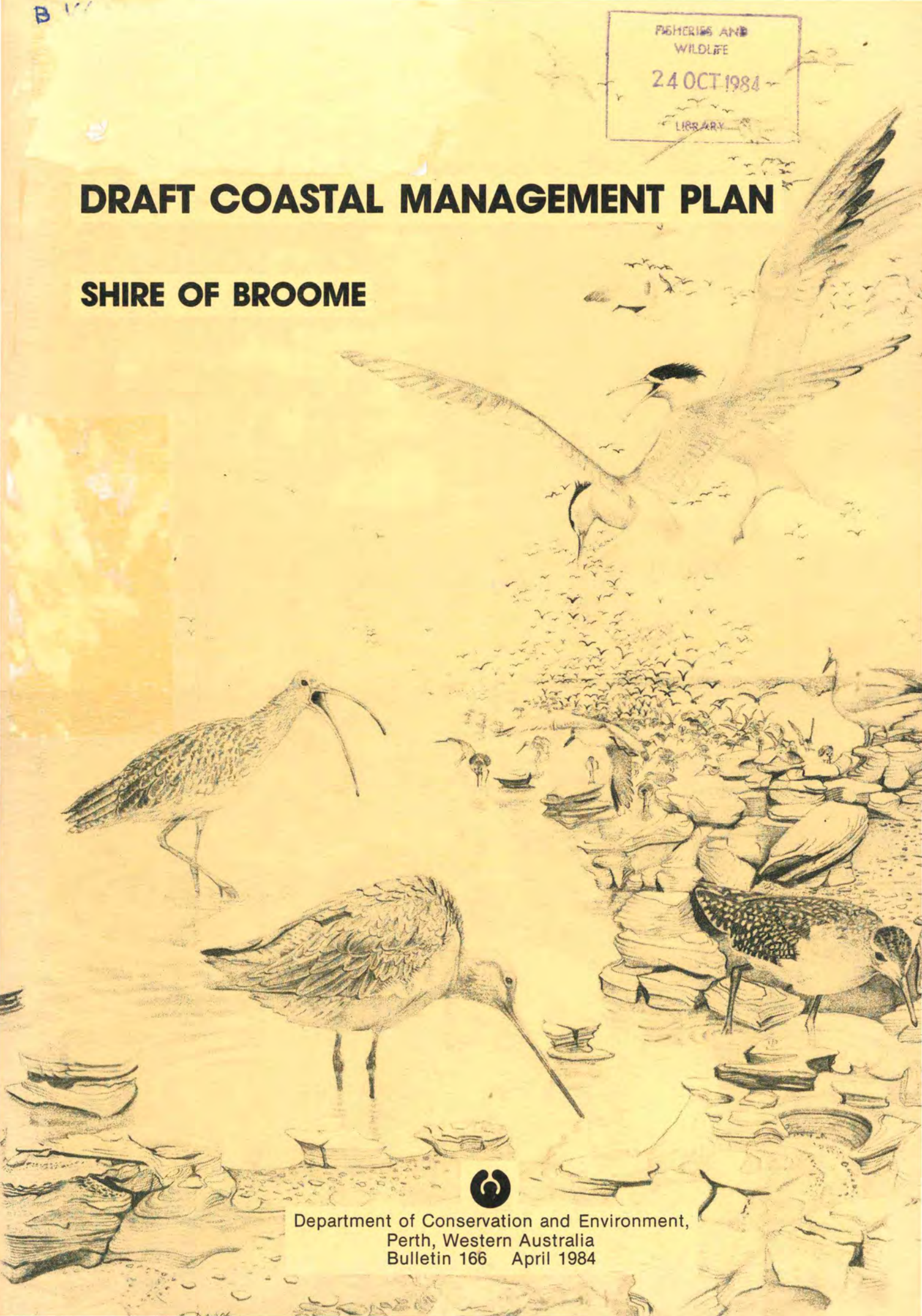
# DRAFT COASTAL MANAGEMENT PLAN

## SHIRE OF BROOME



Department of Conservation and Environment,
Perth, Western Australia
Bulletin 166 April 1984

# DRAFT COASTAL MANAGEMENT PLAN

## SHIRE OF BROOME

A study promoted by the
Department of Conservation and Environment
and the
Coastal Management Co-ordinating Committee
of Western Australia

by

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ACKNOWLEDGEMENTS

Information and criticism have been provided from a number of sources during preparation of this draft plan, which must be acknowledged.

Russell Taylor and Shelley Cook of Taylor and Burrell provided advice about the town planning scheme as did the councillors and officers of the Shire of Broome. Numerous members of the public made written and informal submissions.

Members of the WA Heritage Committee and officers of the WA Tourism Commission made their research available and provided valuable advice about the Broome area. Officers of WA Branch of the Fishing Industry Council and the Departments of Town Planning, Public Works, Resources Development, Marine and Harbours, Mines, Youth Sport and Recreation also provided advice.

June Hutchison provided valuable assistance in proof reading and editing, Brian Stewart, Tony Berman and Patsy Moran prepared the report for publication, and Stuart Chape provided some photographs.

ISBN 0 7244 6874 9
ISSN 0 0156-2983

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COASTAL PLANNING IN WESTERN AUSTRALIA

In 1982 the Western Australian Government established a Coastal Management Co-ordinating Committee (CMCC) comprising representatives from a number of State authorities to:

- advise government about coastal management policies, legislation and administrative arrangements;
- co-ordinate departmental activities on the coast through the exchange of information and views, and review expenditure programmes and priorities;
- overview the preparation and implementation of coastal management plans at regional and local levels for various locations on the coast of WA.

This is the eighth draft plan prepared under this programme and the locations covered by other plans are shown on Map 1.

SUMMARY: DRAFT COASTAL MANAGEMENT PLAN - SHIRE OF BROOME

In 1980 Broome Shire Council approached the Department of Conservation and Environment (DCE) seeking assistance with the preparation of a Coastal Management Plan for the Cable Beach area. However, it was agreed to delay the plan until it could be prepared in the context of an overall town planning scheme to be undertaken by Taylor and Burrell, Consultants in Town Planning and Urban Design.

Town Planning Schemes 2 and 3 were released for comment in November 1983; they identify seven coastal management areas for each of which the Council should prepare a development and management policy.

This Draft Plan contains information about the natural and man made resources which may be affected by or influence use of the coastal zone. It also recommends policies and objectives for the coast to:

- limit use of coastal areas to activities requiring coastal locations;
- protect natural systems and cultural assets;
- protect ground and seawater quality;
- provide for a wide range of recreational uses;
- protect sites of concern to Aboriginal people;
- encourage and cater for tourism;
- provide for appropriate industrial and commercial activities;
- develop a public education programme relating to coastal areas.

