeks] • medium-term [months, years] • long-term [years, decades])
9	Temporal scale of possible impacts - Longevity	Does the impact last for a short or long time?	(Extremely short term [minutes, hours], short term [days, weeks] • medium-term [months, years] • long-term [years, decades])
10	Nature of cause/s	Is there a single cause or are there multiple cause acting together?	(Discrete [single, one off] • continual [single, ongoing] • compound [multiple causes] • systemic [continuous/entrenched])
11	Magnitude of possible impacts on natural systems	How does this impact influence natural systems?	(Minor • moderate • severe • catastrophic)
12	Magnitude of possible impacts on human systems	How does this impact influence human systems?	(Minor • moderate • severe • catastrophic)
13	Level of public concern	Are the public worried or not?	(Low • moderate • high)
14	Basis of public concern	Who is worried and why?	(Widely shared • moderate variance in understanding • disparate perceptions)
15	Reversibility of possible impacts	Can the impacts be fixed quickly or not?	(Easily/quickly reversed • difficult/ expensive to reverse • irreversible)
16	Measurability of factors and processes	Can we measure causes, effects and responses?	(Well-known risk/impact • uncertainty in cause and effect • ignorance)
17	Probability of occurrence	Is this a rare event or could (does) it occur often?	(Extremely low [<1:100,000], low [1:100-1:100,000], moderate [1:5-1:100], high [1:1-1:5])
18	Degree of complexity and connectivity	Do we understand the relationships between causes, effects and responses or are they extremely complex?	(Discrete • linear complex, involving multiple feedbacks and linkages)
19	What are the uncertainties and limits of understanding?	What things do we know and what things can't we determine?	
20	Are there critical information gaps?	Are there important things that we have no information about?	
21	What indicators will be used to evaluate the performance of management?	What things will we use to measure whether management interventions are working?	
22	What are the indicators Limits of Acceptable Change (LAC target)?	The Ramsar guidelines (2002) require the development of LAC (Limits of Acceptable Change) targets where possible. What ones are to be used for this issue?	
23	What range of options could achieve the LAC target in combination or individually?	There may be a number of management actions that can act together to meet LAC targets, or there may be only a single management action. Which ones are possible?	
24	What resource and governance requirements are needed for each option in 23?	What money, people and organisational arrangements do we need?	
25	Deciding which are the best options in 23?	Of the possible options in 23, which are the best?	
26	What actions are required?	What things need to be done to implement the best options?	
27	What steps are required?	What steps need to occur to implement the best options.	
28	Who will undertake the action?	Who needs to undertake the actions?	
29	When will the action be undertaken? (sequencing)	There are often synergies and opportunities that accrue from running some programs together. When will the actions be undertaken.	
30	Existence of goals	What sort of goals have been established.	(Clearly stated • generally stated • absent)
31	Pertinence of management options	Are the people/agencies able to undertake the management actions assigned to them?	(Irrelevant • beyond jurisdiction • primary responsibility)
32	Availability of means	Are there sufficient people, resources, legislation etc to undertake the actions?	(Fully sufficient available instruments/ arrangements/ technologies • totally insufficient)
33	Acceptability of means	How is the community going to react to the actions being undertaken?	(Negligible opposition • moral/ social/political/ economic barriers • insurmountable opposition)
34	How will success be determined?	How will success be determined and how will the community be told?	
35	How do we improve management if future improvements are required?	How will we improve things if the management actions are underperforming?	

5.2 Implications flowing from the assessment of Crab Creek management needs

The assessment of themes has brought forth the goals and objectives listed below.

Goals

- Conserve the environmental integrity of the coastal Country;
- Protect and promote Aboriginal culture and heritage;
- provide opportunities for people to recreate in a manner that is compatible with the protection of the natural and cultural assets of Crab Creek.

Objectives for management

5.2.1	Raise awareness of the natural and cultural values of Crab Creek.
5.2.2	Manage human use pressures in order to reduce the negative impact on sensitive areas.
5.2.3	Collaborate with others to promote the engagement and use of Indigenous rangers in the management of Crab Creek.
5.2 4	Promote recreational and commercial uses that are consistent with the protection of cultural and natural values (e.g. passive low-key recreation).
5.2.5	Develop and use public amenities and signage to direct visitation to acceptable areas of Crab Creek, and to reduce pressure on sensitive areas.
5.2.6	Provide a positive visitor experience by meeting basic visitor needs and thus reducing human impact at Crab Creek.
5.2.7	Lobby and raise awareness to ensure development does not increase foreshore erosion.
5.2.8	Maintain the biodiversity and healthy interconnectedness of species and habitats
5.2.9	Reduce the loss of indigenous species.
5.2.10	Reduce weeds and invasive pests.
5.2.11	Direct human impacts away from important habitats.
5.2.12	Reduce the pressure on Crab Creek from development by effective planning, and informed decision-making at all levels.
5.2.13	Monitor Lyngbya.
5.2.14	Maintain Indigenous access to important food, medicine and cultural stocks.
5.2.15	Support initiatives that encourage sustainable and customary fishing practices.
5.2.16	Encourage the use of Indigenous plants in and around Broome.
5.2.17	Act as a lobby for the development and implementation of protocols, policies and practices that will ensure effective monitoring and control of incoming invasive marine species.

Table 5.2 Goals and objectives for management

5.3 Scale of manageability

In this section we look at the big picture (the degree of manageability), and we then identify what can be realistically done in the local domain, to manage the pressures on Crab Creek.

Through the process of assessment we have identified management objectives and responses that we believe are do-able within the known context in which the RBWG and its membership currently operate. These focus on local effort such as:

- Managing the human pressures on cultural and natural resources;
- Reducing foreshore erosion at Crab Creek;
- Ensuring the provision of public amenities;
- Raising awareness and educating visitors to Crab Creek and decision makers;
- Ensuring water quality;
- Identifying and raising awareness of coastal vulnerability and possible impacts flowing from climate change.

Figure 5.3 presents a conceptual model that attempts to explain the relationships between key management issues for Crab Creek. It shows the extent of the geographical scale, and the projected time frame required for a management response. The shape of the ellipses, (they vary in length, width, position and slope), reflect the various time and geographical scales. The Scale of Manageability on the model (horizontal x-axis), represents the geographical dimensions across which we believe the management responses would be applied (e.g. across Roebuck Bay, Broome, the Kimberley and beyond). The vertical dimension (y-axis), termed Manageability-Time scales indicates the length of time necessary to implement management.

Providing basic infrastructure for people to enjoy Mangalagun

Tourists walk on fossilised dinosaur footprints at Crab Creek

Those objectives that are shown within the CCMP ellipses, (in the left hand column), can be realistically managed on a local scale. It is on these that we focus the management responses for the Crab Creek Management Plan.

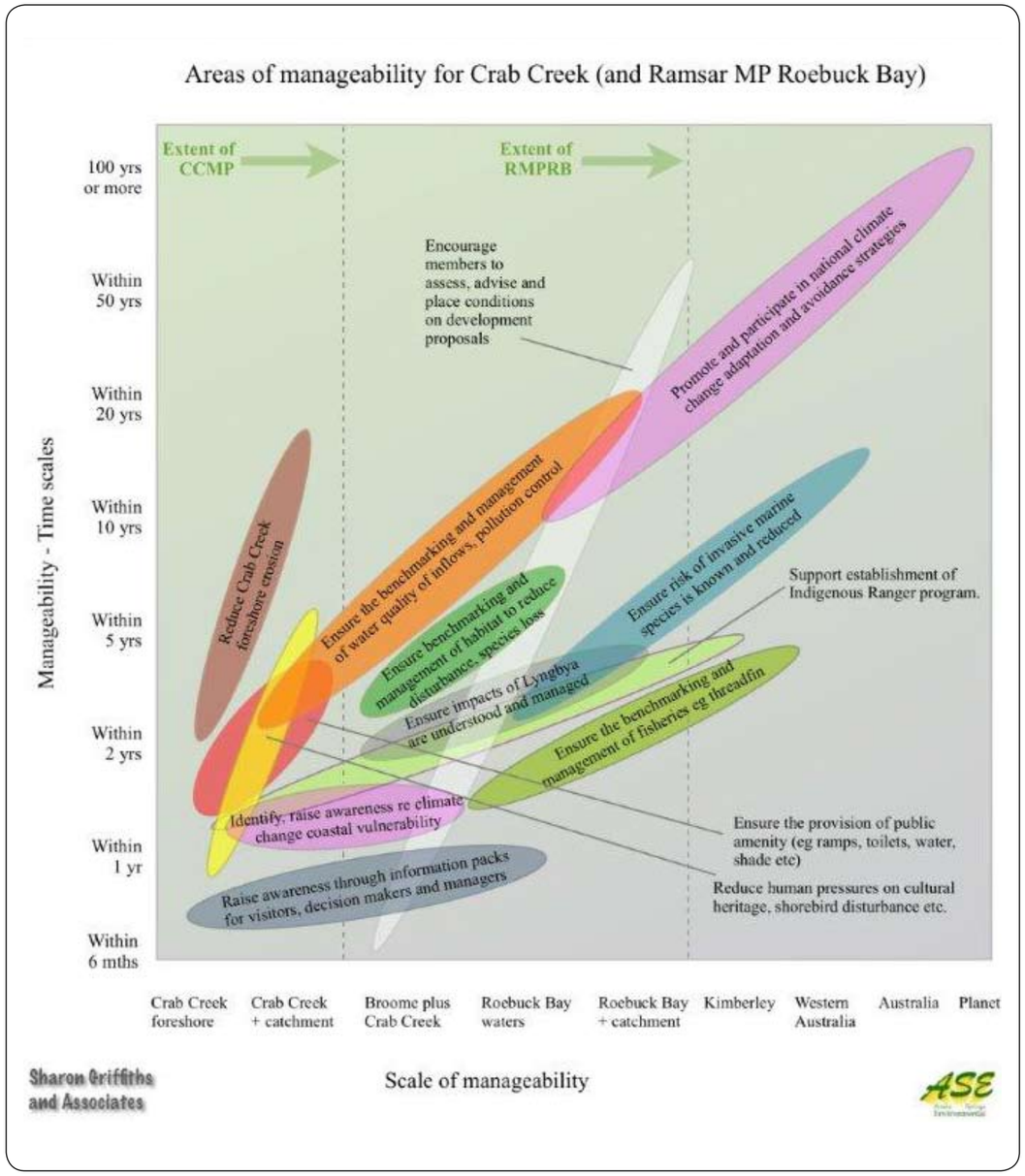


Figure 5.3 Manageability of Crab Creek based on timescales and the geographical extent of effort

5.4 Responses for the management of Crab Creek

This section expands on the 10 levers and drivers, categorised in the management themes in Section 4. It provides information on what we recommend be done to meet the goals and objectives. It sets down the responses and management strategies needed to do this on a local scale. It further develops the time and geographical scales represented by ellipses on Figure 5.3.

5.4.1 Human use pressures on cultural heritage and natural assets

Human use pressures on a global, national and regional scale have the ability to impact negatively on Crab Creek; however localised impacts are within RBWG's capacity to address through effective management.

Response:

The ellipse in Figure 5.3 alerts us to the priority of reducing human impacts on cultural and natural assets (e.g. shorebirds and middens); within a time frame of 1-5 years.

Management strategies such as raising awareness of the area's cultural and natural assets, through public education programmes and projects such as interpretation, tourist information, guided walks and Crab Creek special events could be put in place within that time frame, helping to reduce human pressures to acceptable levels. Many of these strategies are reasonably straightforward, cost effective and manageable at a local community level and within existing stakeholder budgets.

Measures to manage or control human pressures may include zoning, or restricting access to more vulnerable areas, the closure of access, or exclusion of people at key times, for example during periods when shorebirds are feeding and resting/roosting prior to their migrations, or the implementation of stronger management controls over coastal resources (e.g. fish, dugong or cockles). Experience in Broome has shown that while these can be effective management tools they require considerable commitment by a diversity of stakeholders, and ongoing monitoring and enforcement. This is where a ranger program can be very effective. (See 6.3).

5.4.2 Coastal vulnerability (storms, sea level rise)

Much of the coast's vulnerability is a nature-driven situation beyond our control (e.g. extreme weather events such as storm surges, cyclones, and rising sea levels).

This theme of vulnerability links to other themes notably climate change, coastal erosion, and the human use pressures (the anthropogenic factors) on natural resources.

Local authorities across Australia (including Perth) have been undertaking coastal vulnerability assessments to determine priority areas for bringing in measures to reduce the potential impacts on people, places and developments.

In Western Australia, the Planning Commission's *Statement of Planning Policy No. 2.6: State Coastal Planning Policy* provides guidance for the incorporation of mean sea level change in the determination of a coastal setback for new development.

However, as Felicity Farrelly (2007), from the University of WA in her abstract entitled *Planning for the Western Coast—Power Dictates* notes, 'there have been major departures from the bureaucratic led initiatives,[of the coastal policy] both in the 1980s and now, which leads the question whether we have within our governance instrumentalities the mosaic of interactions that drives clever decision-making progress'. Ms Farrelly goes on to give an example. 'The State Government introduced an amendment to the SPP2.6, which was passed in December 2006, supporting nodal high-density infrastructure development on the coastal zone, up to and including those developments to 300 metres from the shoreline.' She also notes, 'that while overall coastal strategy guidelines are shown to be the result of methodical policy implementation, that major externalities of development and political expediency in both 1980 and from 2003, raise questions to the effectiveness of current methods of governance.'