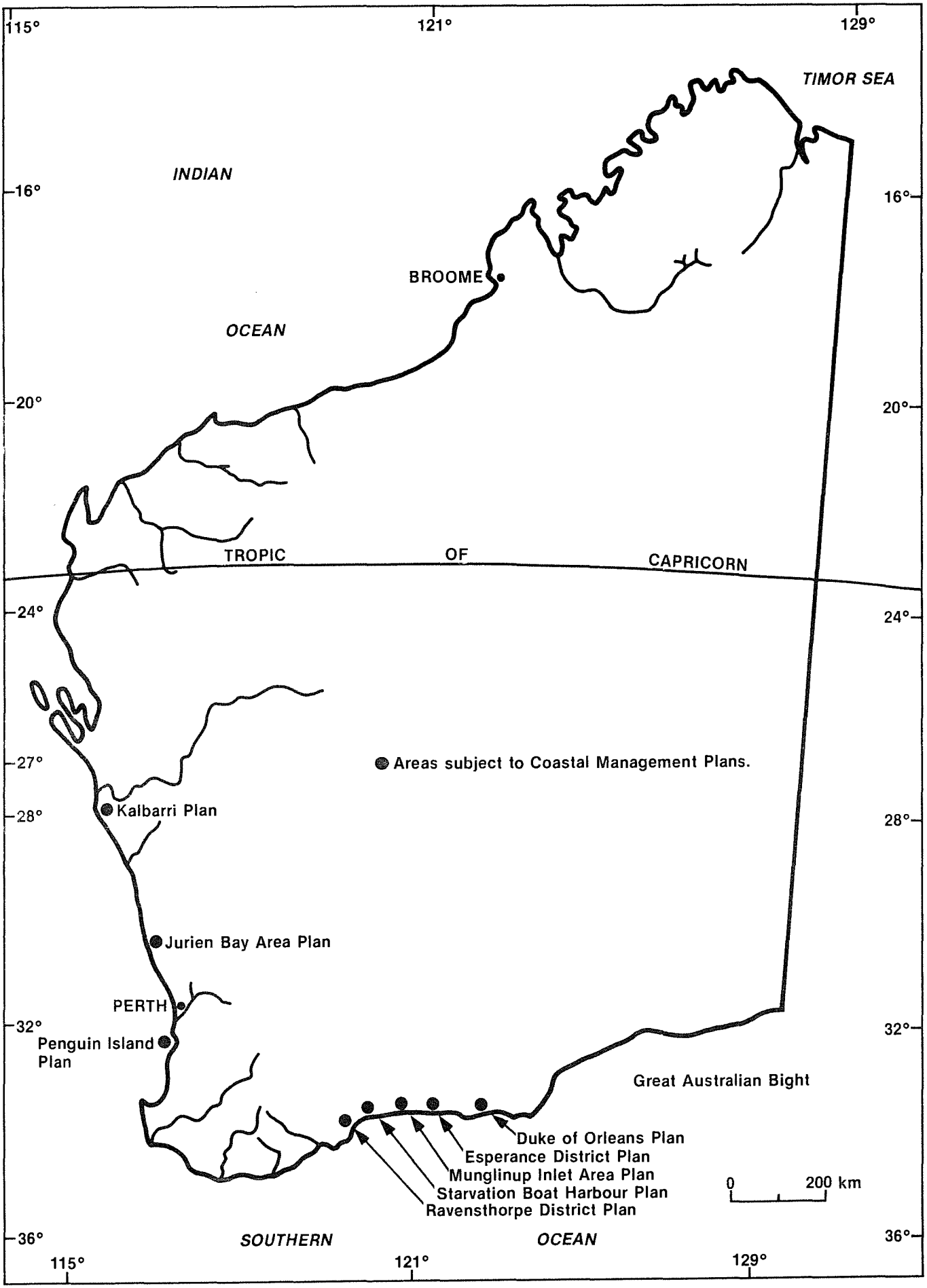
Management units are described which identify areas capable of sustaining varying levels of development and use, and locations are nominated for particular activities.

A number of processes which may create environmental problems are identified and strategies are defined to overcome, manage or monitor losses. In addition, operations are recommended to repair damage which has occurred

because of past careless or unplanned use.

Finally, a chapter describes how the plan may be implemented identifying alterations which will be required to existing Crown land vestings, amendments to the Town Planning Scheme, government agencies which may provide assistance and possible sources of funding.

This draft will be available for comment until 30 September, 1984 after which a final Management Plan will be prepared. However, it is expected that some proposals will take many years to implement and alterations will occur as information becomes available. The final Management Plan may be amended after discussions between Council, DCE, other interested agencies and members of the public.




**MAP 1 AREAS COVERED BY COASTAL MANAGEMENT PLAN**

## 1.0 INTRODUCTION

### 1.1 Location

Broome is a major town on the coast of the Kimberley Region of Western Australia. It is situated on the north-west corner of Roebuck Bay at 17°58' south and 122°14' east, 2365 kilometres by road north-east of Perth. (Map 2)

### 1.2 Background

In October 1980 Council approached DCE seeking assistance in the preparation of a development plan for Cable Beach between Gantheaume Point and Bali Hai. At that time it was agreed to delay the plan until it could be prepared in the context of an overall town planning scheme which was to be undertaken by Taylor and Burrell, Consultants in Town Planning and Urban Design.

Subsequently Taylor and Burrell prepared the Shire of Broome Town Planning Scheme No. 2, which covers the townsite, and Scheme No. 3, which covers the rural areas in the Shire.

Section 5 of the Scheme text relates to General Provisions, and Section 5.1 on coastal management areas states:

PART V - GENERAL PROVISIONS

5.1 Coastal Management Areas

5.1.1 The Council shall prepare or cause to be prepared, policies for each of the coastal management areas as shown on the Policy Map attached to the Scheme.

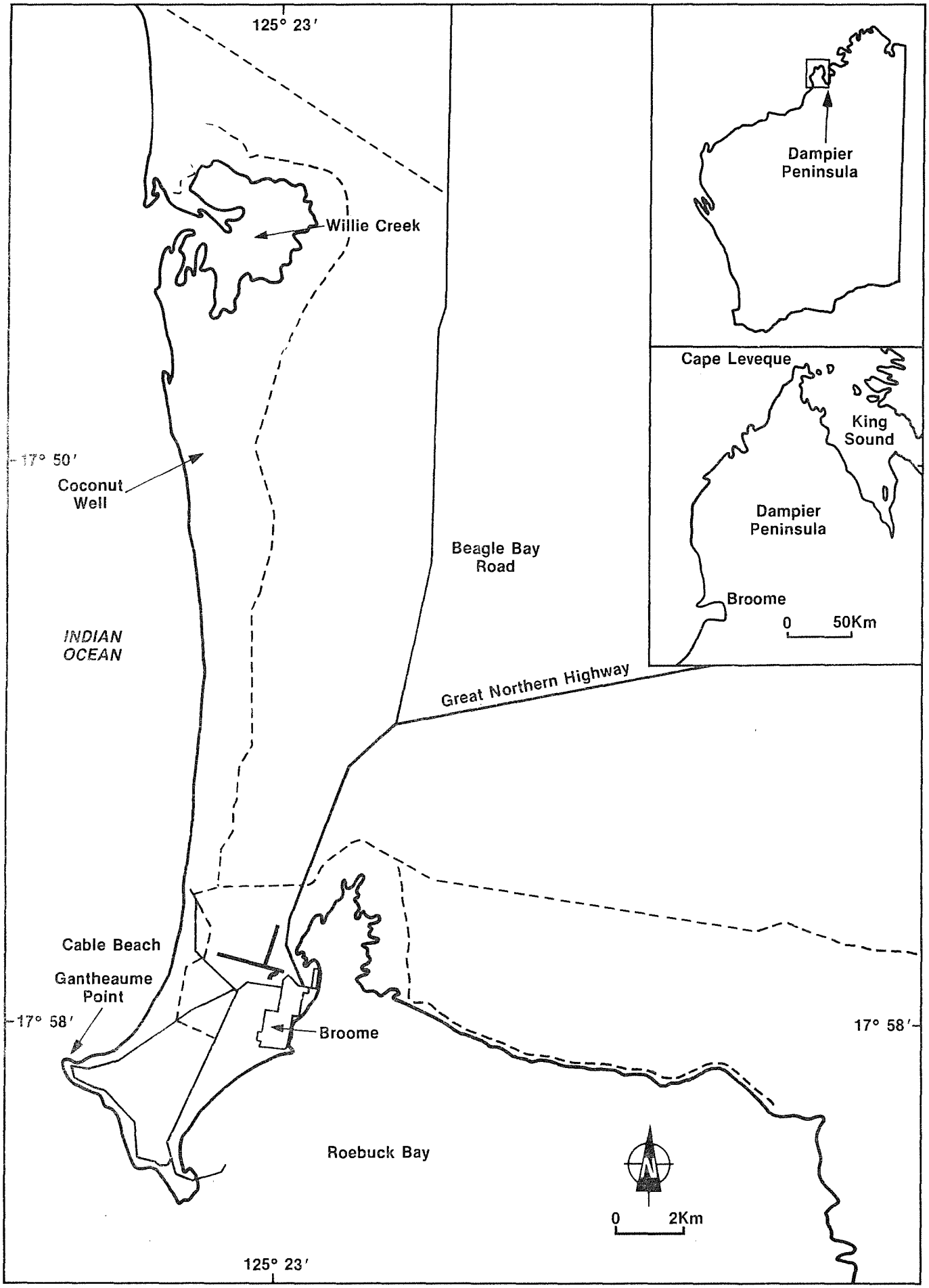
5.1.2 During preparation of the policies and prior to adoption thereof Council will seek comment on the policies and any development proposals from:

(a) Coastal Management Co-ordinating Committee,
(b) Department of Aboriginal Affairs,
(c) Registrar of Aboriginal Sites.