Responses:

The highest point in the study area is less than 25 metres above sea level, and falls way to the coastal flats approximately 2-3 metres above sea level. In light of the threats posed, a coastal vulnerability assessment needs to be undertaken within one year, in order to inform and direct our future activities and planning.

In erosion-prone areas around Broome, coastal management planning and rehabilitation works need to be cognisant of increasing coastal vulnerability. For example, strategic and early rehabilitation of coastal vegetation may enable plant communities to mature and provide protective buffers. Existing infrastructure such as boat ramps, viewing platforms, roads and access tracks may be vulnerable at Crab Creek.

State planning legislation and the Broome Town Planning Scheme need to take account of requirement for effective coastal setbacks in their forward planning.

Mud skipper: mudflats are rich in life

Mud samples being collected to establish impacts from erosion

5.4.3 Crab Creek foreshore erosion

In addition to naturally-occurring erosive forces, much of the foreshore erosion at Crab Creek results from human impact. While this impact arises locally, predominately from vehicular and pedestrian use, it has the capacity to negatively affect the wider Roebuck Bay area.

Large volumes of pindan are entering the intertidal areas on the Crab Creek foreshore and the broader Crab Creek catchment. A pilot investigation, has indicated that eroding pindan sediments from unmanaged vehicle access along the Crab Creek foreshore may be adversely impacting on the structure (as measured by its penetrability) of the inter-tidal sediments, thus reducing the availability of phosphorus to marine plants. There has been speculation that accelerated foreshore erosion into the fragile intertidal areas may be having an adverse impact on the recruitment of mangroves and on large grazing molluscs, where benthic microalgae that the molluscs feed upon have been reduced in abundance.

Response:

Foreshore erosion controls and reducing human impacts are areas in which we have the opportunity to effect management on a local level. As the ellipse in Figure 5.3 indicates, erosion control measures may need to be established within two years and continue on for some time.

5.4.4 Water inflows to Roebuck Bay

Respondents during consultation identified concerns that the quantity and quality (pollutant loads) of surface run off and groundwater inputs to Roebuck Bay (RB) may be causing adverse impacts. Spills, sewage, and lack of stormwater treatment, are further issues that need to be considered for effective management of the coast.

Response:

Management measures need to commence as soon as possible for Crab Creek foreshore and extend for Broome, Roebuck Bay and its waters and catchment.

5.4.5 Habitat disturbance and species decline

There are numerous trends affecting the sustainability of species and habitats, however those most commonly identified by stakeholders to be addressed were:

- Frequent and unmanaged vehicle and pedestrian access into culturally and environmentally sensitive areas or incursions into more remote locations;
- Growth in visitor and resident populations, creating more human pressure on finite resources;
- People from a low socio economic demographic, concentrate their subsistence practices on nearby foreshore areas where important food sources are diminishing;
- Access restrictions in other coastal areas, e.g. Cable Beach, may divert people to Crab Creek;
- Unsustainable takes, for example the taking of natural resources out of

season and contrary to legislation;

- Potential effects to native animals from cane toads;
- Increased wild fires and inappropriate fire regimes;
- Fragmentation of vegetation reducing habitat;
- Proliferation of weeds and invasive species;
- Decline of local plant species as a result of land clearing and the substitution of exotic species in town site plantings; and
- Growth of shipping arriving from foreign waters increasing risk of invasive species.

Response:

- Raise awareness on the value of Crab Creek environs, (e.g. importance of local vegetation, existence of diverse fauna);
- Educate users on the ramifications of their activities (e.g. boat speed on the disturbance of snubfin dolphins);
- Direct visitation through managing vehicle access, may be effective however coupled with stronger measures such as zoning and enforcement may be necessary;
- Zoning such as no-go areas, or seasonal close-offs may be seen as punitive, however others like Environmental Cultural Corridors, or dog exercise areas may be seen as positive strategies;
- Promote the retention of habitat corridors through informing planning decisions;
- Many aspects of habitat disturbance and species loss can be minimised by locally-applied management strategies (e.g. by directing visitors to areas of less cultural and environmental sensitivity);
- Identify and recommend limits for certain marine species e.g fish, through the regulatory process to protect the stocks.

Management measures to reduce disturbance and the decline in species may need to commence within two years and continue on for 5-7 years (see Figure 5.3).

5.4.6 Impacts from development

- Potential negative impacts may flow from developments and inappropriately managed urban, rural, commercial or industrial areas. These impacts may be experienced through Broome, Roebuck Bay, and to Crab Creek and its wider catchment.

Response:

- Potential negative impacts from development proposals need to be identified, addressed and then monitored;
- Relevant strategies are best aimed at people on the higher levels of responsibility for decision making in order to affect results that favour the protection of Crab Creek. The role for RBWG is in using leveraging strategies such as lobbying and the provision of information to bodies such as local, State and Commonwealth governments.

Education and awareness-raising actions, pertinent management responses such as lobbying and the provision of information to decision makers may need to commence within six months and extend indefinitely.

5.4.7 Lyngbya

The blue green algae, Lyngbya has the capacity to cause harmful effects to humans on direct contact, and to natural ecosystems through smothering and shading. Damage to mangrove communities and seagrass meadows have been observed when accumulated mats of Lyngbya trapped within these vegetation communities begin decomposing.

Response:

Measures to manage blooms and accumulations of Lyngbya may need to commence within one year and extend for 2-3 years. Management measures may need to extend from Broome through Roebuck Bay and the broader catchment. Lyngbya has not yet been observed in Crab Creek, so management measures are based on 'a watch' for this area.

5.4.8 Important food stocks and coastal resources

The Crab Creek area contains a wealth of food, medicinal and cultural resources that people use regularly and depend on. It forms an integral part of the non-cash economy.

TOs have long expressed their concern that stocks of cockles are no longer found or have diminished around Crab Creek. Barramundi and Threadfin Salmon have reduced in recent times, and a range of stakeholders held the view that it is due to overfishing in the waters of Roebuck Bay and through the Kimberley. Several RBWG members suggested that a review of commercial fishing licences was needed, and the declaration of no-take areas may be necessary in order to sustain coastal stocks around the Bay. The State fisheries department currently licenses several commercial fishermen to operate throughout the Kimberley region, accordingly the geographical realm of management is wider.

We are advised that the reduction in natural areas has also reduced the availability of resources on land e.g. bush fruit and traditional medicine supplies. Commercialisation of bush tucker (e.g. Gubinge) has posed threats to sustainability. Stocks closer to residential areas are heavily impacted and in some places reported to be disappearing.

Family groups hunting and gathering food stocks

Response:

- Raise visitor awareness of the cultural, natural and economic values associated with Crab Creek;
- Baseline information needs to be gathered to ensure we can monitor the availability (and changes) of important coastal resources;
- Improve enforcement of the current possession limits; and
- Investigate the need for differing possession, size and bag limits for specific areas to protect stocks such as fish and crabs;
- Support education and awareness-raising initiatives (e.g. of DoF and DEC);
- Identify and promote the implementation of sustainable practices e.g. in fishing, hunting, recreation, water use and commercial operations.

To ensure that barramundi and threadfin salmon stocks are adequately maintained, monitoring and/or management measures may need to commence within one year and extend up to five years.

5.4.9 Invasive species

Marine invasive species imported on ships and equipment, and in the ballast waters of international shipping have the capacity to significantly harm marine ecosystems like those of Roebuck Bay, should the harmful organisms become established. Australia is a signatory to the *International Convention for the Control and Management of Ships' Ballast Water and Sediments*, and ships visiting Australian ports have been required to attain a particular standard of ballast water management. Despite this, there is still a significant risk of invasive marine species arriving from this source, as older ships take time to be retrofitted with new ballast management procedures, and not all shipping nations are signatories.

Unfortunately, detecting microscopic marine invasive species during their larval stage is almost impossible. Often the only time they are noticed is after they have become established and grown into plague proportions at their adult stage.

Improved surveillance and monitoring may need to commence within two years and continue for some time. This management measure may need to extend beyond Roebuck Bay to waters in Western Australia.

The remote coastal areas are most vulnerable to exotic pests, weeds and diseases. On land, such invasive species include buffel grass, declared plant Bellyache bush (*Jatropha gossypifolia)* and Coffee Bush. Introduced animals (cane toads, feral cats and foxes) and the escape of exotic plants from gardens into local bushland all pose threats to food and cultural stocks, threaten the survival of indigenous species, and create potential health threats through food chains.

Response:

- Focus on long-term education and awareness raising activities;
- Work with others to affect decision making. For example encourage Broome Shire Council to have policies supporting the use of local species in the approval process for developments;
- Undertake a monitoring and 'watch' to alert the community to trends or threats from invasive species.

5.4.10 Climate change

As mentioned earlier, climate change is a global issue, and has the potential to impact at the local scale. For example:

- temperature rise and rain patterns changing (more floods, fire trends;
- extreme weather increased coastal erosion;
- sea level rise;
- potential penetration of stormwater into fringing ecosystems; and
- nutrient load effect on mangroves, wader birds, cockles etc.

Response:

The responses to climate change must be global and the Australian Government is tackling this issue through coastal vulnerability assessments, community education, the introduction of a carbon emission trading scheme and the development of climate change adaptation strategies. Following the growing knowledge about climate change, sea-level rise planning policies are being amended nationally to reflect the latest predictions. (See 5.4.2 on page 58).

For Crab Creek the following actions may be required:

- Undertake coastal vulnerability assessments;
- Develop and apply site-specific climate change strategies and actions to mitigate impacts;
- Encourage local authorities to commit to any national climate change initiatives.

Shorebirds take flight as people walk the dog

Monitoring seagrass & understanding baseline information

MANAGEMENT STRATEGIES 6

The management strategies and actions arise from the assessment of the management themes and responses described in Section 5. They reflect the reality of implementing effective management at a local level for Crab Creek. (The scale of manageability is better understood by viewing the diagram in Section 5.3).

Actions in response to stressors coming from a scale broader than Crab Creek (and the nearby areas) are beyond the local management effort and need to be dealt with differently. For example, stormwater runoff emanating from Broome has the capacity to adversely impact the Crab Creek ecosystem. Accordingly, education, awareness-raising, lobbying and persuasion are strategies that can be used to draw attention to actions that need to be taken at other levels, often remote from Crab Creek.

The range of stategies required can be categorised as:

1. Education and awareness-raising;
2. Leveraging; utilising the combined influence of the diverse membership of RBWG;
3. Rangers;
4. Collaboration/coordination;
5. Policy and procedures development;
6. Zoning;
7. Infrastructure development; and
8. Research.

Promoting and inspiring responsible use of the outdoor environment and doing this in partnership with others is vital. An important management strategy to support this is to work in a coordinated and collaborative manner with key stakeholders and utilise tools, such as agreed policies and Codes of Conduct, to ensure effective decisions are made and understood, and to promote transparency, reduce uncertainty and duplication, and to maximise the outcomes flowing from the limited resources available for natural resource management.

6.1 Education and awareness-raising

Education, awareness-raising, and decision-making are key management responses that need to be initiated and applied at a broad and local scale to influence change, since many of the issues, impacts and decisions that influence Crab Creek originate beyond the jurisdiction of the Roebuck Bay Working Group. Accordingly, they can be best dealt with through leveraging (using the power of RBWG to get things done), raising awareness, education, communication and lobbying directed at a range of people including residents and visitors to Broome, users of Roebuck Bay, and decision-making authorities who are often remotely based in other parts of Australia such as Perth or Canberra.

The trends show:

- raised expectations of visitors coming from more developed areas; for visitor information, guided tours, directional signage, and basic public amenities
- a growing interest in Indigenous culture, and a desire by many visitors to have a 'cultural' experience;
- an increasing number of international visitors who may require signage and information in clear, user-friendly formats incorporating international symbols;
- more elderly travellers and an increased number of self-drive visitors coming to Crab Creek;
- high turnover of agency staff in Broome and the Kimberley with a subsequent loss of corporate knowledge, necessitating consistency in attention to the presenting issues, understanding ramifications and past history, big picture overlays, before decisions affecting Crab Creek are made;
- volunteers are a significant source of labour and expertise in both research and on-ground work around Crab Creek.

When decisions are made that have the capacity to impact negatively on Crab Creek, (e.g. development proposals), the informing and alerting of decision makers to the fragility and vulnerability of Crab Creek (and Roebuck Bay), would result in better outcomes generally for the area.

Neil McKenzie explains the cultural use of Crab Creek area to politicians

Children are involved in catch and release bird monitoring at Crab Creek

As the ellipse in Figure 5.3 suggests, within nine months or so, information could be collated and made available through information packs, self guided pamphlets or other media serving to raise the awareness of residents, visitors, decision-makers and managers. More detail is provided in the *Implementation and Action Plan—Draft* found at Appendix 5.

- Increasing the understanding of the natural values and interconnectedness of natural systems is considered a worthy objective.
- Education and raising awareness on coastal food resources and their vulnerability from over-exploitation will help to sustain species and indeed the broader food chain.

Before venturing out to Crab Creek visitors need to be aware of what public facilities are available at Crab Creek e.g. from Broome Visitors Centre, signage at the intersection of Broome Highway, brochures distributed in places that tourist frequent such as resorts and fishing shops.

Safety issues can be addressed and visitors' stay made more enjoyable by effective information and signage. Visitors can be alerted to the presence of *Lyngbya*, its potential harmful effects, and the treatment if affected. The risk of dehydration, sunburn, crocodile habitat and the risks associated with tidal inundation can be provided.

This management response links to all the themes and indeed is seen as a powerful measure. In the short term, making good information available can assist in making the visitor safer and their stay more enjoyable, and funnelling visitation to less sensitive areas, will reduce foreshore erosion, reducing the sediment erosion and disturbance to flora and fauna (e.g. migratory shorebirds, turtles nesting, snubfin dolphin and sand crabs). In the longer term, it can raise awareness and increase knowledge and thereby the possibility of changing attitudes and with it, modifying behaviours. Behaviours such as parking vehicles off the beach and away from fragile cliffs, slowing the speed of boats to reduce the risk of harm to snubfin dolphins, planting indigenous species to maintain habitats and the fauna that depends on them.

Many of the actions needed in this response are best undertaken by Aboriginal Rangers (see section 6.3 below). Rangers on-ground can effect management and achieve personal and meaningful interaction with visitors by guiding, directing, monitoring, and informing them. This also facilitates the cultural awareness and exchange that travellers often seek.

Management strategies should include raising awareness of the area's cultural and natural assets through public education programmes and projects e.g. provision of off and on-site interpretation, tourist information, guided walks and Crab Creek special events. These actions could be implemented within a reasonably short time frame, and over time will help to reduce human pressures as people understand the area and its values, and respond with appropriate use. Many of these strategies are straightforward, cost effective and manageable at a local community level and within existing stakeholder budgets.

6.2 Leveraging

In simple terms, leveraging is using the power of the RBWG to make things happen e.g. to increase the chances of decisions being made that are in the interests of protecting Crab Creek and Roebuck Bay. This strategy requires people to advocate for the protection of the key natural and cultural values of the area.

Most of the threats and pressures, and the issues that impact on Crab Creek originate beyond the jurisdiction of the RBWG. Accordingly, they may be best dealt with through advocating for Roebuck Bay and leveraging i.e. using the power of RBWG to get things done.

The wide and diverse membership of RBWG can be well utilised to undertake this action. Having both knowledge and skills, and by applying combined pressure at the level required to ensure those making decisions for Crab Creek and the Bay are well informed.

As the RBWG membership is broadly representative of most sectors of the Broome community, there are also valuable opportunities for member organisations, agencies and individuals to leverage resources for its management and protection.

Again we recommend that a range of strategies such as education and awareness-raising, and advocacy and leveraging will be needed to draw attention to actions that need to be taken at other levels.

6.3 Rangers

This management response was highly regarded by key stakeholders. They recognised that an on-ground Indigenous Ranger presence, guiding and informing visitors, monitoring sensitive cultural and natural areas, and carrying out tasks such as maintaining public facilities, reducing weeds enforcing policies or regulations and providing an on-ground response or troubleshooting (e.g. to accidents or fire) would be an effective management strategy.

Due to the increasing visitor pressure and early signs of adverse signs occurring on natural and cultural assets, it has become increasingly important to get on-ground management initiatives in place, particularly Indigenous Ranger programs in light of the Native Title determinations.

The recognition of Native Tile and Aboriginal land rights has provided the impetus for Yawuru Traditional Owners, the legally recognised native title holders of Broome, to care for Country in more formal ways as well as the customary way. Ranger programmes are increasingly opening opportunities for employment and training for people from that Country. An Aboriginal Ranger programme has been operating successfully in coastal areas within the Shire of Broome, including Minyirr Park and along the Dampier Peninsula from Beagle Bay to Ardyaloon.

Apart from cultural transmission, and providing guiding, advice, and other measures that enhance people's experience at Crab Creek (and that help reduce the pressures they exert), Rangers may provide education and awareness-raising; e.g. seasonal considerations such as food takes, turtle nesting, bush tucker availability, bird feeding and roosting, routes to take, areas to avoid, and tidal considerations.

Hopefully, Rangers would be directed by and responsive to Traditional Owners and custodians for the Crab Creek area. This cultural transmission up and down from on-ground issues to broader governance matters would ensure more appropriate decision-making and effective management.

This strategy links in with other Ranger responsibilities and initiatives: the Kimberley Land Council's Caring for Country Indigenous Ranger programme, the Shire of Broome local government ranger responsibilities, Department of Fisheries, Australian Customs and AQIS projects. A number of departments are contracting out field work to Indigenous Rangers where they are best placed to work in remote areas.

The rangers may well have a monitoring role for other departments, for example, the Department of Water or the Shire for water quality, or for monitoring seagrass, mammals, bird populations, weed infestations, and threats to fauna, or the presence of Lyngbya.

Another possibility is monitoring compliance (or enforcement of legislation) with for example, fish size, bag limits, litter, Shire by-laws (e.g. camping or dog control) and vehicle access.

The placement of rangers to monitor and maintain public amenities, signage and infrastructure and provide guidance to visitors is important.

The Indigenous respondents particularly stated the need for more trained Rangers to be on ground and an increased presence from the Department of Fisheries inspectors, working at weekends, public holidays and on 'good tides' for fishing times, in order to monitor the implementation of State regulations in relation to fish takes, and to monitor the exploitation of creek resources (e.g. mud crabs).

Rangers could effectively operate from Crab Creek across the entire extent of Roebuck Bay and could extend into the wider Broome area. This cultural transmission from on-ground issues to broader governance matters would ensure more appropriate decision-making and effective management. Recruiting rangers from the local community, in particular those who have a cultural responsibility and connection, will be better supported and be more effective.

RBWG members and scientists plan management strategies

Aboriginal rangers from around the Kimberley

6.4 Collaboration and coordination

The aim of the coordination strategy is to attract and maintain involvement by a wide range of stakeholders in managing Crab Creek. Further, to secure the necessary management resources to implement the Plan.

In the past, the management of Broome's coastal areas has suffered from a lack of coordination between the stakeholders and the community. Traditional Owners recognising the problem identified the need for: a central point for collecting and disseminating information; coordinating the preparation of funding submissions and administering grants; overseeing the numerous on-ground coastal projects in and around Broome, and the need to facilitate and support a coordinated approach to joint management. This resulted in the establishment of the Coastal Park Management Committee, a Rubibi and Shire of Broome initiative (Griffiths, 1999).

Continuing this strategy, the RBWG was established and has made a concerted effort to work in a collaborative way to ensure the best prospects for managing the Roebuck Bay area, and to ensure the cost effective use of human, financial and capital resources for management.

While a range of agencies and organisations have various management responsibilities for natural and cultural environments and assets, volunteers and groups who have no management responsibility bring to the process a sense of stewardship, care and passion for the coast, and are often the people undertaking most of the on-ground management action at Crab Creek. Importantly when people participate hands-on they gain an appreciation and understanding of the ecosystem links, the cultural significance, and gain a practical understanding of technical terms like 'protecting biodiversity' (Griffiths, 1998). Continuing to foster this opportunity at Crab Creek and bringing people together to understand nature and culture in the company of their peers can be a strong long-term motivator in caring for country.

Collaboration and effective coordination needs to underpin all strategies including research, the development of policy or procedures for across-the-board implementation, zoning considerations, the establishment of a Ranger programme, securing the resources to undertake management actions, and in applying leverage to make things happen e.g. the decisions made are in the interests of protecting Crab Creek and Roebuck Bay).

Plethora of signs: co-ordination is needed to maximise public awareness of safety and zoning issues

6.5 Policy and procedures development

Following the formulation of the management strategies, land and sea owners/managers should consider the establishment of policies to define the 'ground rules' for those charged with implementing the strategies. This is particularly important with the broad interests and large number of agencies, groups and people who have a management role at Crab Creek.

Policies should provide guidance for operational decisions and set out clearly the roles and responsibilities of each stakeholder, leading to better decision making, wider stakeholder involvement and commitment and more efficiency in managing the work and resources (including human resources) equitably and with greater accountability and transparency.

Clear policy and procedures can foster increased community participation in the decisions and rally more support for on-ground action; (i.e. when people know what they are expected to do, why, when and for whom).

Procedures (i.e. Guidelines, Operational Agreements or Codes of Conduct), could guide for users of Crab Creek, for example, fishers, drivers, tour operators, boat owners, researchers and volunteers. Some are already in operation, i.e. DEC has whale watching guidelines, while others may need revision or development. For example, The Navigable Waters Regulations for waters around the Bay may need to be revised and restrictions set on boat speeds or prohibit access to some areas in order to reduce coastal erosion, protect cultural sites, take pressure off marine mammals, and protect the safety of people.

Fishing rules, boating regulations, by-laws for off-road vehicles and fire restrictions may be some of the current 'rules' that need to be reviewed and revised.

Whether it be legislative changes or the development of policies or procedures, all need to be implemented, monitored and regularly reviewed to ensure they are meeting the objectives e.g. to improve the sustainability of food stocks, to reduce pressures, or to ensure more effective management by stakeholders.

RBWG should continue to work collaboratively with land and sea owners/managers to ensure the development of agreed policies and procedures that are linked to the *Action and Implementation Plan*. (See 7.2)

6.6 Zoning

The strategy of zoning or precincts is essentially to steer high impact use away from sensitive environmental and cultural areas and to focus high impact use on public infrastructure and less valued areas e.g. degraded areas.

Zoning controls may be location-based or seasonal — the closure of access, or exclusion of people at key times, for example during periods when shorebirds are roosting, or the implementation of stronger management controls over coastal resources e.g. fish, dugong or cockles. Experience in Broome (Griffiths, 1998) has shown that while these can be effective management tools they require considerable commitment by a diversity of stakeholders and ongoing monitoring and enforcement. This is where a ranger program can be most effective. (See 6.2 and the pale green ellipse in Figure 5.3).

It has been suggested that greater restrictions on access by non-residents may be necessary to ensure sustainability of coastal stocks and that some areas may need to be set aside for Indigenous use only. Conversely some areas may need to be no fishing zones for a period of time in order to allow the fish to breed and grow up without disturbance, thus ensuring sustainable stocks for a longer period of time. (See Appendix 2 Mangalagun Site Planning).

The use of fishing closures, access close-offs, restrictions and zoning need to be carefully considered; it can be seen by users as unwarranted and negative i.e. controlling or 'taking away' rights. The use of complementary management strategies such as a long-term media campaign to educate uses may help to reduce resistance and indeed foster support.

Planning uses in specific locations that are consistent and safe with adjacent uses can be an effective tool. However, when restrictions are needed, this will require considerable forethought and resources to market the reason behind the introduction of restrictions, to inform the users and to garner their support and then to enforce the restrictions.

Creating precincts or zones can enhance a user's experience, protect the very resources they wish to sustain, and provide safety and certainty and can be seen as 'zones of opportunity', as in the Shire of Broome *Coastal Park Management Plan—Broome Western Australia* (Griffiths, 1998).

Environmental Cultural Corridors (ECCs)

The concept of a zone known as an environmental cultural corridor (ECC) has been used in the Broome town site and adopted in the fourth town plan. ECCs are reserved as open space, to provide for Aboriginal cultural heritage uses, the conservation of the natural environment, fauna and flora habitats, corridors for the movement of native animals, to allow for major drainage areas and aquifer recharge, as well as for outdoor public recreation.

We propose that the ECC initiative that links the north-south and east-west movements and Indigenous traditions across the Broome Peninsula be extended to link with areas at Crab Creek. We are told the corridors and their boundaries identified on the Shire town planning scheme No.4 will be reassessed in the forthcoming local planning strategy expected to be completed in 2009.

The use of buffer zones in adjacent developments should also be promoted, in order to maintain the visual amenity of the Crab Creek area.

6.7 Infrastructure development

This management response follows the assessment of the growing pressure from human impacts particularly on the coastal foreshores of Crab Creek. The focus with this strategy is on the provision of public amenities and signage to control and guide visitation.

The trends show that visitors often expect better public facilities like signage, toilets, shade and seating, drinking water, BBQs, information boards, rubbish bins, recycling provisions, phone access, car parks, camping grounds, established walking trails, roadside laybacks and coastal vantage points, camera viewing areas and bird hides.

Quality, well maintained facilities tend to attract more visitors; and attractive and strategically placed amenities could increase respect for the area and help to reduce pressures on more sensitive areas and encourage visitors away from vulnerable areas. This has positive implications for erosion and litter reduction, plant protection, protection of cultural sites (e.g. middens), development of roads and tracks, and reduced disturbance to shorebirds and turtles.

The planning and provision of public amenities is also linked to:

- Water sourcing and disposal; public facilities often require water and waste water services;
- Developments that need to be well-sited with a minimum footprint, located in areas that will reduce the possible impact on habitats and local species. They will need to have all the required heritage clearances and approvals;
- Increased interest in Crab Creek, as access restrictions to Cable Beach for vehicle and commercial enterprises, may exert additional pressures elsewhere.

The recommendation is that public amenities such as toilets, drinking water, signage, bird hides and shade structures be planned for Crab Creek within eighteen months. An overall land-use plan, a site plan, and a signage plan should underpin this action. The installation of directional signage should be possible with two years, as is the required action to provide visitor information in advance of going onto Crab Creek Road from the Broome Road.

Within five years, the provision of further public facilities in the broader catchment needs to be assessed in relation to its potential to help contain human impacts on Crab Creek via facilities such as car parks, roads, and boat ramps, etc.

Basic infrastructure to meet visitors needs and protect the cliffs

6.8 Research

Gathering essential baseline data is important for managing Crab Creek and indeed the catchment. The Bennelongia Ecological Character Description has identified gaps and research needs as has the Department of Fisheries (DoF, 2009).

Significant research work has been undertaken over many years in relation to the understanding and protection of migratory shorebirds and their habitat needs; much of this facilitated by Birds Australia and the Broome Bird Observatory and undertaken by volunteers and groups of committed and interested people. It has often been a collaborative effort between community groups and national and international organisations, researchers or interest groups.