5.1.3 Following preparation of the policies Council shall advertise a summary of the policy once a week for two consecutive weeks in a newspaper circulating in the area giving details of where the full policy may be inspected and where, in what form and for what period (not being less than 21 days) representations may be made to Council.

5.1.4 Having considered the submissions made under the provisions of clause 5.1.3, Council may resolve to adopt a policy for an area and may adopt management strategies in accordance with the recommendations of the policy and will thereafter determine development in accordance with the strategy.

5.1.5 Prior to adoption of coastal policies and the strategies resulting therefrom Council will refer any development proposals falling within a policy area to the bodies referred to in clause 5.1.2 and request that they advise




**MAP 2 BROOME — LOCATION**

on the proposal and any requirements recommended by any one of the bodies.

5.1.6 After receipt of the advice or recommendations from the bodies identified in clause 5.1.2, Council may use the advice or recommendations to either:

(i) approve the development proposal;
(ii) refuse the proposal;
(iii) grant approval subject to conditions which may include a requirement to prepare an Environmental Review and Management Programme.

The Coastal Management Areas as described in the Scheme are shown on Map 3.

In 1981 the WA Department of Tourism (WADT) published the Kimberley Regional Tourism Survey which amongst other things concluded that the tourist industry will be favourably affected by the recent sealing of the Great Northern Highway and the increasing importance of Darwin as an international gateway to Australia.

The Survey noted that although the "majority of residents in all towns surveyed recognised tourism as being important to their town's economic and social development" it appears that the "ensuing competition between residents and visitors for scarce facilities has precipitated some negative feelings. .... Although this attitude is not prevalent it should be treated seriously as 'local atmosphere' is important to visitor satisfaction".

A visitor survey conducted at Broome showed that approximately 60% of attractions visited were coast oriented (i.e. lay in the coastal zone), highlighting the importance of the coast as a resource of Broome.

In 1982 the WADT published the Caravan Parks Survey of Northern Western Australia and showed that the number of visitor arrivals in the Kimberley had increased 10% per year over the past five years.

These findings suggest that there will be increasing pressure on both the resources and residents at Broome and that careful planning and management are required to avoid:

- continuing "competition" between residents and visitors for scarce facilities and resources;

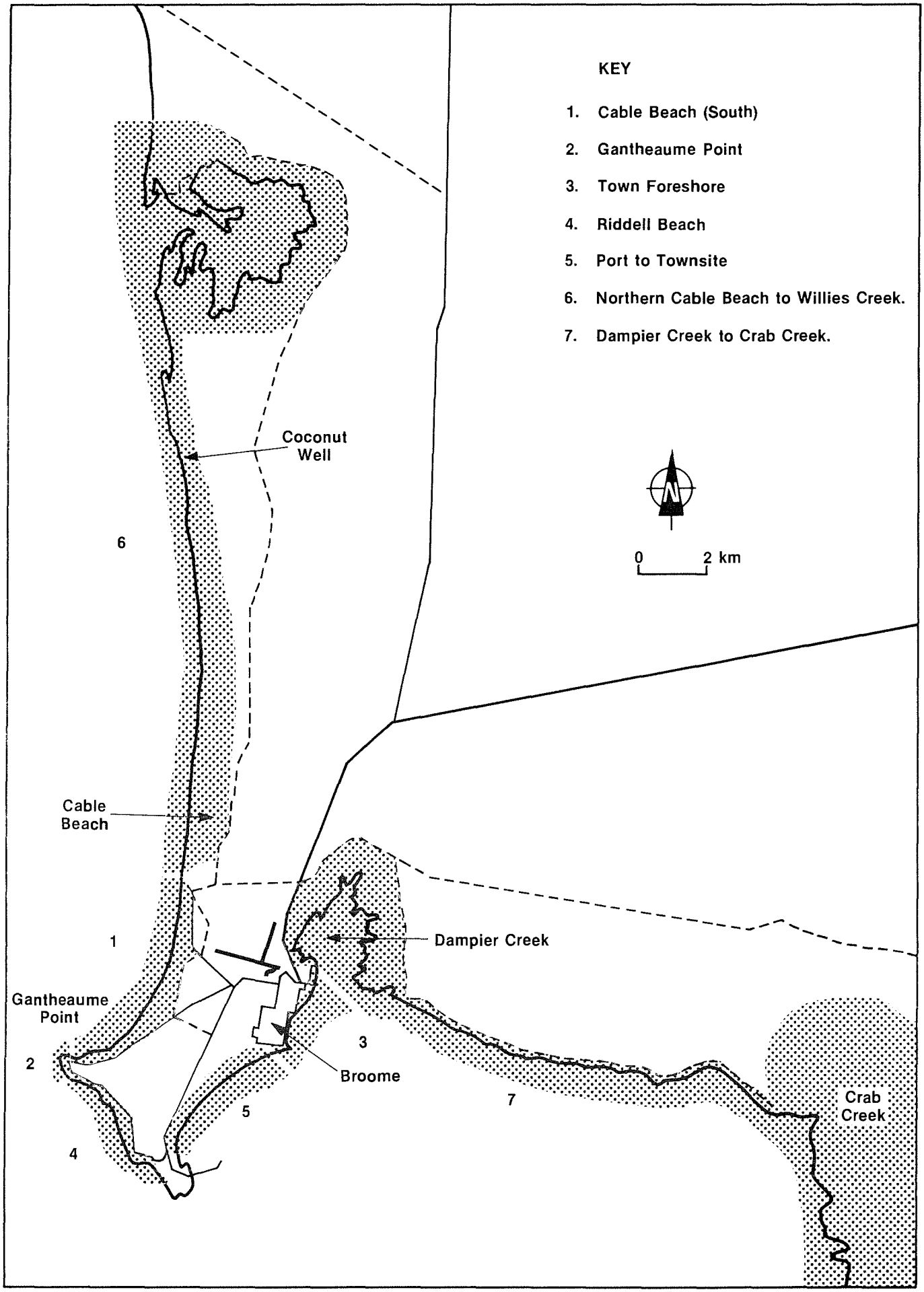
- degradation of coastal resources already in demand;

- unwise allocation and use of scarce coastal resources.

while providing for:

- increased tourist and residential use of the coast;

- preservation of the environmental quality and "atmosphere".




**MAP 3 COASTAL MANAGEMENT AREAS**

Following receipt in 1982 of the Town Planning Scheme recommendations for the coast, DCE commenced preparation of a Draft Management Plan after considering comments made by the bodies mentioned in 5.1.2 above, Council, the Departments of Agriculture, Fisheries and Wildlife, Marine and Harbours, Lands and Surveys, Mines, Tourism, Youth Sport and Recreation, Town Planning, as well as the WA Museum and WA Heritage Committee, National Trust and Australian Fishing Industry Council.

This Draft Management Plan for the Coastal Zone at Broome attempts to address the issues outlined above. The Draft will be available for comment by Council and other interested parties until 30 September, 1984 after which a final Management Plan will be prepared.

## 1.3 Extent and present status of the study area

The areas under consideration in this Draft Management Plan, which have been defined in Town Planning Schemes Nos 2 and 3, are outlined on Map 3, and involve areas of vacant Crown land and Crown reserves, as shown on Table 1.

## 1.4 Purpose and aims of the plan

In the past, decisions concerning the use and management of coastal land around Broome have occurred on an uncoordinated basis. The purpose of management planning is to achieve a systematic and coordinated approach to management and development while recognising natural processes and resource characteristics as well as human needs. The aim of this Draft Plan is to:

- facilitate orderly and long term development, conservation and management of the coastal zone;
- identify areas suitable for particular uses that require a coastal location;
- identify areas which should be protected and make recommendations about their management;
- identify problem areas and recommend management strategies;
- identify relevant authorities and people that should participate in the planning process and outline authorities which may provide a management input into the area;
- illustrate relationships between coastal management areas and nearby land uses to define possible conflicts and suggest compatible activities;
- identify possible sources of financial assistance.