Data from research undertaken in recent years, such as community monitoring of Lyngbya, of seagrass beds (sea grass is the principle food source for both the sea turtles and Dugong in the Bay), monitoring of turtle, dolphin and dugong, mud sampling, and the study of disturbance to shorebirds should guide and assist future management. This should provide some reliable and scientific information to add to anecdotal evidence.

To date a number of research needs have been consistently recognised by RBWG stakeholders including:

- water quality monitoring in the Bay;
- coastal vulnerability assessments;
- monitoring Lyngbya to ensure the impacts are understood and managed;
- erosion monitoring; and
- impacts from recreational and commercial fishing on fish stocks.

Elsie Edgar and Miklo Corpus work with Shirley Stack-Smith to help understand Crab Creek's past

Seagrass monitoring

Where possible and relevant, research should be multidisciplinary and participatory, for example involving Traditional Owners, botanists, environmental scientists, ecologists, planners, anthropologists, geologists, archaeologists, sociologists, coastal engineers, ornithologists, naturalists and volunteers etc.

While much of the research required is scaled outside the Crab Creek foreshore area (see Figure 5.3) local effort is significant to monitor and measure impacts. The timescale begins within one year and continues long-term beyond 20 years. This will be needed to keep abreast of changes particularly to the physical environment, and to ensure the sustainability of the area's key habitats and ecosystems.

Furthermore, consistent with an adaptive management approach, management actions may need revision or new strategies devised in response to ongoing research or findings.

Turtle being monitored

Tourism activity at Crab Creek: hovercraft

Mangrove forests and muddy tidal flats are vital habitats

IMPLEMENTATION AND ACTIONS 7

7.1 Setting performance indicators and targets

To monitor conditions and changes around Crab Creek, indicators or benchmarks are needed. These measures should include the limits of acceptable change (LACs) as set down in the Ramsar requirements for the protection of wetlands of international significance. The underlying concept of LAC targets is that Ramsar compliant management and monitoring requires baseline conditions to be set, against which changes in the wetland ecosystem can be assessed (Ramsar, 2002). Changes may be either detrimental or beneficial. LACs are required to describe conditions outside of which detrimental change occurs. (Bennelongia, 2008).

LACs along with other important targets such as those set by the land/sea owners will be considered in consultation with the key stakeholders during the second phase of management planning for the Roebuck Bay Ramsar site.

Due to the focus on the local management effort for Crab Creek in this plan, some basic targets have been set against the recommended strategies and actions within the *Draft Implementation and Action Plan* (see Appendix 5). The RBWG members will need to review the draft recommendations and develop agreed targets for the actions, and/or for each of the stated management objectives. These targets should assist the RBWG to assess the success, or otherwise of the management responses and actions. An *Implementation and Action Plan—Draft* is tabled at Appendix 5.

Coastal Award for Excellence 2007 being received by Neil McKenzie and Kandy Curran who represented RBWG

RBWG brought together the community to discuss the values and uses of Roebuck Bay

7.2 Implementation and Action Plan

7.2.1 Sequencing, roles and resources for implementation

The Appendix 5 table shows recommended strategies and actions, (what needs to be done and when), and sets down proposals for who may be responsible for the management response. The *Implementation and Action Plan—Draft* needs to be considered and revised by RBWG stakeholders in light of the resources available, the agreed priorities and the current operational environment.

Resource availability is paramount to the success of any management strategy. Certain strategies, such as the ranger initiative and the development of public infrastructure and amenities will require stakeholder commitment to ongoing resources. This is to ensure continuity and reliability of services to the public, to maintain and upkeep facilities, and to ensure capacity-building and sustain the morale of those people working at ground level.

The RBWG membership, representing many key government agencies, industry groups, community organisations and motivated individuals has an important role to play in securing resources for the management and protection of Crab Creek.

7.2.2 Monitoring

At Appendix 3, Bennelongia, (2008) outlines current components of the Roebuck Bay ecosystem, identifies knowledge gaps, priorities to be addressed, and recommended monitoring actions. In addition to the scientific monitoring requirements, there is a need for monitoring and assessment of the various strategies and actions arising from the Crab Creek Management Plan, in particular the *Implementation and Action Plan—Draft*.

Until tenure and governance is finalised for the area, (see 2.4), it may be best for RBWG to ensure monitoring is undertaken in a timely and coordinated manner, and that information gathered is provided to the required stakeholders for followup.

Ecosystems change and management planning is not static. The revision of actions and targets, and changes to priorities or responses will be needed; some strategies may be unsuccessful or better responses become apparent from new information, or in response to the changing environment in which the stakeholders operate, (for example, political or legal factors), and these may require a different approach. This is what adaptive management is about.

7.3 Ensuring the plan's success

In line with some of the basic features of Adaptive Environmental Management (AEM), now termed Transition Management, we need to remember to:

- Promote the continued active involvement of a wide spectrum of interested parties and the stakeholders, from the beginning in any planning process. These include community members who are affected directly by the problem and its management (Gilmour, 1998). RBWG was established on that premise and has had great success at garnering support for collaborative works. The Crab Creek planning process has maintained that approach and built on it to give a greater sense of ownership of the plan to the stakeholders.
  Encourage the RBWG collaborative approach to planning to be extended to the implementation of management, at least in the interim period until an agreed form of governance is established for the Crab Creek area.
- The inclusion of environmental, cultural, ecological, economic, historical, political, physical, and social conditions in the (assessment and) management process (Iles, 1996) — through the approach to the planning process and the recognition of these factors in the outputs e.g. the posters, and the Management Plan.
  The use of a workshop approach with all, or at least representative stakeholders involved in a cooperative rather than an adversarial process. (Gilmour and Walkerden, 1994). A series of planning workshops were undertaken throughout the development of the CCMP.
- The recognition and acceptance of uncertainty (Wynne, 1992) — even embracing it as an opportunity to learn more about the system/problem and to adapt management strategies accordingly (Walters and Holling, 1990).
- Management is linked to appropriate temporal and spatial scale (Peterson, 1996) and does not focus exclusively on 'the short term and the local' (Gunderson, Holling & Light, 1995).
- The recognition that management policies are experiments (Lee, 1993) and are not fixed sets of actions (Holling, 1978).
- 'Monitoring (is) designed as a part of active interventions to achieve understanding and to identify remedial response' (Gunderson, Holling & Light, 1995).

REFERENCES AND FURTHER READING 8

8.1 References

ABS (2008) Australian Bureau of Statistics 4704.0—The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples, 2008. Issue release 11:30am (Canberra time) 29/04/2008

Bennelongia (2008), Ecological Character Description for Roebuck Bay. Report to the Department of Environment and Conservation. Bennelongia Pty Ltd, Jolimont. Draft December 2008.

Commonwealth of Australia (2000). Environment Protection and Biodiversity Protection Regulation 2000, Schedule 6. Managing wetlands of international importance.

Community Solutions (2004) Report on Roebuck Bay values mapping. Report for WWF Australia, The National Shorebird Conservation Project. Consultancy report No. 33227 Incorporating Report No. 34503. September, 2004

Community Solutions (2006) Interim Management Guidelines: A step towards Community-based Management Planning for Roebuck Bay. Prepared for the Roebuck Bay Working Group and WWF-Australia (August 2006)

Crough, C and C Christophersen (1993) Aboriginal People in the Economy of the Kimberly Region. Australian National University. 1993.

Deeley, D.M. and Paling, E.I.(1999) Assessing the ecological health of Estuaries in Australia. Land and Water Resources Research and Development Corporation Occasional Paper 17/99, Urban sub-program report No 10.

Department for Planning and Infrastructure (2008) Broome Boating Guide. December 2008

Department of Conservation and Land Management (1994) A Representative Marine System for Western Australia. Report of the Marine Parks and Reserves Selection Working Group. CALM June 1994

Department of the Environment and Heritage (2003). Information Sheet on Ramsar Wetland (RIS) – Roebuck Bay, Western Australia – 33. Australian Government, Canberra. Oct 2003

Department of Fisheries (2009), Coastal and Marine Resource Condition Monitoring— Scoping Project, May 2009

Dovers, S. (2001). Informing institutions and policies, in Higgins, J & Venning, J (eds), Towards Sustainability: Emerging Systems for Informing Sustainable Development,University of New South Wales Press, Sydney, 2001

Farrelly, F. (2007), Planning for the Western Coast - Power Dictates. University of WA. www.fbe.unsw.edu.au/cityfutures/SOAC/planningforthewesterncoast.pdf [accessed 8 Nov 2010]

Garnett, S., Woinarski, J., Gerritsen, R. and Duff, G. (2008) Future options for north Australia. Charles Darwin University Press.

Griffiths S, (1999) Shire of Broome Coastal Park Management Plan—Broome Western Australia—March 1999. Rubibi and the Shire of Broome.

Griffiths S, (2008) Roebuck Bay Information—RBWG Broome WA.

Kimberley Development Commission (2001) The Aboriginal Component of the Kimberley Economy . August 2001.

Kimberley Development Commission, and the Department for Local Government and Regional Development, (2006), Kimberley Economic Perspective.

Kimberley Development Commission. Minimising your impact on the Kimberley environment.

Kimberley Development Commission (2009), The Kimberley An Economic Profile March 2009

Millenium Assessment (2005) Ecosystems and human well-being: Scenarios: Findings of the Scenarios Working Group, Millennium Ecosystem Assessment / edited by Steve R. Carpenter et al. Island Press Washington, Covelo, London

Paton DC, Ziembicki M, Owen P & Heddle C (2000). Disturbance distances for waterbirds and the management of human recreation with special reference to the Coorong region of South Australia. Unpublished report to the Migratory Waterbird Component of the National Wetlands Programme. Report prepared for Environment Australia, Canberra.

Pearson, G., Grosse, A. and Willing, T. (1999) 10 Management implications for Roebuck Bay. In Intertidal sediments and benthic animals of Roebuck Bay, Western Australia. Eds Pepping, M., Piersma, T., Pearson, G. and Lavaleye, M. (1999) Netherlands Institute for Sea Research (NIOZ), CALM, Curtin Uni. NIOZ Report 1999-3.

Randall, M., MacBeth, J. and Newsome, D. (2006) Investigating the impacts of off-road vehicle activity in Broome, Western Australia. Annals of Leisure Research 9 (1-2), 17-42.

Ramsar Convention (2002) New Guidelines for management planning for Ramsar sites and other wetlands. 'Wetlands: water, life, and culture' 8th Meeting of the Conference of the Contracting Parties to the Convention on Wetlands (Ramsar, Iran, 1971) Valencia, Spain, 18-26 November 2002 [adopted by Resolution VIII.14]

Ramsar Convention (2002) New Guidelines for management planning for Ramsar sites and other wetlands. 'Wetlands: water, life, and culture' 8th Meeting of the Conference of the Contracting Parties to the Convention on Wetlands (Ramsar, Iran, 1971) Valencia, Spain, 18-26 November 2002 [adopted by Resolution VIII.14]

Rubibi's Native Title Claim on behalf of the Yawuru people

Shire of Broome/Rubibi (1997) Local Government Development Project Broome Townsite

Coastal Reserves—a Case Study (March 1997)

Shire of Broome (1998), Local Government Development Project—Final Report. Written by Sharon Griffiths for Rubibi and the Shire of Broome.

Smith P& Smith R (1996), Community and Council—a partnership in cultural planning

—Shire of Broome August 1996.

Storey A (2006), How a stable isotope/food web study can predict the likelihood of elevated nutrient levels in the Bay and the possible relationship to Lyngbya blooms. University of Western Australia; Paper presented to Celebrate the Bay forum, 17 June 2006. Broome Bird Observatory & Department of Conservation & Land Management.

Tourism Western Australia (2008), Australia's North West Fact Sheet Year Ending December 2008.

Vernes T, McKenzie N & Mann M (2005), Roebuck Bay: It's a Values Thing. Paper presented to WA State Coastal Conference — Coastal Solutions: Balancing the waves of change, Busselton, November 2005

Vogwill, R. (2003), Hydrogeology and aspects of the environmental geology of the Broome area, Western Australia. Unpublished PhD thesis. Curtin University Western Australia.

WAFIC (2005), Retailers' survey. Reported in RBWG Issues Paper, 2006.

Western Australian Planning Commission (Dec 2005), Final Report of the Broome Planning Steering Committee.

Western Australia Planning Commission (2008), Broome Regional Hotspots Land Supply Update April 2008

Other:

P.A. Hesp, P. Curry (2004) A Land Resource Survey of the Fall Point Coastline, Broome, WA

Resource Management Technical Report No.38. Department of Agriculture Western Australia.

NA, (undated),Threats Identified by DEC in recent Monitoring Protocol Document (with assistance from EK).