The allocation of compatible uses to appropriate resources is critical to successful coastal zone management. Failure to plan upon this basis may result in degradation of resources, significant increases in management costs, or loss of the resource and any improvements.

Many proposals are described in this plan and their implementation will be time consuming, expensive and in some instances require amendment to the Town Planning Scheme. However, these disadvantages will be offset by the more efficient use of land, the reduction in costs associated with

TABLE 1

Crown Reserves in Coastal Management Areas

| RESERVE | PURPOSE | APPROX. AREA (ha) | VESTED AUTHORITY | DATE | MAP NO. |
|---|---|---|---|---|---|
| 35494/132 | Gravel | | Commissioner for Main Roads and Shire of Broome | 11/8/78 | |
| 30906 | Use and benefit of Aborigines | 121.4 | Aboriginal Lands Trust | 3/8/73 | |
| 631 | Gravel | 153.3 | Controlled by Shire Broome | 5/9/19 | |
| 26516 | Community Welfare Purposes | 20.2 | Minister for Community Welfare | 30/6/72 | |
| 36477/1374 | Recreation | 3.3 | Shire of Broome | 15/2/80 | |
| 33275/1195 | Horse Stables | 3.4315 | Shire of Broome Power to lease 21 years | | |
| 35157/1231 | Remote Receiver | 1.1378 | Not Vested | | |
| 22648/1848 | Rec. and Racecourse | 66.4058 | Shire of Broome | 22/5/47 | |
| 19289/628 | Recreation | 5.7238 | Shire of Broome | 11/8/78 | |
| 30387/700 | Rec. Accommodation for Diocesan staff | 2.0234 | Crown Grant to R.C. Vicar | | |
| 37337/1643 | Children's Hostel | 0.5473 | Rothhavesthnne Inc. | 7/8/81 | |
| 30386/699 | Rec. Accommodation for Sisters of St John of God | 2.0234 | Crown Grant to the Sisters of St John of God | 5/6/70 | |
| 35828/1341 | Recreation | 23.5277 | Shire of Broome | 19/1/79 | |
| 28650 | Harbour Purposes | 108.3112 | Minister for Transport | 19/3/82 | |
| 35827/1342 | Recreation | 3.5900 | Shire of Broome | 19/1/79 | |
| 36426/1337 | Pistol Club Site | 4.0154 | Shire of Broome with power to lease 21 years | 21/12/79 | |
| 33592/1197 | Club and Club's Premises | .5016 | Shire of Broome with power to lease 21 years | 12/9/75 | |
| 29300 | Public Rec. (Golf Links) | 85.3376 | Not Vested | | |
| 17132 | Rec. (Bathing) and Caravan Park | 6.1559 | Shire of Broome | 13/1/61 | |

| RESERVE | PURPOSE | APPROX. AREA (ha) | VESTED AUTHORITY | DATE | MAP NO. |
|---|---|---|---|---|---|
| 1643/1327 | Cemetery | 0.1094 | Unvested | | |
| 31340/838 | Recreation, Bathing Caravan Park | 2.6791 | Not Vested | | |
| 36057 | Drain | 0.1142 | Shire of Broome | 11/5/79 | |
| 34907/620 | Drain | 2032 | Not Vested | | |
| 17987 | Exempted from Sale | 2.0303 | Not Vested | | |
| 9105 | Water Supply | 4.4743 | Not Vested | | |
| 25790 | Community Welfare Purposes | 1.0117 | Not Vested | | |

continued maintenance of degrading resources, resolution of differences between conflicting land users and retention of the amenity which attracts visitors to Broome.

Agencies which are potential sources of funds are more likely to provide financial assistance for works that are part of a long term plan. Preparation and acceptance of this Draft Management Plan is a first step in this direction.

## 2.0 THE BROOME ENVIRONMENT

This section describes briefly the natural resources of the Broome coastal zone. Some of these resources have been or will be exploited, while others may not. However, it should be understood that together they form a changing ecosystem and that disturbance or exploitation of one resource is likely to affect others. This interrelationship has been considered during the planning process. Management strategies to safeguard the environment while allowing controlled development are detailed in section 4.

The section describes processes that led to evolution of the Broome coastal landscape as we see it today, as well as the flora and fauna that inhabit the zone. Without an understanding of how the coastal zone evolved, or what factors are important in maintaining a stable natural system, it is difficult to predict what may happen in the future, either with or without human activity. However, if the natural system is understood the allocation of land on the coast can be planned so disturbance and conflict are minimised and maintenance costs are reduced.

### 2.1 Physical environment

#### 2.1.1 Geology

The distribution of sediments around Broome is shown in Map 4 (parts a-c). The oldest sediment is the Cretaceous Broome Sandstone which outcrops at the base of coastal cliffs at Gantheaume Point and east of Dampier Creek. Overlying the basement is about 1 m of lateritised cobbles and pebbles which are exposed along the coast around Gantheaume Point, at Bali Hai, east of Dampier Creek and along the abandoned sea

cliff at Coconut Well. A veneer (2-6 m) of red pindan sandstone which forms a horizontal and gently undulating surface that is characteristic of the Broome area overlies the laterite. (Photograph 1)

1. Gantheaume Point. The pale Broome Sandstone, which is overlain by Pindan sandstone, has been eroded to form a wave cut platform and cliffs.

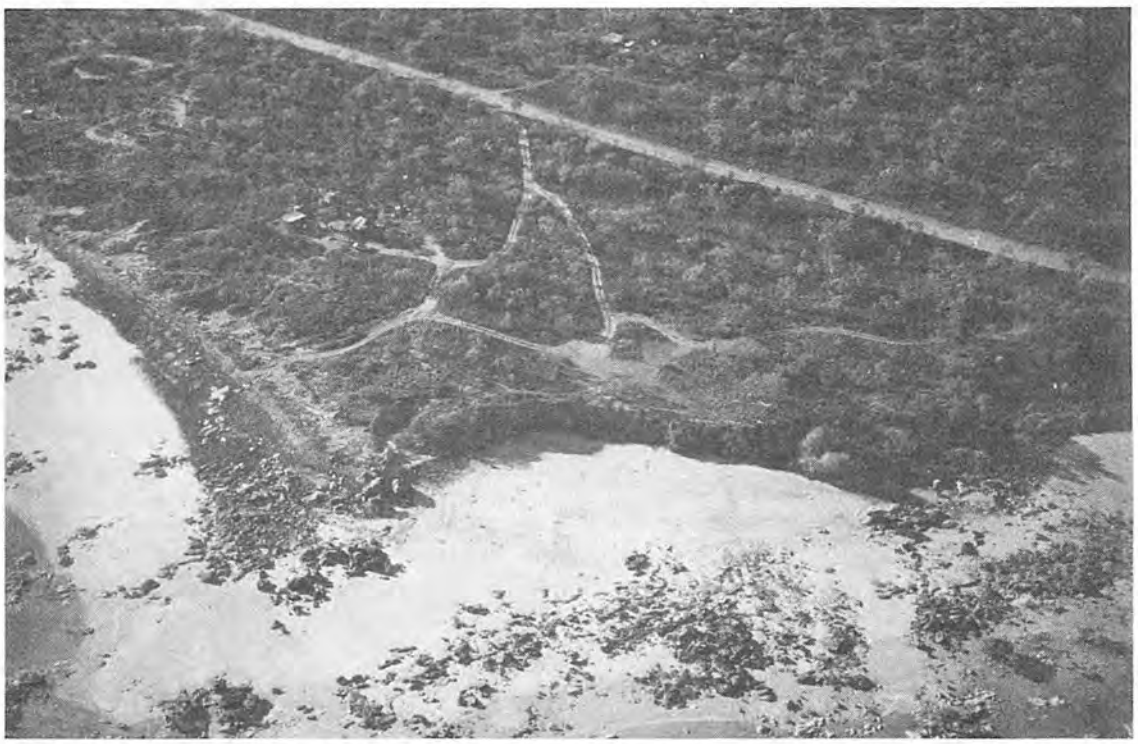
Two generations of Quaternary sediments are found around the coast. The older, or Pleistocene unit, comprises beach, dune and tidal flat deposits that are characteristically pink. Cemented beach sediments which are cross and trough-bedded, outcrop as a low tide reef between Bali Hai and Willies Creek. Leached dune sediments are found around most of the coast and extend further inland than their younger Holocene counterparts. Tidal flat sediments are found around the margins of the existing tidal flats. (Photograph 2)