Reimbursing the future: an evaluation of motivational, voluntary, price-based, property-right, and regulatory incentives for the conservation of biodiversity. Biodiversity Series, Paper No. 9

M. Young, N. Gunningham, J. Elix, J. Lambert, B. Howard, P. Grabosky & E. McCrone(1996), CSIRO Division of Wildlife and Ecology, the Australian Centre for Environmental Law, & Community Solutions Biodiversity Unit, Department of the Environment, Sport & Territories.www.abs.gov.au/ausstats/abs@.nsf/39433889d406eeb9ca2570610019e9a5/CCC3FA6CF6F31177CA2574390014B075 [accessed 10 February 2009]

www.abs.gov.au/AUSSTATS/abs@.nsf/mf/4714.0/ [accessed 12 May 09]

www.bom.gov.au/weather/wa/cyclone/about/broome/rosita.shtml (photo p45)

www.kdc.wa.gov.au/kimberley/tk_demo.asp [accessed 8 Nov 08]

www.drivewa.com/item/81/broome.html (Sea level)

8.2 Acronyms

ABS	Australian Bureau of Statistics
AEM	Adaptive Environmental Management
ALT	Aboriginal Land Trust
ATV	All Terrain Vehicle
AQIS	Australian Quarantine & Inspection Service
BBO	Broome Bird Observatory
BSC	Broome Shire Council
BVC	Broome Visitor Centre
CC	Crab Creek
CCMP	Crab Creek Management Plan
CDEP	Community Development Employment Program
CVA	Conservation Volunteers Australia
DEC	Department of Environment & Conservation
DoF	Department of Fisheries, WA
DOLA	Department of Land Administration
DPI	Department of Planning & Infrastructure
ECC	Environmental Cultural Corridor
ECD	Ecological Character Description
ILC	Indigenous Land Corporation
IMGs	Interim Management Guidelines
KDC	Kimberley Development Commission
KLC	Kimberley Land Council
LAC	Limits of Acceptable Change
LGDP	Local Government Development Program
RBWG	Roebuck Bay Working Group
RBRMP	Roebuck Bay Ramsar Management Plan
SCP	Shorebird Conservation Program
TOs	Traditional Owners
UCL	Unallocated Crown Land
WAPC	Western Australian Planning Commission

8.3 Glossary

Benthic	Relating to or characteristic of the bottom of a sea, lake, or deep river, or the animals and plants that live there.
Biota	All organisms; the total complement of animals and plants in a particular area.
Country	Term used by Aboriginal people in Broome to include land, landforms, waters, the sky and air.
Driver	A natural process (Bennelongia 2008).
Invertebrate	An animal that does not have a backbone, e.g. an insect or worm.
Lever	An anthropogenic factor
Leverage	Power to get things done. The way to get an advantage (e.g.lobbying); Leveraging, in this plan is using the influence of RBWG to achieve outcomes.
Littoral	On or near a shore, especially the zone between the high and low tide marks.
Ramsar	Refers to 'the Ramsar Convention on Wetlands signed in Ramsar, Iran in 1971 is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources'. From Wetland Management Planning — A Guide for Site Managers Compiled by Archana Chatterjee for WWF, Wetlands International, IUCN, and Ramsar
Stressor	Something that causes stress
Theme	Subject matter. In this plan management themes (or dimensions of management), incorporate the main stressors and management issues into linked groups.
Visitor	In this plan visitor refers to any person coming to the study area, except those who reside there.

ADDITIONAL INFORMATION 9

9.1 Acknowledgements

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- Broome Port Authority
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p5	Rangers install the sign	Kandy Curran
p5	Three men fishing from boat	Jeff Cooper
p13	Boat homecoming	Maria Mann
p13	People relaxing	Sharon Griffiths
p14	Roebuck Plains	Ricki Coughlan
p19	Residents fishing	Sharon Griffiths
p19	BBO entry	Anne King
p23	Oil spill	RBWG (KC)
p23	Cyclone Rosita	Bureau of Meteorology website
	www.bom.gov.au/weather/wa/cyclone/about/broome/rosita.shtml	
p27	Cattle	Web (Google image)
	http://images.google.com.au/images?hl=en&q=cattle+stations&cr=country	
p27	Fishing rods ©	Gene Eckhart (MM)
p29	Truck and boat	Sharon Griffiths
p29	Fishing from rocks ©	Jan Van de Kam, The Netherlands
p31	Townsite aerial	Paul Griffiths
p31	Foreshore development	Sharon Griffiths
p33	Lyngbya	Emily Burke
p33	Ships and boats	Sharon Griffiths
p35	Shell midden ©	Jan Van de Kam, The Netherlands
p35	Camper vans on cliff (Fatima)	Sharon Griffiths
p35	Fire at Crab Creek©	Gene Eckhart
p37	Vehicle tracks on cliff at Mirda	Minyirr Park (SG)
p37	Crab Creek Roebuck Bay aerial ©	Rod Hartvigsen of Murranji Photography
p41	Elsie and cockle shells	Ben Wurm-KLC
p41	Tree and eroded cliff ©	Jan Van de Kam, The Netherlands
p41	Turtle and vehicle tracks	Louise Beames
p42	Australian Snubfin dolphin ©	Marguerite Tarzia
p42	Neem tree	Sharon Griffiths
p45	High tides & townsite drainage	Sharon Griffiths
p45	Neil & DIA gravel pit	Minyirr Park (SG)
p47	Shipping©	Maria Mann
p47	Bellyache bush	Sharon Griffiths
p49	Toad	Qld Govt. web http://www.derm.qld.
	gov.au/wildlife /threats_to_wildlife/cane_toad.html	
p49	Foreshore seascape	Holly Sitters (RBWG)
p55	Women enjoying shade	Minyirr Park (SG)
p55	Walkers on dinosaur footprints	Sharon Griffiths
p58	Collecting mud samples ©	David Deeley
p58	Mud skipper ©	Gene Eckhart (MM)
p61	Family group hunting & gathering ©	Jan Van de Kam, The Netherlands
p63	Monitoring seagrass—anemone	Fiona Bishop—Seagrass Watch
p63	Shorebirds & walkers	©Jan Van de Kam, The Netherlands
p66	Neilo and politicians	Minyirr Park/ KLC LSMU
p66	Child bird release	Kandy Curran
p69	Rangers	Kimberley Land Council (JF)
p69	RBWG members and scientists	Roebuck Bay Working Group
p70	Plethora of signs	Maria Mann
p 73	Basic infrastructure	Sharon Griffiths
p74	TOs with Shirley Stack-Smith	Ben Wurm—KLC
p74	Seagrass monitoring	Fiona Bishop—Seagrass Watch
p75	Mangroves	Sharon Griffiths
p75	Turtle ©	Jan Van de Kam, The Netherlands
p75	Hovercraft	Kandy Curran
p77	RBWG workshop	Tanya Vernes WWF-Australia
p77	Coastal Award 2007	WA Govt (RBWG)

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9.3 Copyright

9.4 Disclaimer

This plan has been prepared for the Roebuck Bay Working Group by Sharon Griffiths and Associates, in association with Acacia Springs Environmental Pty Ltd. The content of this plan is based upon information available to us at the time of writing, and on key stakeholder comment. It contains various opinions, assumptions and predictions. Any representation, statement or opinion expressed or implied in this plan is made in good faith and on the basis that neither the consultants nor the RBWG are liable, to any person for any damage or loss whatsoever that has occurred or may occur from any action in respect to information in this document. Relevant professional advice should be obtained before applying any information contained in this document to particular circumstances. Furthermore, conditions may change over time and new information will become available. This Management Plan should be considered in light of the latest information available and the operating environment in which management will take place.

Appendix 1

The Roebuck Bay Working Group Membership

As at July 2009 the Roebuck Bay Working Group (RBWG) had 49 representative members from:

- Australia's North West Tourism
- Australasian Wader Studies Group
- Broome Bird Observatory
- Broome Fishing Club
- Broome Community Seagrass Monitoring Project
- Broome Port Authority
- Broome Visitor Centre
- Broome Fishing Club
- Broome Shire Council
- Community volunteers
- Conservation Volunteers Australia
- Department of Agriculture and Food
- Department of Environment and Conservation
- Department of Fisheries
- Department of Planning
- Department of Transport
- Environs Kimberley
- Global Flyway Network
- Indigenous Land Corporation
- Kimberley Land Council
- Kimberley Professional Fishermens Association
- Pearl Producers Association
- Research scientists
- Thangoo Station
- Water Corporation
- West Kimberley Recreational Fishing Advisory Committee
- WWF Australia
- Yawuru Native Title Holders Aboriginal Corporation

Note: The RBWG does not have decision-making powers over Roebuck Bay, but works collaboratively to improve communication and co-ordination and to advance community-based initiatives that help protect Roebuck Bay's key natural and cultural values.

Appendix 2 Mangalagun (Crab Creek) Site Planning

Tasks

- Identify fishing areas (precincts)?
- Bird Hide (where?)
- Seek funding for Rangers
- Ensure appropriate protection for cultural heritage sites
- Move road from coastline (suggest behind BBO)

1. Fatima (Quarry Beach)

Text for map
Signage
Public amenities
Visitor information
Ranger station
Tour meeting point
Carparking
Walktrails

- Maintain welcome and basic directional signage — now
- Develop Interps Centre/shelter
- Ranger Station; and associated
- Tour guide (meeting point)
- Public Amenities , shade, water, bench/tables for picnic, toilets,
- drinking water, visitor information (to take with them)

2. Toward Kunin (Fisherman's Bend)

- No visitor access to Kunin (bollards?) close vehicle access off

Text for map
Close vehicle access
Protect cultural heritage

3. Gabanyanya

- Area leased to TOs for camping.
- Provide shade
- Ensure appropriate protection for cultural heritage sites

Text for map
Protect cultural heritage
Rationalise vehicle access
Develop shade (vegetation?) or bough shelter

4. Sarbu Rock

- Acceptable place for small boat launching (TOs)

Text for map
Upgrade boat launching area,
Monitor impacts

5. Murraginygun (Broome Bird Observatory)

- To be decided.

6. Barrgangaba (Blackberry Tree)

The beach side areas around Crab Creek area are not easily accessed by people with disabilities however the viewing platform on the coast in front of the Broome Bird Observatory offers the opportunity for the elderly and disabled to get close-up and personal with the coast and to view migratory shorebirds. Indigenous people have asked for improved access at this area to enable their old people and those with disabilities to access a cool shaded spot. This is becoming more important, as the requirements to remove vehicle access is heightened.

- Maintain existing viewing platform and interpretative signage;
- Develop access for disabled and elderly to platform; and associated with car parking or drop-off area nearby.
- Designate area for carparking opposite the platform (exists) and with track leading to BBO.

Text for map
Improve access for disabled/elderly; and
Linked to carparking and walktrails.
Maintain existing signage and viewing platform

7. Mirda (One Tree)

- Restrict boat launching here
- Provide designated parking areas at end of road. (Stop vehicle access to Creek and cultural areas nearby).
- Agreed area for car parking well defined, with associated Walk trail to Creek.
- Needs bollards (?) and signage to direct visitors.

Text for map
Protect cultural practices and sites
Restrict boat launching
Install directional and interpretative signage
Develop clearly identified car parking area; and
Develop walktrail to Creek

Note: This has been drafted after onsite consultation with Traditional Owners Neil McKenzie and Frank Sebastian. It does not claim to represent the views of the Yawuru Native Title Holders. The draft site plan has not been circulated for comment or opened up for wider consultation at this point (1 June 2009).

It provides one example of how management strategies in Section 6 may be planned for on-ground implementation at Crab Creek.

Appendix 3

Gaps in knowledge, priorities and monitoring actions
Adapted from the Roebuck Bay Ecological Character Description (page 113,Bennelongia, 2009) the table outlines current components of the Roebuck Bay ecosystem, identifies knowledge gaps, priorities to be addressed, and recommended monitoring actions.

Priorities shown in red (ECD).

COMPONENT/PROCESS	KNOWLEDGE GAP	RECOMMENDED ACTION
Hydrology	Ground and surface water inflows to Roebuck Bay and the Ramsar site	Targeted study to construct water balance model.
Water Quality	Spatial and seasonal bioavailability of dissolved inorganic nutrients (NO_x, NH_4, PO_4). Nutrient loads, residence times. Relative contribution of various point and diffuse sources to nutrient loads.	Investigation into the actual and potential threat posed by nutrient enrichment. Determine likely 'hot spots' for eutrophication.
Sediments structure and nutrient content	Extent of change in sediment characteristics. Sediment nutrient stores (TOC, TN, TP), re-cycling and denitrification rates. Relative contribution of various point and diffuse sources to nutrient loads.	Penetrability surveys Investigation into the threat posed by nutrient enrichment. Determine likely 'hot spots' for eutrophication.
Lyngbya	History, current extent, frequency, duration and distribution of blooms.	Mapping of extent, frequency and species composition.
Benthic plants	Current extent, biomass and health of seagrass and macroalgal communities.	Mapping (aerial) and condition assessment (on-ground). Build on existing monitoring program.
Littoral vegetation	Current extent, biomass and health of mangrove communities.	Mapping (aerial) and condition assessment (on-ground).
Benthic invertebrates	Monitoring at two locations for the past 10 years. The number of sites needs to be increased to 4 to develop a more robust data set.	Build on existing monitoring program but reduce sampling frequency to annual.
Fish	Insufficient information to set a baseline for most fish species. Unfortunately although CPUE is collected for commercial fish in Roebuck Bay (*e.g.* Threadfin Salmon, Barramundi) this information is not reported publicly and so cannot be used to establish baseline values	Surveys to establish baseline condition of high conservation value fish species.
Shorebirds	Monitor total waterbird numbers in the Bay. Insufficient information to set a reliable baseline for most species. Extend surveys to provide species information.	Annual aerial monitoring count of the whole of Roebuck Bay. Annual monitoring ground count of species in 4 km section centred on Fall Point

Appendix 4

Options for governance workshop results.
Six options for implementation were presented to tease out from RBWG, existing governance opportunities and future requirements. The six scenarios were workshopped which gleaned that co-management with a statutory basis

was required).

No	Implementation scenario	Description	Resources required/ revenue	Opportunities	Constraints
1	Business As Usual (BAU)	Crab Creek environs non-vested. Ad hoc management, opportunistic funding, BBO and TO stakeholders resource-poor.	$	Existing model,well understood. The status quo.	Broome population and visitor growth will see continuing human-use pressures, habitat degradation, bird disturbance, lack of integrated management response, continuing uncertainty over native title/ ownership/ management arrangements.
2	DEC managed wilderness area Restricted access (<5000 visits pa)	Restricted access, National Park model.	$$	Variation on well understood NP model. Legislative powers once area vested in DEC. Could have Indigenous advisory board, employment, training opportunities. low visits so environmental protection assured.	TO/native title issues would need clarification. Potential disaffection of TO title holders because of dis-empowerment. Potential disaffection of local residents who may demand greater access.

3	Traditional Owner Managed wilderness area Restricted access (<5000 visits pa)	Non-statutory Indigenous managed area, (similar to Minyirr Park arrangements but with restricted access), informal partnership between TOs, Shire of Broome, BBO and DEC	$$	Co-management between local stakeholders. Similar to a successful existing local model. Low visits so cultural/ environmental protection assured.	Lack of statutory enablement. Potentially resource poor. Potential disaffection of local residents who may demand greater access.
4	DEC managed eco-tourism precinct (>5000 visits pa)	National Park model with eco-tourism focus	$$$	Well understood NP model. Legislative powers once area vested in DEC. Could have Indigenous advisory board, employment, training opportunities. High visitor numbers, environmental communication opportunities.	TO/native title issues would need clarification. Potential disaffection of TO title holders because of dis-empowerment. Visitation would need careful management to avoid shorebird disturbance, habitat damage, culturally inappropriate actions.
5	Traditional Owner Managed eco-tourism precinct (>5000 visits pa)	Statutory, Indigenous managed area, (similar to Uluru), lease back arrangement with DEC, delegated legislative powers to joint management body (TO in majority).	$$$	Co-management between TOs and DEC. Similar to a successful Uluru model. High visitor numbers, environmental and cultural communication opportunities.	Model not yet implemented in WA. New ground. Potential tensions, lack of commitment between partners during establishment phase. Visitation would need careful management to avoid shorebird disturbance, habitat damage, culturally inappropriate actions.

Conclusions from the Implementation Options Workshop

- Statutory base desirable;
- Shared (co) management desirable so long as equal power and decision making.

Mangalagun Crab Creek Management Plan - IMPLEMENTATION AND ACTION PLAN

The Crab Creek Management Plan has been developed by the Roebuck Bay Working Group to define appropriate management strategies to maintain the ecological, cultural and amenity values of Crab Creek. This Implementation and Action Plan forms part of the management plan. It seeks to provide a range of realistic actions that can be undertaken at a local level to manage Crab Creek. The responses to the management issues were identified through broad community consultation, and suggestions for timeframes and responsibilities are made along with some actions that, in the main, resulted from a RBWG workshop in held in 2008. It is however a working document that needs to be reviewed regularly to reflect the operational environment in which the management plan is implemented, and after evaluating the effectiveness of the strategies and actions in protecting Crab Creek.

The management strategies addressed include:

1. Education and awareness-raising
2. Advocacy and leverage across organisations
3. Collaboration/coordination
4. Aboriginal rangers
5. Infrastructure development
6. Policy and procedures development
7. Research
8. Zoning

Clearly, many actions will address more than one of these management strategies, and in general this Plan seeks to list actions within the most relevant strategy. In many instances consideration should be given to the action in addressing other Management Strategies.

Mangalagun Crab Creek Management Plan - IMPLEMENTATION AND ACTION PLAN

MANAGEMENT STRATEGY 1: Education & raising awareness

OBJECTIVES:

- Improve understanding and protection of the cultural and natural processes and assets of Crab Creek
- Foster informed decision-making
- Educate people to use Crab Creek in a sustainable manner
- Raise awareness about the Ramsar values

What needs to be done	How we will do it	Our target	What and When	Who will do it
Work collaboratively with others to raise community and visitor awareness	Provide clear information on Crab Creek and the principles underlying its protection to decision-makers and managers	An Information Pack delivered to all land managers and decision makers by May 2011	a- Secure resources by Feb 2011 b- Develop draft information and materials for pack by March 2011 c- Revise materials, print and arrange distribution of Pack May 2011	RBWG members
	Promote events that raise awareness of Crab Creek such as 'Celebrate the Bay'	- A community awareness event held each year eg Shinju Float, workshops, shopping centre video display; guest speakers; talks to school groups; guided cultural walks; - Annual Crab Creek Clean Up Days	-Minimum 1 event per year -Minimum 1 event per year	Vary, depending on event
	Guided Visitation			
Operate approved tours around Crab Creek guided by TOs and/or those who are 'champions' of the cultural and natural values of Crab Creek	1. Actively encourage the development of approved guided tours for visitors	1. Readily available guided tours (approved by TOs) available for visitors, volunteers and researchers by 2011; 2.Ensure provision of 1 x guided cultural walk per year by 2011 for new staff at BBO	1.By 2011 2. Initiate the development of tour as a one-off cultural awareness training for each new warden/research or volunteer team; (As it arises, or at least annually) by December 2010	1. Yawuru, BBO, RBWG and other organisations as appropriate eg Mamabulanjin 2.BBO Yawuru
	2. Promote approved tours	2. Regularly promote approved tours/activities that raise awareness of Crab Creek values	2. Promote as appropriate eg in newsletter, on website (for $) in Information Pack.	
	3. Support initiatives that ensure tourist activities operate in an approved manner.	3. The development & implementation of a Code of Conduct and approved training for tourism operators. (Ongoing)	3.Pursue & support the development of a Code of Conduct for all tourism operators, (and others eg, visitors, researchers, and volunteers)	Yawuru BBO WATC BVC KLC

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What needs to be done	How we will do it	Our target	What and When	Who will do it
Develop special interest & guided walks and talks by entertaining experts eg TOs, twitters, plant & animal enthusiasts	Support initiatives that offer these opportunities to raise awareness	Timetable walks to link to related events like - arrival of the migratory waders, - NAIDOC, - start of each six-seasons; - Shinju Festival - Education Week.	-Ongoing. Pursue possible initiatives; & provide advice & support to get approved operations up and operational. -Promote approved operations, or regular activities.	RBWG Yawuru BBO BVC Entrepreneurs or enterprises
	Marketing & promotion			
Ensure information about CC/RB is publicly available and accessible locally	Ensure a media plan is developed and implemented, to inform people about CC and its values and attractions	Outputs: - 1 segment on Goolarri TV - 2 x per year radio interviews with good news segments	- Media plan developed by March 2011	RBWG PO in collaboration with all stakeholders
	Use the media (for leverage) to promote informed decision-making with regards to developments at Crab Creek and on adjacent areas	An informed community; and the best decisions are made.	Ongoing and as it occurs	All stakeholders
Inform media contacts and networks of worthy news	-Develop media releases with great photos	- Positive media coverage of minimum 3x Crab Creek/Roebuck Bay events, or linked news items each year	- At every available opportunity	All stakeholders RBWG P O
	-Invite media people to attend RBWG functions and events	- Establish a media contacts list by August 2010	- Update contacts list at least annually	PO
	Develop and distribute a RBWG newsletter	1 x 'special' item on Crab Creek in each issue.	In each issue	RBWG PO, or seek volunteer
Distribute the Roebuck Bay Visitor Brochure widely	Ensure the revision, reprinting and timely distribution of the Rubibi/WWF Roebuck Bay brochure	Brochure stocks available in 8 x outlets in Broome eg DEC, Shire, BVC, Fish n Chip shop, Tackle Shop, resorts, BBO and hire car outlets	Assess stocks of brochure bi -annually 1x in April prior to tourist season, and 1x in August.	RBWG PO or volunteer
Informative booklets on RB/CC are readily available for visitors	Develop attractive & informative booklets or guides, on specific themes such as birds, biota, flora, culture, geology, that show the link in natural and cultural systems, (such as the Minyirr Park series)	Affordable ($10-$20) guides/booklets available all around town, targeted mainly 1) for general readership; but later for 2) special interests fishers, geotourists, cultural tourists, eco tourists.	1 x booklet of general interest developed by Sept 2010, and publicly available for sale by 2011 tourist season	DEC has similar booklets for Kimberley. Consider localised versions?

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What needs to be done	How we will do it	Our target	What and When	Who will do it
	Awareness Raising			
Develop an audio visual of Crab Creek highlighting values, appropriate uses & behaviours	Identify and secure resources to develop and promote this initiative	An attractive, informative, positive promotional aid for showing to visitors to Broome	-Audio visual presentation offered and available at BVC, resorts, Shire etc by April 2011 - Liaise with shop-front tour companies, operators of bus tours, charter boats for showing or 'air-time'	All stakeholders PO Goolarri Media
Raise visitor awareness of the cultural heritage values of area	Ensure production and distribution of a 'friendly' Crab Creek fact sheet or leaflet for visitors	- Freely available at 10 outlets - Introduce the fact sheet / brochure and its objectives to Broome Visitors Centre staff	- Stocks available by April 2010 -At delivery of brochure, approach BVC Manager. Seek to introduce brochure and objectives at BVC members meeting	Yawuru RBWG Member of BVC
Reduce Shorebird disturbance	Establish and implement a satisfactory way to quantify awareness levels (e.g survey)	Raise visitor awareness on the migratory shorebird needs	1. Initial survey? conducted by July 2010	1. Researchers or volunteers eg CVA Greencorps
	2. As per other strategies eg Signs Brochures Mud maps available Goolarri TV segment Fact sheet Protocols for researchers etc	As above		
Undertake community education on pressures affecting the CC values	Presentations to school groups;	Increase understanding in the community on pressures & how simple behavioural change can reduce negative impacts. *For example shorebird flight response to disturbance from unrestrained dogs; flow-on effects from vehicle access & human activities; impacts on mangroves; boat speed on marine mammals; & disturbance or removal of shells, rocks, sites etc*	Seek resources by July 2011, to ensure sufficient PO hours, or skills recruited to undertake community education activities	All RBWG PO
Raise awareness of iconic (and key) marine species that exist at CC eg dugong, dolphins, turtles, crabs & their habitat & usage.	As above, through a media and education plan	- Reduce disturbance and maintain habitat	Schools education Media releases Community events Informative guides or factsheets	DEC, Fisheries, BBO, Yawuru

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What needs to be done	How we will do it	Our target	What and When	Who will do it
Encourage the use of designated vessel landing sites around RB *(see also zoning & access)*	Encourage public awareness of the approved locations for boat access to RB	Vessels entering or leaving the Bay are not putting undue stress on CC	Boating guide Approach DEWHA to consider info revised into fact sheet (Dec) 05-09	DEWHA DEC DPI / DOF Shire Yawuru
	Ensure availability of positive and timely information, to support future enforcement (+engagement of boaters)	Each year and ongoing; 1) Public advertisements about access, by-laws, sustainable uses, and values	1) Educate users; LT -coordinated policy and improved public amenities; with -strategic zoning ; and enforcement	RBWG TOs Shire DEC BBO
Direct visitation to appropriate areas *(see also zoning & access)*	Make available mud maps for visitors showing 'approved' roads, walk tracks, boat launching, car parking areas etc	Draw up mud maps and have photocopies available from BVC and BBO and Shire by March 2010	Interim measure for 2010, with more informative materials available to general public *(see also infrastructure)*	TOs with RBWG or BBO
	Develop and maintain positive, informative signage	*See also infrastructure*		
Promote behaviours that reduce the impact on marine mammals	1)Talk to fishing club membership; 2) Distribute brochures or fact sheets eg advising speeds and manoeuvres	Reduce disturbance to marine mammals	1) By June 2010 2) To boat retailers, tackle shops, at DPI registration time, handout @ Sailfish Comp	1)Member of RBWG eg Deb Thiele or DEC 2) Distribute amongst RBWG members
Reduce the impacts of rubbish particularly plastics, in the environment	Raise community awareness of a) the negative impacts of rubbish b) ways to recycle, re-use and reduce rubbish	To stop littering at Crab Creek. - 50% reduction in rubbish volume from clean up (Regardless of increased numbers using the area)	Ensure accurate reporting of rubbish at annual clean up (immediate)	Shire, Clean Up Australia, EK
	Encourage a campaign to reduce plastic bag use in Broome	Make Broome and surrounds a plastic bag-free town	By 2012	Shire EK
	Reduce boat & fishing-related litter in the environment	Enlist support of pearling industry (asap)	-Liaise with industry body (PPA) Nov 09 - Reduce buoys (flotsam) by 75% - Recycle buoys	RBWG 2 reps

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MANAGEMENT STRATEGY 2: Advocacy and leveraging across organisations

OBJECTIVES:

- Use the capacity of the Roebuck Bay Working Group to influence decisions made locally and more remotely (wherever decisions are made) to ensure that the natural and cultural values of Crab Creek are understood
- To secure the best decision possible for the protection of Crab Creek.