The younger, or Holocene unit, comprises sublittoral, beach, dune and tidal flat deposits that front and overlie or partially cover pre-existing sediments and coastal landforms. Beach and dune sands are typically white except where they are adjacent to an eroding pindan cliff. (Photograph 2)

A veneer of sublittoral sediment exists on the seabed off Cable Beach and off the town in Roebuck Bay. There is probably abundant sand-size material north of Cable Beach especially near Willies Creek between the beach and beyond the offshore reef. To the south where the reef merges with the shore between Bali Hai and Gantheaume Point, there appears to be much less sand on the seabed. Beween Gantheaume Point and the jetty there is little sediment in the nearshore zone. East of the jetty the coast is fronted by fine tidal flat sands and silts which contain a coarse shell fraction. (Photograph 3)

Holocene beach sediments occur along much of the coast and comprise: coarse shelly, cemented beach rock which is found between the Council caravan park and the jetty; coarse shelly sand which forms a narrow

**2.** Willie Creek. Cemented Pleistocene beach sediments, which are partially covered by a thin veneer of white Holocene beach and dune sands, outcrop at low tide. Note also the accumulation of sand at the mouth of the creek.



**3.** East of Dampier Creek. A narrow high tide beach punctuated by outcropping Cretaceous rocks fronts a Pindan cliff. Note the squatter shacks and proliferating tracks.

beach and recurved spit between the Council caravan park and Dampier Creek; unconsolidated quartz sand with a small percentage of shell material. In front of eroding pindan cliffs east of Dampier Creek and at Riddell Beach these quartz sands are coloured pink and overlie a rocky platform of Pleistocene and Cretaceous rocks. At Cable Beach the sands are white and front Holocene dunes though they may only form a thin veneer over older rocks. The majority of sandy beaches fronting

pindan cliffs only occur between high and low water marks except at Cable Beach where a supratidal beach extends inland into beach ridges and dunes. (Photograph 4)

4. Cable Beach south of Bali Hai. The presence of outcropping Cretaceous and Pleistocene rocks suggests that the Holocene beach sands may only be a thin veneer.

In most cases Holocene dunes form only a thin (1 m or less) veneer over the seaward margin of the older Pleistocene dunes except along Cable Beach where they override and partially cover the latter. Along Cable Beach and at Coconut Well, partial cementation of the older Holocene dunes has occurred. Where ablation (wind erosion) has taken place, the cemented dune core has been exposed. (Photograph 5)

5. North Cable Beach. The wide zone of white Holocene dunes behind Cable Beach.

Holocene tidal flat sediments are found at Willies Creek, Coconut Well, Dampier Creek and Crab Creek.

Geological History: The oldest sediment in the area, Broome Sandstone, was deposited in a shallow sea during the Cretaceous (130 million years ago). Dinosaur footprints have been recognised in the sandstone near Gantheaume Point.

During the early Tertiary the area was lateritised under conditions of a seasonally wet climate. With change to an arid climate in the late Tertiary the deposition of sand dunes commenced. A change to wetter conditions in the Quaternary has modified and subdued the dune topography and led to development of the thick red pindan soil that now mantles the landscape. Reworking of these sediments by coastal processes during the Quaternary resulted in deposition of two generations of dune, beach and tidal flat sediments around the coast.

The first occurred during the Pleistocene (1 million years ago) when a raised sea partially stripped and reworked the pindan mantle into beach and dune deposits around sweeping bays, that linked exposed bedrock headlands. Low areas were drowned and tidal flat sediments deposited.

During the last ice age about 30,000 years ago sea level dropped to minus 100 m and these coastal sediments were coloured pink possibly through the addition of dust derived from inland. At the same time the deep gorges (Roebuck Deep, inner anchorage etc.) which drained Roebuck Plain were formed.

Around 6000 years ago the sea rose again to its present level, sweeping any loose material from the drowned shelf into beaches and dunes. Reworking of Pleistocene and older sediments continued, resulting in further retreat of cliffed coasts where sediment supply was low, or deposition of dunes and beach ridges where sediment supply was greater. Low areas were again drowned and tidal flats developed. (Photograph 6)

**6.** Broome Industrial Area. A thin veneer of Holocene dune sand overlying the seaward margin of a band of Pleistocene dunes east of the Broome jetty. Note the exposed Pindan cliff at the back of the beach beneath the dunes indicating that the coast is eroding.

With a stable sea level and diminishing supplies of sand from offshore, growth of beaches and dunes has ceased along most of the coast with the result that the veneer of Holocene sediments has been gradually removed and the underlying Pleistocene, pindan and Cretaceous rocks increasingly exposed. The history of coastal development is discussed in more detail in Woods (1983).

### 2.1.2 Geomorphology/bathymetry

The area around Broome is characterised by a low-lying (3-8 m) gently undulating plain of red pindan sandstone. Around most of the coast the plain terminates abruptly in vertical cliffs 1-10 m high that are fronted by narrow high tide beaches, rocky outcrops or extensive tidal flats that become exposed at low tide. On west and south-east facing coasts the edge of the pindan cliff is mantled by a narrow shore-parallel belt of dunes. On south-east facing coasts erosion has exposed the underlying pindan so that the dunes are now perched on top of the cliff. Only along the west facing Cable Beach has the edge of the pindan remained covered by white beach and dune sands. Here a wide sandy beach and belt of dunes and beach ridges that increase in width to the north provide a sharp contrast to the rest of the coast. At low tide a rocky reef is exposed along this coast from Bali Hai to Willies Creek. (Photograph 7)

7. Cable Beach. Looking towards Willie Creek showing a wide sandy beach, a wide belt of Holocene and Pleistocene dunes, an abandoned tidal flat and the Pindan plain in the distance.

Low-lying areas on the pindan plain which experience periodic tidal inundations, are occupied by tidal and mangrove flats. Dampier tidal flat is partially cut off from Roebuck Bay by a chain of sandy islands and spits. In contrast the flat behind Cable Beach has been almost completely separated from the sea by a sand spit. Abandoned marine pindan cliffs near Coconut Well are evidence that the eastern shore was once subject to open marine processes.

The Cable Beach coast is fronted by a seabed that slopes gently down to a wide flat plain 10-14 m deep. Approximately 6 km offshore a shore

parallel ridge rises to 4 m depth. Between Gantheaume Point and the jetty the seabed deepens rapidly to bottom in Roebuck Deep - a shore parallel trough over 80 m deep but only 500 m offshore. East of the jetty the coast is fronted by a wide expanse of shallow water (1-2 m) that is separated from the shallow (2-7 m) waters of Roebuck Bay by the inner anchorage, a shore parallel depression 14 m deep. (See Map 6.)

### 2.1.3 Landscape

The Broome landscape has three major elements including the built and modified environment of the township and port, the semi-tropical atmosphere of the plantations and the relatively unspoilt coastal vistas of the undeveloped areas.

The town landscape is characterised by the traditional buildings, plantings of Australian and exotic species which make the semi arid environment a sub-tropical one, and the old structures used in maritine industry and associated waters. (Photograph 8) Important vistas exist in a number of locations as shown on aerial photographs 1-3.