What needs to be done	How we will do it	Our target	What and When	Who will do it
Understand Crab Creek's coastal vulnerability	Use leveraging to ensure assessment is undertaken *(see also climate change actions)*	- Vulnerability assessment for people, property and natural systems with 1 year - Identification of vulnerable areas and risks (Try for Dec 2010)	Letter to relevant authorities encouraging action toward getting assessment as soon as possible - October 2009	RBWG
	Assess impact of existing commercial operations on CC 's natural, cultural and amenity values	Ensure commercial operations are consistent with the Ramsar values	Assess impact of hovercraft on CC	RBWG members
Institute a proactive and positive approach to future stressors (*rather than reactive)*	Maintain a watch on proposals for future developments likely to impact negatively on CC	Informed decision-making that recognises the natural and cultural values of CC	1) Read BSC Council agendas each month-ongoing. -Notify RRBWG (PO) of any concerns. 2) Maintain a media awareness paper/radio	1) Shire Rep RBWG member; PO; 2) All members
"	Establish a process for RBWG to quickly respond to possible future impacts on CC	Clear and collaborative process to inform the RBWG membership, in order to influence decision makers	-Develop an interim process by Feb 2010 *(see also policy and procedures)*	RBWG members (working group?)
Ensure informed decision-making on all developments likely to impact negatively on the Crab Creek area	Encourage early and comprehensive consultation with key stakeholders before threatening activities are approved eg land clearing or coastal developments	All proposals for developments that are likely to impact negatively on Crab Creek are referred to the relevant RBWG key stakeholders through RBWG – eg model on WaterCorp's WWTP process.	- Agreement with key stakeholders to seek this advice by 2011 or - Agreement if necessary, to support this requirement to consult and advise. (asap)	All members of RBWG All stakeholders for Crab Creek
		Solid technical and professional advice is sought and considered before decisions are made.	- All planning instrumentalities ie DPI/Shire/DIA etc notify RBWG or management of proposals and seek professional advice before decisions are taken.	
		Encourage key stakeholders to consider proposal and make recommendations to RBWG for advocacy/lobbying	- Planning instrumentalities give due consideration to RBWG/BOM recommendations when assessing applications for development	

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	Provide key stakeholders and planning instrumentalities with timely and best available information on the values and goals for the Crab Creek area	Informed decision making	Ongoing	PO with RBWG membership

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MANAGEMENT STRATEGY 3: Collaboration/coordination

OBJECTIVES:

- To attract and maintain involvement by a wide range of stakeholders in managing Crab Creek
- To build a sense of stewardship among both volunteers and managing agencies
- To secure necessary management resources to implement the Plan
- To undertake joint management actions to conserve the values of the Crab Creek area

What needs to be done	How we will do it	Our target	What and When	Who will do it
Encourage all parties to work together for shared management of the Crab Creek area	Seek joint agreement between key parties to manage CC collaboratively in the interim (until tenure/governance issues finalised)	An Interim Management Agreement or MOU-2010 - signed by key stakeholders by Dec 2010	*(See also Advocacy and leveraging)* TBC - Dependent on State /Yawuru negotiations and timeframes	Land Owners and managers
Promote opportunities for the community & visitors to develop a sense of stewardship for the Crab Creek area	Activities such as -monitoring species/changes -Clean Up Days -Bird banding -Mud sampling.	- Arrange 4 events each year on-site @ CC, eg BBO to draw people to CC -2 clean ups per annum	Annual "Back to the Bay" or similar events held Undertake research activities involving all ages (like cannon netting, bird banding, mud sampling, seagrass watch)	As per now, but encourage wider involvement from all CC stakeholders
Encourage the involvement of the wider community in activities around the Bay	*(see also marketing/media)*	-More residents involved in on-ground management actions (50 pa); -Increase involvement of school groups in the study and management of RB (numbers and interest established by April 2010)	Each year involve at least 50 new people in Crab Creek activities. - Notify schools of opportunities, & encourage consideration in curriculum and field trips as appropriate	All members PO
	Continue to promote and foster the collaborative activities of others in research and management eg BBO, Yawuru, SeagrassWatch, EK, CVA etc	Increased number of collaborative opportunities encouraged and promoted – (see also research)	Ongoing and as opportunity arises. -RBWG agenda records possibilities for members to promote or collaborate on. -Provide a link to relevant others (ie through effective liaison and networking)	All RBWG PO /RBWG PO

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Coordination and Collaboration

What needs to be done	How we will do it	Our target	What and When	Who will do it
Vegetation				
Rehabilitate coastal vegetation in degraded areas (consistent with natural vegetation occurrence)	Protect existing vegetation Revegetate with native species	1) Identify priority area/s requiring protection or rehabilitation; and 2) Secure community work team eg volunteers, prisoners, or groups like CVA, or Greencorps.	1) Identify areas requiring rehabilitation in the short/medium to long term. (March 2010) 2)Investigate availability of resources particularly labour and endemic plant species (June 2010) Ensure support to develop an effective community work team (ongoing).	1) Yawuru with relevant others eg DEC, BBO, Broome Botanical Society, SKIPS KEH
Reduce weed invasions	Identify target areas and infestations of weeds in CC and catchment areas	1)Reduce ?weeds by ? % within 5 years 2)Report Declared Weeds and monitor to see they are removed	1) Liaise with relevant body re a weed plan showing priority areas for weed reduction by August 2010 2) Ongoing	PO DEC / Shire Yawuru ILC or relevant land owners
Maintain native species and ecosystems	Ensure the implementation of feral cat and fox control	Reduce feral animals in and around CC	1)Seek advice from DEC re best approach/incidence and priorities. TBA 2) Through RBWG share info and seek strategies to reduce - ongoing	DEC Shire, ILC or relevant land owners
"	Encourage Shire to actively promote native vegetation in residential and public areas	-Retention of native bushland where possible; -Increased usage of endemic species throughout Shire; -Reduce incidence of high water and fertiliser dependant species	Encourage Shire initiatives in making species and info available eg Expo	
Protect Crab Creek from impacts of oil spills	Work with Port Authority to identify ways in which stakeholders can avoid and contain oil spills	No oil spills, ever. If spills do occur they are swiftly contained and all necessary measures taken to prevent negative impacts on Roebuck Bay	Port to address the RBWG (stakeholders) and outline what we can do together to alleviate risk and any impacts	Project Officer to invite Port
Prevent the introduction of invasive non-endemic plants & animals to land & waters at CC	1) Support initiatives that increase vigilance; and that reduce the incidence or mitigate the causes . 2) Report threats/concerns to relevant agencies	a) No new invasive, non-endemic species at Crab Creek b) Eradicate existing infestations at CC	1) and 2) –Ongoing b) *see pest & weed control* 2) Reports asap to responsible agency	RBWG with AQIS, Port, DPI and DEC 2) all members
Reduce feral animals from the Crab Creek area	Initiate consideration of a feral dog and cat trapping program	No feral animals such as dogs and cats in the Crab Creek area	1) Seek members views on this pressure, and responses May 2010 2)Liaise with relevant agencies re reductionprogram	1) RBWG & wildlife carers 2) PO

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MANAGEMENT STRATEGY 4: Indigenous Rangers

OBJECTIVES:

- To gain support for an ongoing Aboriginal Ranger programme around Roebuck Bay; and
- To ensure resources are secured to maintain an effective Ranger service in the long-term.

What needs to be done	How we will do it	Our target	What and When	Who will do it
Develop and maintain an Aboriginal Ranger programme		Initially to provide an on-ground monitoring presence, and positive guidance for visitors, as well as to raise cultural awareness and care for country.	In longer term may be enforcement duties and management responsibilities as decided by land owners/managers	-Yawuru (initial) -In LT relevant agencies eg Shire along with owners/managers
	Work collaboratively to ensure the establishment of an Aboriginal Ranger programme	Rangers operating at Crab Creek on a regular basis by 2011	-Actively support the resourcing, recruitment, training and operation of Ranger program. ASAP and ongoing -Rangers 2or 3 casual rotating part-time positions for Crab Creek	Yawuru L&SMU/KLC Shire DEC BBO DoF Aqis
	Promote and support an Aboriginal Ranger program at Crab Creek	Work with relevant bodies to support and maintain an ongoing Ranger program for the area that encompasses the role of positive visitor interactions rather than just enforcement.	Collaborate with Yawuru, and KLC/DEC/BSC/DoF/AQIS on providing a trained resourced and supported Ranger presence around the CC area (Investigate who, what, how by March 2010) -Ongoing	As above with RBWG
	Establish a Ranger station at Fatima (Quarry Beach) with basic facilities for tourists eg info, toilets, shade and picnic tables/benches.	A Crab Creek Ranger station that clearly identifies a ranger presence and provides sufficient facilities to support the Ranger programme, and funnels visitor to appropriate info and facilities.	-In advance of the first land release of Broome North (2012)	Yawuru, State govt KLC & L&SMU Shire

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What needs to be done	How we will do it	Our target	What and When	Who will do it
Encourage involvement of Rangers in tourism and awareness-raising at CC	Work with tour companies that operate at Crab Creek and BBO to raise cultural awareness	**Talk with, and provide cultural information to each tourist enterprise operating in CC area before the commencement of the tourist season - Each year**	- Offer to accompany the tours (value-add with cultural input) if jobs available. or - Provide operators with an informative text on culture and behaviours while visiting CC Country - Provide a guided tour to every BBO Warden, at the commencement of their duties	Yawuru TOs to Birdwatching Turnstone Discovery Mamanbulanjin Hovercraft BBO etc
	Require all commercial tour operators to undertake a cultural orientation before permission to operate in the Crab Creek area is given *(Yawuru approval)*	Give notice to Broome Visitors Centre/Nth West Tourism/BSC of this requirement by 30 /1/11 (prior notice of intent to operate from 2011 Dry season)	a. Identify a TO/custodian to undertake this by Nov 2010. b. Seek resources to pay for cultural advice, to develop a suitable package of cultural info/guide), and to pay guides by Sept 2010 c. Implementation date 01/05/2011	a. Yawuru b. Yawuru/BBO/tourism operators/ RBWG

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MANAGEMENT STRATEGY 5: Policy and procedural development

OBJECTIVES:

- Clear guidance available for all stakeholders who manage Crab Creek
- Establish agreed policies & procedures to define 'rules' for on-ground works
- Provide consistency in operational decisions
- Define roles and responsibilities of each stakeholder involved in the management of Crab Creek
- Support commercial operators, researchers and volunteers by providing direction & clarity
- Improve efficiency and thereby secure resources for management works
- Encourage greater accountability and transparency

What needs to be done	How we will do it	Our target	What and When	Who will do it
Direct and effectively manage vehicle, vessel and pedestrian access	a) Support strategies for vehicle free beach b) Seek advice and agreement on 'approved' access areas at CC c) Ensure visitors to CC are informed	-No vehicle access on Crab Creek (except emergency & service vehicles - Pedestrians are using approved walktrails and access points - Impacts on CC from water traffic are reduced	- Develop agreed policy/procedures on access to Crab Creek June 2010 -Publicise the agreed access at CC by signs, leaflets, media by Dec 2010 *See also zoning & access and Infrastructure sections*	Yawuru Owners and managers land & sea
Implement policy and contingency plans in response to climate change probabilities	Revise management plan and actions in light of Crab Creek's vulnerability	- Management Plan revised to reflect risks and priorities	June 2011 *(See also climate change)* RBWG to advocate	Relevant stakeholders,
Reduce disturbance from dogs	Develop agreed policy re dogs (and horses?)and implement at Crab Creek	-Shorebirds are not disturbed by free-ranging animals ie dogs -Areas suitable for dog walking are identified & used by visitors	June 2010 -RBWG to approach BSC & Yawuru about dogs (leads, prohibition, legislation etc) *(See also zoning, & education)*	DEC Shire
Promote behaviours that support the protection of CC natural and cultural values	Agree on appropriate behaviours for visitors to the CC area, and set down in policies, and marketing materials	a) Ensure provision of clear guidelines, protocols and set down basic behaviours for RB b) Develop agreed policies and codes of conduct for distribution eg brochure, fact sheets etc c) Publish and make publicly available, guide to behaviour, e.g. commercial operators' code of conduct, information and interpretative signage.	a) work with TO's on the development of agreed protocols/behaviours/guidelines. By November 2010 b) Secure resources (sponsorship/in-kind /grants/volunteers) to develop, publish and advertise in 2011. *(see also education and awareness-raising)*	RBWG Yawuru BSC DEC BBO

Mangalagun Crab Creek Management Plan - IMPLEMENTATION AND ACTION PLAN

MANAGEMENT STRATEGY 6: Zoning and access

OBJECTIVES:

- Use zoning and precinct based access management to steer high impact use away from sensitive environmental and cultural sites
- Focus high impact use on less valued areas and toward public infrastructure

What needs to be done	How we will do it	Our target	What and When	Who will do it
Human use pressures		*(See also education & awareness-raising, policy & procedures, & coordination & collaboration)*		
Reduce the occurrence of inconsistent or unsafe uses around Crab Creek	1) Investigate possibility of zoning to	- No camping on Crab Creek beaches - No vehicles on foreshore by Dec 2010	Establish agreement on management of camping, vehicle access, pedestrian use, commercial use boat access etc ; and -Develop policy or procedures to support this. Commence asap.	Yawuru & other Land owners and Managers in consultation with RBWG members
	- Protect sites, species and habitats	- Reduce disturbance to migratory shorebirds habitat; protect birds, biota, water quality by restricting inconsistent uses in the area	As above	As above
	- Protect opportunities for cultural practices	- Ensure Aboriginal people can continue cultural and economic practices unencumbered;	As above	As above
	- Provide safe recreational opportunities	-Suitable recreation areas and safe uses identified that provide for community needs, & are consistent with cultural & natural values	Establish agreement on recreation areas and uses. Sept 2010	As above, & Planners (BSC?) in consult with the above
Reduce habitat disturbance and species loss	Investigate zoning to reduce impact on birds feeding & roosting, from uses such as fishing, beach walking, camping, dog exercising etc	Suitable areas are defined & promoted for - dog walking; - launch/retrieval of boats - fishing - recreational purposes; - commercial operations on land & sea eg hovercraft & tours	As above -Rationalise the use of CC area; & achieve 'win/win' for many users by establishing precincts for specific uses. 2012	As above, & Planners (BSC?) in consult with the above
	a-Designate dog exercise areas (for dogs off lead?) b-Designate 'no dog' areas	a-1 x exercise area for dogs by 2010 - Signage and brochures to show where people can and cant take dogs (see also education)	- Identify and promote approved exercise area - Encourage Shire to develop and distribute brochure , site sketch in fact sheet that shows dog exercise and prohibited areas- Distribute info at time of Shire registration. -Distribute to vets, kennels, BVC etc	Shire/DPI/DEC Resourced by advertising from vets, pet products etc