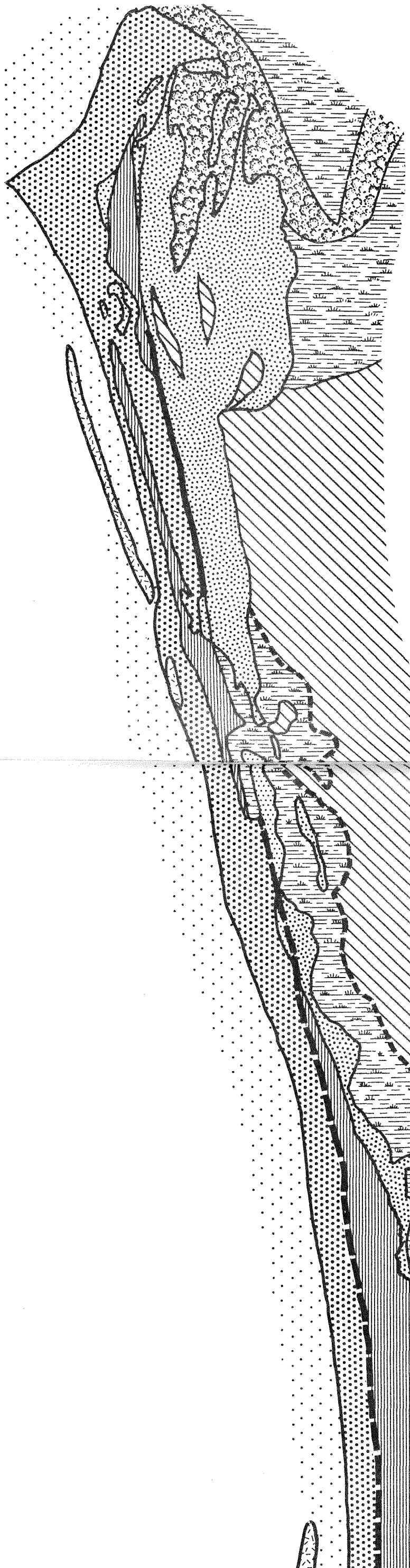
8. Townscape

There is a significant risk that rapidly developing urban areas will become unattractive if appropriate plantings are not undertaken quickly. Trees and shrubs should be used in these areas purposely to soften the new urban landscape, and improve pedestrian comfort by providing shelter from the sun and wind. Eventually new areas should have a similar appearance to the established part of the town.

The plantations, camping areas, plant nurseries and homesteads at Bali Hai and Coconut Well provide another significant landscape element which enhances Broome coastal areas.

The third landscape element is the unspoilt coastline in the undeveloped portions of the study area with low headlands, beaches, creeks, mangals and beautiful waters. (Photograph 9) The only major

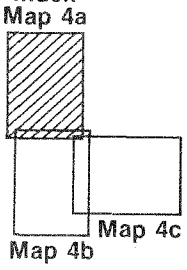
MAP 4a GEOLOGY



Key

- Cretaceous
- Pindan
- Pleistocene Dunes
- Pleistocene Beach
- Holocene Dunes
- Holocene Beach
- Tidal Flat
- Mangroves
- Low Tide Beach

Index Map 4a

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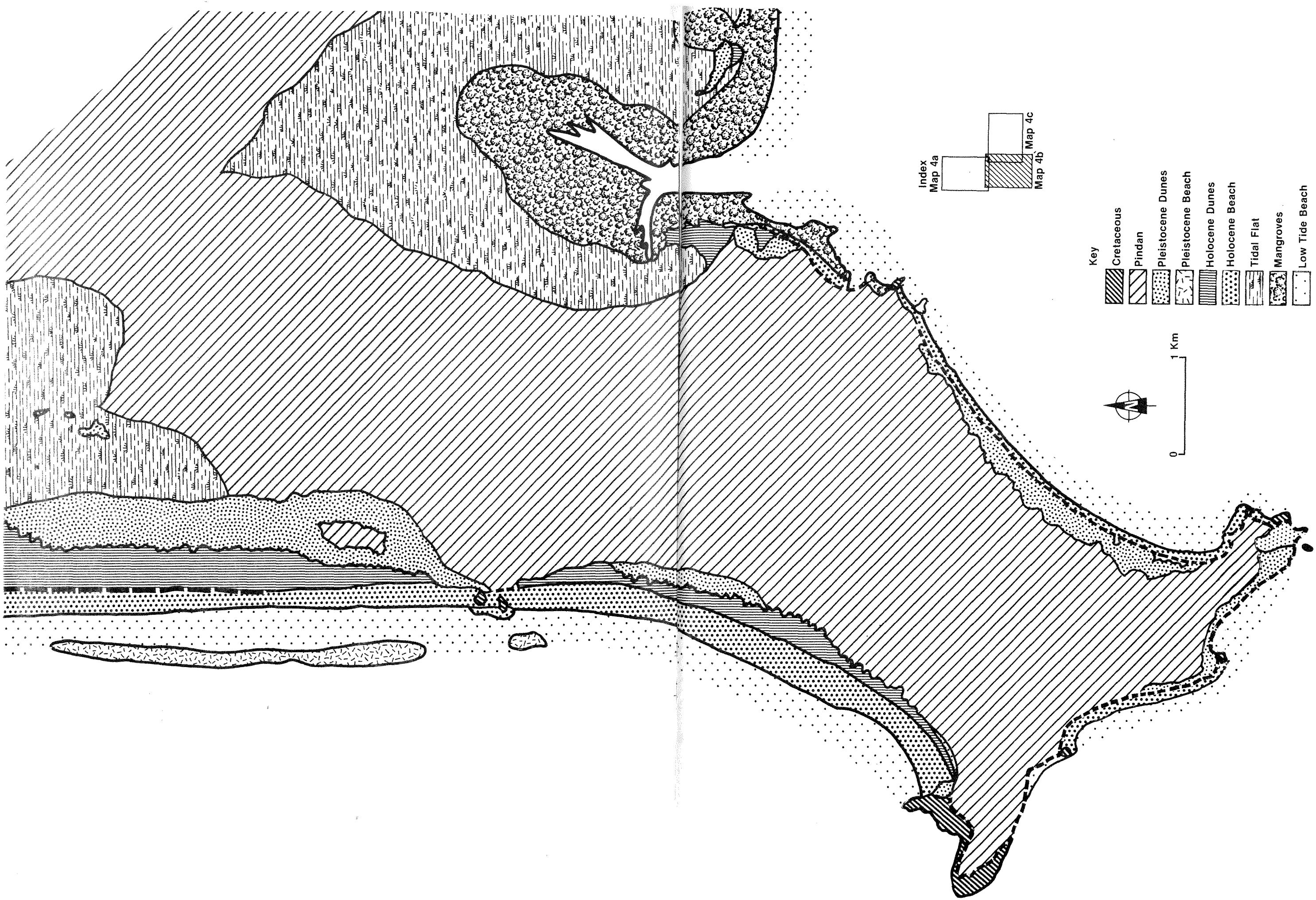
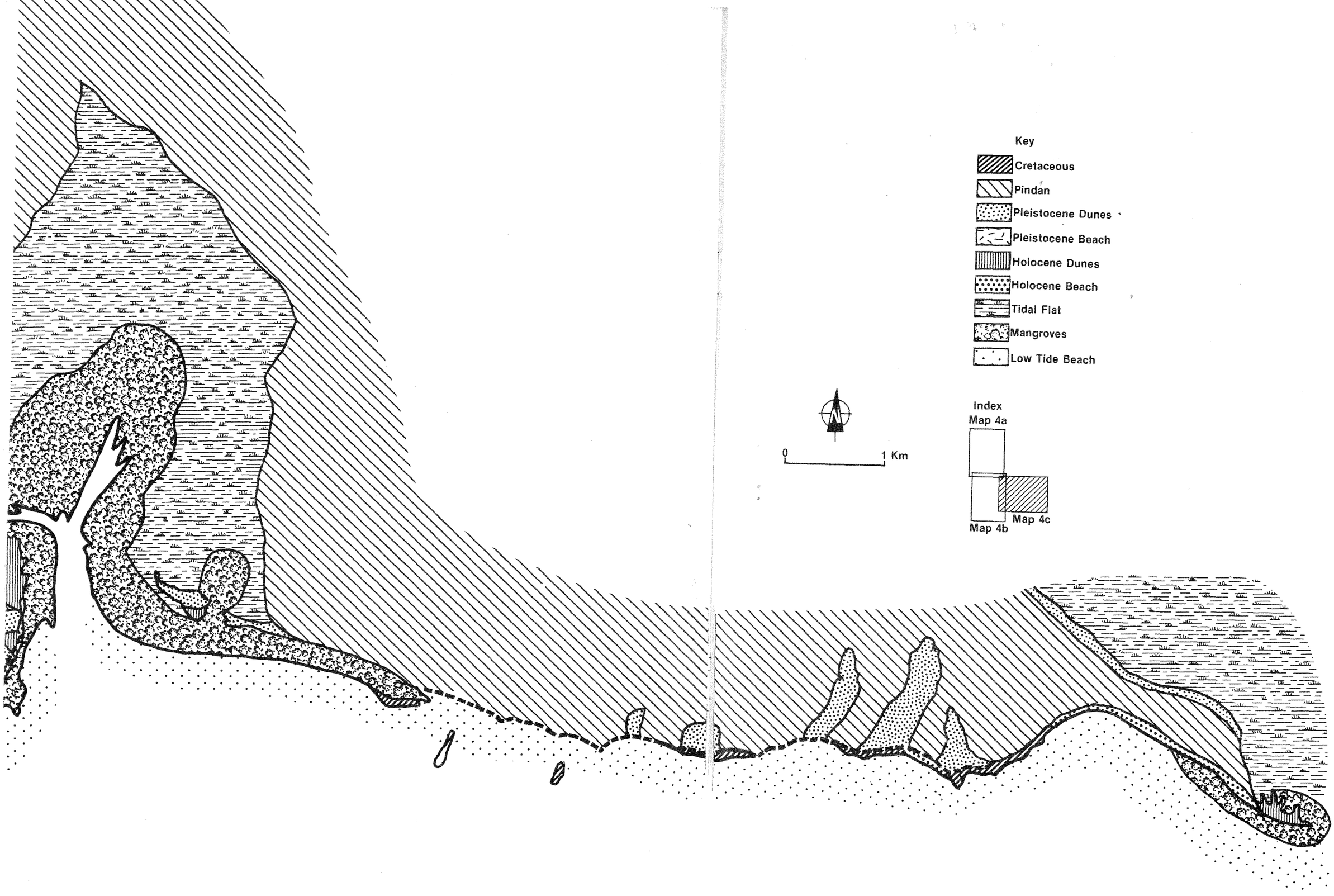



**MAP 4b GEOLOGY**




**MAP 4c GEOLOGY**

improvement suggested for this area involves the rehabilitation of old quarries near the Crab Creek Road. However any development undertaken in this element could result in a loss of amenity and care is required to protect the landscape.

9. Broome Coastline.

2.1.4 Soils

Apart from the Holocene dunes, which lack a soil horizon, and the immature soils developed in the Pleistocene dunes, the major soil unit at Broome is the pindan which developed during the Quaternary on a desert dune sandstone.

As soil types are intimately associated with geological units, their distribution is identical to that shown on Map 4(a-c).

## 2.2 Climate and oceanography

### 2.2.1 Climate

The Broome region experiences a tropical monsoon climate characterised by a winter (May-October) dry season and a summer (November-April) wet season. (Figure 1)

### 2.2.2 Winds and weather

Seasonal migration of a belt of high pressure anti-cyclonic (anti-clockwise) winds south of Broome controls the wind and weather in the region. During winter when the belt moves north, east to south-east winds (10-30 km/hr) and fine dry conditions prevail; while summer, when the belt moves south, brings a north-west monsoon with attendant westerly winds (10-20 km/hr), tropical rain and humid conditions. Between December and April tropical cyclones may affect the area bringing gale to hurricane force winds and rain. The incidence of gale force winds other than those associated with cyclones is low (less than 1% of observations) and most commonly associated with thunderstorms.

### 2.2.3 Rainfall and temperature

Seasonal variation in rainfall and temperature is marked at Broome. In January the mean daily maximum temperature is 33°C with mean rainfall 163 mm. In contrast, in July the corresponding temperature is 28°C and rainfall 6 mm.

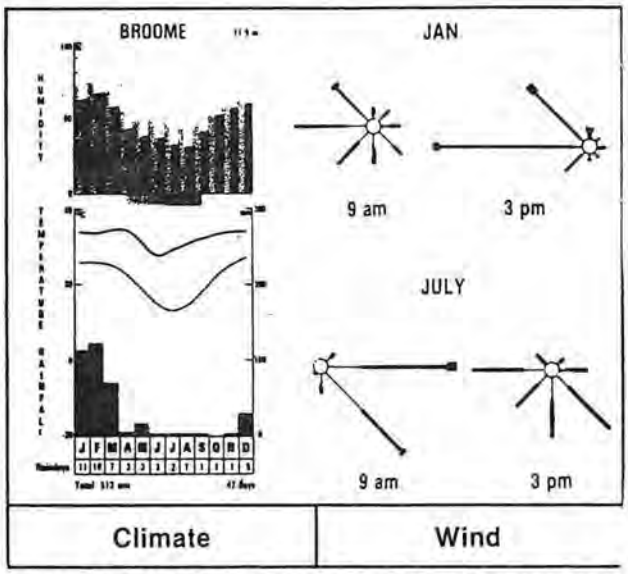



**FIGURE 1 RAINFALL, TEMPERATURE AND WIND ROSES**

### 2.2.4 Cyclones and storms

Tropical revolving storms, or cyclones, in which winds reach hurricane force are the most violent type of storm affecting the coastline near Broome. Cyclones (clockwise winds) originate in the Timor Sea between November and April and typically travel south-west. Many cross the Western Australian coast between Cape Leveque and Exmouth though a proportion travel further west and south to cross the coast south of Carnarvon. Gale to hurricane force winds (+ 85 knots = 160 km/hr) are often experienced within 20 to 150 nautical miles from the centre. Since 1909, 24 cyclones have crossed the coast within 150 km of Broome and of these, eight have crossed within 50 km. A further 16 cyclones that did not cross the coast have passed within 150 km of Broome and of these, three have passed within 50 km. As the majority of cyclones pass to the north and west the major impact on the coast around Broome is the incidence of winds that swing from east through north to west, and north-west to westerly swells which impinge on west and north facing shores. However, the cyclones that pass to the east or south result in winds arriving from south-west and south-east quadrants. These generate waves and storm surge in Roebuck Bay that affect south and east facing shorelines around the townsite. Despite the comparative rarity and short life of cyclones the scale of forces associated with them is relatively so great that these events pose the major threat to coastal works. Planning coastal work is complicated by the difficulty of quantifying the effect of cyclones; as the combination of onshore hurricane force winds, high tide, storm surge and very rough seas must be allowed for as a worst case.

### 2.2.5 Seas (waves and swell)

There is a dominant and a seasonal change in sea and swell conditions along the north coast of Western Australia. During most of the year, the Broome coast is subject to a refracted westerly swell that originates in the roaring 40s and south-east trade wind belt of the

Indian Ocean. In winter the swell is low to moderate and in summer it is
low. During winter when south-east winds dominate, south facing shores in Roebuck Bay are subject to wave activity. In summer, under the influence of the north-west monsoons and occasional thunderstorms, waves from the north and north-west are more common and affect west and north facing shores. Temporary very rough seas and heavy swell associated with cyclones which also affect the coast are probably dominant in shaping the coastline around Broome.

### 2.2.6 Tides and currents

Oceanic currents off the north coast of Australia are considerably affected by seasonal changes in the regional wind system. During winter the predominant current direction is westerly. During summer the direction is reversed with currents flowing to the north-east though weak south-west flowing counter currents may develop near the coast.

Broome experiences tides with a large range (11 m) and regular cycles. Tidal streams over Roebuck Deep reach 4-5 knots during spring tides though at other times the rate seldom exceeds 2 knots. Tides are a major factor affecting the coastal environment in that they increase the range of wave and current action. (Map 6)

Besides being a tourist attraction in themselves, the large tides have an important influence on the species and number of plants and animals which are found in the variety of habitats provided, and on the cultural and daily life of Broome. (Photograph 10)

**10.** Crab Creek at Low Tide. A wide band of mudflats and mangroves is exposed. The mangroves and salt flats in this area form an important biological system.

## 2.2.7 Coastal processes

The main coastal processes operating at Broome are:

- marine erosion and littoral transport of erosion products and sediment away from Gantheaume Point (i.e. northward along Cable Beach and south-east to east on coasts fronting Roebuck Bay and Roebuck Deep);
- swell-induced onshore transport of seabed material to Cable Beach;
- offshore transport of suspended sediment in ebbtidal currents in Roebuck Bay;
- onshore transport of coarse shelly material under storm conditions to beaches in Roebuck Bay;
- inland aeolian (wind-driven) transport of fine sand on west and south-east facing coasts.