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Access		*(see also Rangers and Education)*		
Limit and manage vehicle and pedestrian access around Crab Creek and in catchment area	1. Map existing tracks and access points 2. Reduce inappropriate tracks 3. Designate access & inform by signage 4. Policy & legislation (by laws)	Rationalise access points 2) Closure of old access tracks within 2-5 yrs 3) Ensure community is informed, and signage is maintained to guide visitors (in advance & ongoing) Within 2 yrs	1) Map existing tracks from aerial photo 2010 2) Rehabilitate vegetation on old tracks as needed (barriers to protect?) As necessary 3) Reduce access to 3 main points (not onto beach) (*See also education and infrastructure*)	RBWG DEC Shire TOs BBO RP Station/ILC
Review the Crab Creek Road access	Investigate alternative road site /access points (1 yr)	Crab Creek Road is positioned to provide effective access to Crab Creek while reducing the stress on the important cultural and natural areas.	-Investigate within 1 year - Identify appropriate vehicle access tracks & new site for CC road in 1 yr -Implement new access road 5-8 yrs	Yawuru DEC /Shire BBO/ILC RP Station Main Roads (re Brm Rd)
Reduce disturbance to shorebirds from air traffic, particularly helicopter flights	-Seek limitations on, or change flight paths to, reduce impacts on shorebirds -Raise awareness to educate the pilots & operational managers	Flight paths that reduce disturbance to shorebirds are adhered to	RBWG and /or BBO to continue to liaise with airport control + enforcement + compliance *(see also education, collaboration, advocacy, policy)*	RBWG, BBO, airport control Shire DEC
Encourage use of designated vessel landing sites at CC	Identify and implement zoning around the foreshore	Vessel landing area designated by Sept 2010	Strategic zoning, (*see also education, indigenous rangers, and coordination*	Yawuru DPI, DEC, DOF
	-Investigate legislative options to control vehicle access such as by-laws	-Educate and raise awareness in advance of restrictions or controls. Ongoing.	*(See also Rangers & Education)*	Yawuru Shire DPI / DWEC
Rationalise vehicle access and boat launching at CC	Identify & promote use of the agreed zone for boat ramp	An agreed area designated for launch/retrieval of small boats at CC by May 2010	- Upgrade existing agreed boat launching area by May 2011. -Advertise approved boat launching zones by 2011.	-RBWG/Shire/ TOs/BBO/DPI -DPI & Shire
Closure of the inappropriate access to Crab Creek	Restrict access to area used for boat launching adjacent to Crab Creek	- Reduce to 1 boat launch zone in 1 year, and -Ensure erection of barriers and signage on minor ramps within 1 yr -No boat launching beside Crab Creek by 2010	- Block off vehicle access to Creek after - Signage and promotion of agreed boat ramp area at Sabu Rock, is undertaken (TBC)	Yawuru DPI/Shire BBO/DoF

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	Inform users on areas (zones) for boat launch through signs, boating guide, possible next step is legislation/enforcement	*(See also Education, collaboration)*	- DEC to continue to liaise with DPI re speed limits, education of users, and legislative requirements. Ongoing - DEC to report back re above to RBWG meeting by June 2010.	DEC DPI Yawuru RBWG

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MANAGEMENT STRATEGY 7: Infrastructure development

Objectives:

The provision of public amenities to

- Direct and effectively manage visitor pressures
- Provide an incentive for visitors to use actively managed areas identified as suitable for visitation
- Funnel visitors away from and protect culturally significant areas/sites
- Funnel visitors away from and protect migratory bird habitat and other environmentally sensitive areas
- Increase the economic returns from visitation.

What needs to be done	How we will do it	Our target	What and When	Who will do it
Public Amenities				
Provide and maintain basic public amenities, and infrastructure to draw visitors to acceptable areas at Crab Creek	Encourage stakeholders to provide directional signage, toilet, walktrails associated with approved parking zones and, shade at Crab Creek	- Car park developed by March 2011 - Ramp for disabled access constructed by May 2011	See below *(also coordination)*	Yawuru decision DPI/Shire/DEC arrange construction
	Identify BBO and other landholders/lessees intentions re public provision eg for water, toilets, camping	Establish a clear and coordinated agreed approach to planning and delivery of public facilities at Crab Creek *(see also collaboration)*	-RBWG to seek comment and advice from all stakeholders as to their aspirations plans by June 2010 -Liaise closely with key agencies groups in the area to ensure all clear and no duplication	Yawuru, RBWG Key stakeholders
		Shaded interpretative area opposite entry to Fatima (Quarry Beach), and signage at designated car parking areas	-Develop site plans for visitor areas consistent with retention of cultural/natural values. Ongoing.	As above
	Investigate the resources required & siting necessary for providing & maintaining basic visitor amenities eg toilets drinking water, rubbish collection from a central point at CC (eg at Fatima interpretation shelter & Ranger Station)	Develop and maintain public facilities	1. Consider short term and long term needs for basic amenities infrastructure by May 2010. 2. Undertake initial site visits and draft site planning proposals by June 2010	By or under direction of Yawuru & include or consult with relevant owner/managers eg DPI, Shire,

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What needs to be done	How we will do it	Our Target	What and When	Who will do it
	Cont...Investigate the resources required & siting necessary for providing & maintaining basic visitor amenities		3. Cost out proposals by August 2010, and if agreed 4. Define priorities, & seek resources to implement plans by Jan 2011	... DEC,BBO
		All public facilities are maintained in a safe and attractive condition (ongoing) -Signage is updated and easily visible.	- Regularly inspect signs and viewing platform (every 6 months) - Report conditions to relevant body	DPI/Shire/BBO/ Yawuru/DEC
Improve visitor facilities in and around Crab Creek	Provide appropriate access for people to access - fishing spots - take old people /disabled to shore - the foreshore - bird watching	Provide minimum 1 x access (carpark, pedestrian access, ramp etc) to foreshore (shaded area) for people who are disabled or aged	1 x Disabled Ramp May 2011 ;and 1x parking space designated near the viewing platform on CC Rd May 2011	Yawuru BBO/ DPI/Shire/DEC
^^^	Install directional signage (*see education , collaboration)*)	Develop and maintain positive signage in key areas at Crab Ck and strategically around town	1. Following the site study, develop a signage plan for all Crab Creek area 2. Identify needs 3. Identify proposed sites 4. Undertake site clearances 5. Secure resources needed 6. Ensure maintenance of current CC signage	1.RBWG, Shire, DPI under direction of TOs 4. Yawuru, DIA, Shire 5. RBWG members 6. land managers
^^^	a-Increase shade for visitors b-provide drinking water	a-Natural plantings at key 'rest' areas, and shade shelter at Fatima b-At Fatima, with Ranger station	Ongoing as infrastructure develops	DPI/Shire/ BBO/Yawuru/DEC
Direct (funnel) visitors to areas away from significant sites or fragile areas	Provide 'approved' viewing areas and hides for visitors/birdwatchers	1 x bird hide in agreed area	- Identify an appropriate hide site, and seek TO and key stakeholder agreement. - Get Yawuru clearance to install/construct (*See zones & access*)	BBO Yawuru NT Holders
	Designate and make clear car parking areas and pedestrian access/walking trails Block off inappropriate access Install informative signage	Provide 3 x clearly identified areas for car parking and linked to pedestrian access to coast by December 2010, at 1) Mirda 2) Fatima 3) Viewing platform	-By Dec 09, identify and draw up site plans consistent with -By May 2010, secure resources required to undertake the development of low-key parking areas linked to walk trails and beach entry points, and clearly designated by consistent basic directional signage.	Yawuru and/or Shire, DEC Relevant others eg BBO

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Direct and effectively manage vehicle, vessel and pedestrian access	Support strategies for a vehicle free beach Or Reduce (Ensure no) vehicles on foreshore and cliff areas	No unauthorised vehicles on foreshore/cliffs by Dec 2010	Only emergency and service vehicle access to CC foreshore by 2010 1) Educate in advance, Goolarri TV segment, GWN, media coverage, early and regular. 2) Forewarn. Give friendly notice to those driving on beach currently that need to stop (note distributed?)	Yawuru Native Title holders & BSC - Policy Rangers-Enforcement DPI
Reduce pressure on coastal foreshore by re-sighting Crab Creek Road	Encourage the land managers/owners to prepare plans for road alignment away from the coast	Get parties to agree on where Crab Creek Road should go	RBWG letter to key parties by Dec 09	Project Officer, after consulting with RBWG
Provide central information and help for visitors to Crab Creek	Establish a ranger station at Fatima (Quarry Beach) with facilities for tourists eg information, toilets, shade and picnic tables/benches/water	An effective functioning Ranger station associated with a central visitor information area	*(see also Rangers & Collaboration, zoning, access)*	Yawuru KLC L&SMU

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MANAGEMENT STRATEGY 8: Research

OBJECTIVES:

- Gather essential baseline data important for the management of Crab Creek and its catchment
- Fill identified gaps in research information
- Encourage multidisciplinary research
- Involve Traditional Owners, field naturalists and other interested individuals in research and data collection
- Encourage ongoing monitoring and evaluation over the long-term, to assist in adaptive management of Crab Creek and its catchment.

What needs to be done	How we will do it	Our target	What and When	Who will do it
Identify available data/information needed to effectively manage CC, and through this the gaps in knowledge	b. Request stakeholders to identify gaps in knowledge necessary to effectively manage CC area; and c. Identify priorities for research to fill knowledge gaps	Information gaps identified by December 2009	b. Ongoing	b. All stakeholders c. RBWG members
	Secure the appropriate people (and resources) to research the gaps in knowledge and data	Effectively supervised research leading to increased understanding of RB and its stressors, and the actions necessary to reduce these.	See above	Depends on info. needed, but may be coordinated by RBWG
Actively pursue the collection of baseline data on key species and elements and impacts eg fish stocks, molluscs	a. Encourage national and international collaborations with research institutions, universities and environmental and volunteer organisations	1.Support the maintenance of the existing participation of researchers with BBO/Birds Australia; 2.Improve coordination and reduce duplication in securing good information; 3.Ensure all RBWG members are aware of relevant research (both internal and external to agencies) and where to gain access to findings;	1.Ongoing 2.Ongoing. Refer info to RBWG to consider for RBWG web site 3. Ongoing *(consider procedures & policy)* -Seek possibilities for priority research and report back to RBWG meeting by March 2010	Yawuru, DEC and RBWG + BBO, Birds Australia
Protect seagrass beds	Map seagrass beds Monitor to increase knowledge	To manage impacts on seagrass beds, and protect dependent species and systems	Support ongoing seagrass research	Seagrass watch EK DEC

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What needs to be done	How we will do it	Our target	What and When	Who will do it
Maintain a watch for occurrence of Lyngbya (blue green algae)	Encourage the communities watchful eye	No negative impacts from Lyngbia occurring in Crab Creek	Ongoing	All members
Consider likely impacts of climate change on Crab Creek ie. foreshore erosion & inundation of nearby areas	Establish baseline data eg measure retreat of mangroves, samphire flats, pindan cliff erosion	Understand and prepare for likely events in key areas, and to protect where possible of key species		All stakeholders in RBWG
Research that helps fill the knowledge gaps	Refer initially to gaps in ECD (Bennelongia 2008) and DoF	Encourage research that is identified and agreed as high priority	Ongoing, and as opportunity arises (eg interest expressed by students or Uni)	RBWG in association with others
Encourage the collection, dissemination and use of research	Ensure sufficient and current information available to decision-makers to enable informed decision making	All decisions on issues that impact on Crab Creek are made based on good sound information e.g assessments on development proposals, commercial operations, access, fish quotas	Ongoing. - Develop sound working relationships with decision makers. - Maintain a watch on forthcoming proposals; - Monitor outcomes and impacts.	All members of RBWG, and those with statutory responsibility

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Commonly used abbreviations

BBO	Broome Bird Observatory
BVC	Broome Visitor Centre
BSC	Broome Shire Council
CC	Crab Creek
CVA	Conservation Volunteers Australia
DEC	Department of Environment & Conservation
DIA	Department of Indigenous Affairs
DOF	Department of Fisheries
DPI	Department of Primary Industries
ECD	Ecological Character Description (scientific description of values of the area, required for all Ramsar sites)
EK	Environs Kimberley
KLC	Kimberley Land Council
L&SMU	Land & Sea Management Unit Kimberley land Council
LT	Long term
PO	Project Officer for RBWG
RB	Roebuck Bay
RP	Roebuck Plains
RBWG	Roebuck Bay Working Group
SKIPS	Society for Kimberley Indigenous Plants and Animals
TOs	Tradition Owners of the area
WWF	WWF Australia (previously World Wildlife Fund)
Yawuru	Yawuru Native Title Holders Aboriginal Corporation