Sediment transport regime: Under the influence of the wave and current regime described above, the dominant transport direction of sediment in the littoral zone is away from Gantheaume Point.

The main process along the Roebuck Bay coast is erosion and stripping of the pindan from the Cretaceous basement leading to formation of pindan cliffs and exposure of bedrock (Photograph 1). Erosion products are transported eastward in the littoral zone to form the spits and dunes
at Crab Creek (Photograph 10). Any fine material moved offshore is transported to the west in ebb tidal currents. There appears to be little onshore transport of material to the coast probably because there is a lack of sand-size material available, due to the rapid breakdown of shells by micro-organisms, and lack of quartz grains in the bay. The only time material is transported ashore is during storms when shells are winnowed from offshore and swept onto the beach where they are stranded. Normal tidal action then moves the sediment slowly into the mouths of Dampier and Crab Creeks. South of the Council caravan park where the pindan is eroding, movement of the sediment is slow due to the mature shape of the crescent-shaped bay north of the jetty, and cementation into beach rock has occurred. (Photograph 11)

Between the jetty and Gantheaume Point, transport of sediment again is minor due to lack of supply. The major activity is erosion and the cutting of two crescent-shaped bays at Riddell Beach with any swell-induced littoral transport of erosion products to the south-east.

North of Gantheaume Point, prevailing swell-induced transport is onshore and northwards. Probably during passage of cyclones to the north, when north-west winds and waves are generated, sand is temporarily transported south. The dune scarps found on Cable Beach today probably formed during such conditions, and the lack of a continuing sediment supply ensures their longevity.

The large sublittoral sand bar off Willies Creek indicates that sediment is moving both south and north. The beach ridges here indicate that this area is a sediment sink, so that sand moved north off Cable Beach is not likely to be replenished by sand moving south from north of the Creek. There is no obvious feed of sand to Cable

11. The crescent-shaped bay north of the jetty which is pivotted on the basement outcrop at Channel Rocks and beneath the base of the jetty.

Beach from offshore visible in the air photos. Also, there does not appear to be much chance of material moving from Roebuck Bay to Cable Beach due to:

. the swell-induced transport regime in the opposite direction; and

. the deep trench which would syphon any sediment from Roebuck Bay offshore.

It is possible that sediment from the end of the trench finds its way to Cable Beach though the scale of forces to move it from a depth of 100 m may not be available.

Under the influence of the normal wind conditions, inland sediment movement takes place during summer on west facing shores, when west to south-west winds prevail. During winter when south-east winds are common, sediment movement takes place on shores exposed to the south and east. As most of the Roebuck Bay coast lacks an offshore sediment source no dune building has taken place and marine erosion has produced cliffs. In contrast, along Cable Beach there has been a supply of sand to the coast and dune building and inland movement of sand has occurred. However, the presence of exposed dune cores along much of Cable Beach suggests that there is now little dune sand coming ashore to form dunes or blow inland.

It is likely that wind transport occurs during cyclones when, under the influence of hurricane force winds, stripping of vegetation and movement of sand takes place. The relative importance of the prevailing winds, compared to the short-lived though high energy cyclonic winds, in transporting sand-sized material is not known.

## 2.3 Terrestrial biota

### 2.3.1 Vegetation

The Broome area is part of the Dampier Botanical District within the Northern Botanical province, as described by Beard. The majority of the peninsula is monotonous undulating and plain dominated by the Eucalypt-Acacia association commonly described as pindan. Some significant diversity is provided by relatively small areas of mangrove, samphire flat, grassland, coastal dune, freshwater swamp, remnant rain forest, Melaleuca thicket and vine thicket which are all associated with particular land forms (McKenzie 1983).
The pindan scrub is dominated by A. holosericia, A. bivinosa, A. victoriae and a variety of Eucalyptus sp.

The seaward side of the coastal sand dunes support dune species typical of the north-west including Spinifex longifolius, Canavalia maritima and Ipomoea brasiliensis. The sheltered side of the dunes support remnant rain forest communities characterised by Terminalia petiolaris Ponteria sericea, Lysiphyllum cunninghamii with an understory of Crotalaria cunninghamii and Santalum lanceolata.

The major mangrove species are Rhizophora stylosa and Avicennia marina while nearby salt marshes support a number of species of Holosaria, and salt affected areas of higher ground are dominated by Sporobulus virginicus. (Photograph 10)

### 2.3.2 Mammals and birds

The wildlife of the Broome area was investigated as part of a study of the Dampier Peninsula and the results published in Wildlife Research Bulletin, Western Australia, No. 11. That study includes the Broome area in a wider biological district known as the Phanerozoic South West Kimberley which lies between the humid and sub-tropical areas to the north and the semi-arid and arid areas to the south. This intermediate location produces animal habitats supporting 33 species of native mammals in three major groups: sub-humid tropical, arid desert, and "more cosmopolitan" species. Since European settlement, a mere 150 years ago, a number of species have already disappeared or become rare.

The area is rich in birdlife due to the diversity of habitats especially near the coast. Of the 214 bird species recorded, 63 (29%) have been recorded in coastal habitats which account for only 15% of the total area of the peninsula. In contrast only 56 species are associated with the pindan habitat which covers about 70% of the Dampier Peninsula. The most important coastal habitats are Tristania swamps, samphire flats, coastal dunes, creekside vegetation, mangroves, mudflats, beaches and cliffs. Several of these occur in the study area and will be identified. While it is unlikely these areas warrant dedication as Nature Reserves, their value is noted and they will be protected where practicable.

Migrant Holarctic wading birds: Of major importance in the study area are the habitats provided for migratory wading birds by the mangroves and tidal mudflats of Roebuck Bay, Crab Creek, Dampier Creek, Willies Creek and other smaller waterways.

Each year migrant wading birds, which comprise 20% of the species recorded in the Dampier Peninsula, travel along the north coast of

Western Australia. Many of these species are long distance migrants travelling from southern Australia to northern Asia, Europe, Canada, the Arctic and adjacent islands, where they breed (Map 5). Australia has long been a signatory to international treaties protecting these birds and their habitats.

When the birds arrive on Australia's north coast they are often exhausted and rely upon the highly productive tidal flats to rehabilitate and gain strength before moving south to their summer feeding grounds. As these birds are highly stressed by the physical demands of their migratory lifestyle, a loss of habitat in any part of their route reduces their chances of survival.

The Department of Fisheries and Wildlife in WA has been conducting surveys of wading birds in the area since August 1981 and considers the 700 km of coastline from Port Hedland to Broome an extremely important link in the migration of these Holarctic waders. Three areas stand out as requiring special consideration: Leslie Salt Works, Eighty Mile Beach and Roebuck Bay.

In 1982 there was an overwintering population of about 50,000 birds in proportions 10:30:10 respectively at the three locations. Birds migrating from the northern hemisphere began to arrive during the third week in August and numbers increased until mid-November when surveys on the 14th-19th recorded 654,000 birds.

By February 1983 the population had decreased slightly to 486,000 . The return northern migration began in late February and continued until April.

The species composition varies at each location (see Appendix 1). A greater proportion of the larger waders occurs at Roebuck Bay than at any of the sites further south, a fact that may be attributed to the particular richness of the mangrove muds in the area. Consequently Roebuck Bay is considered to be one of the most important wader habitats in northern Australia and possibly the whole of Australia.

The combination of food-rich mangrove mudflats, sandy tidal flats at Fall and Sandy Points, and sheltered high tide roosts along the northern shore of the bay has attracted many thousands of waders with a unique variety of species. In 1981 the number of great knots at Roebuck Bay was 17,000 which, when combined with the total of 21,800 for the Eighty Mile Beach, is greater than the previous estimates of the total world population.

Similarly the populations of other species such as oriental plover, large sand plover, mongolian plover, godwit, eastern curlew and whimbrel indicate that Roebuck Bay is unique for species diversity and density.

The wader activity in Roebuck Bay is linked very closely with the tidal movements. At high tide the birds are forced off the mudflats and on to elevated beaches around the bay.

At high tides above 8.2 m the birds become nervous when roosting on the beaches below the cliffs. If disturbed they prefer to fly direct to beaches west of the town and south of Gantheaume Point. As maximum tides recede below 8.2 m the birds resume their normal roosting behaviour.

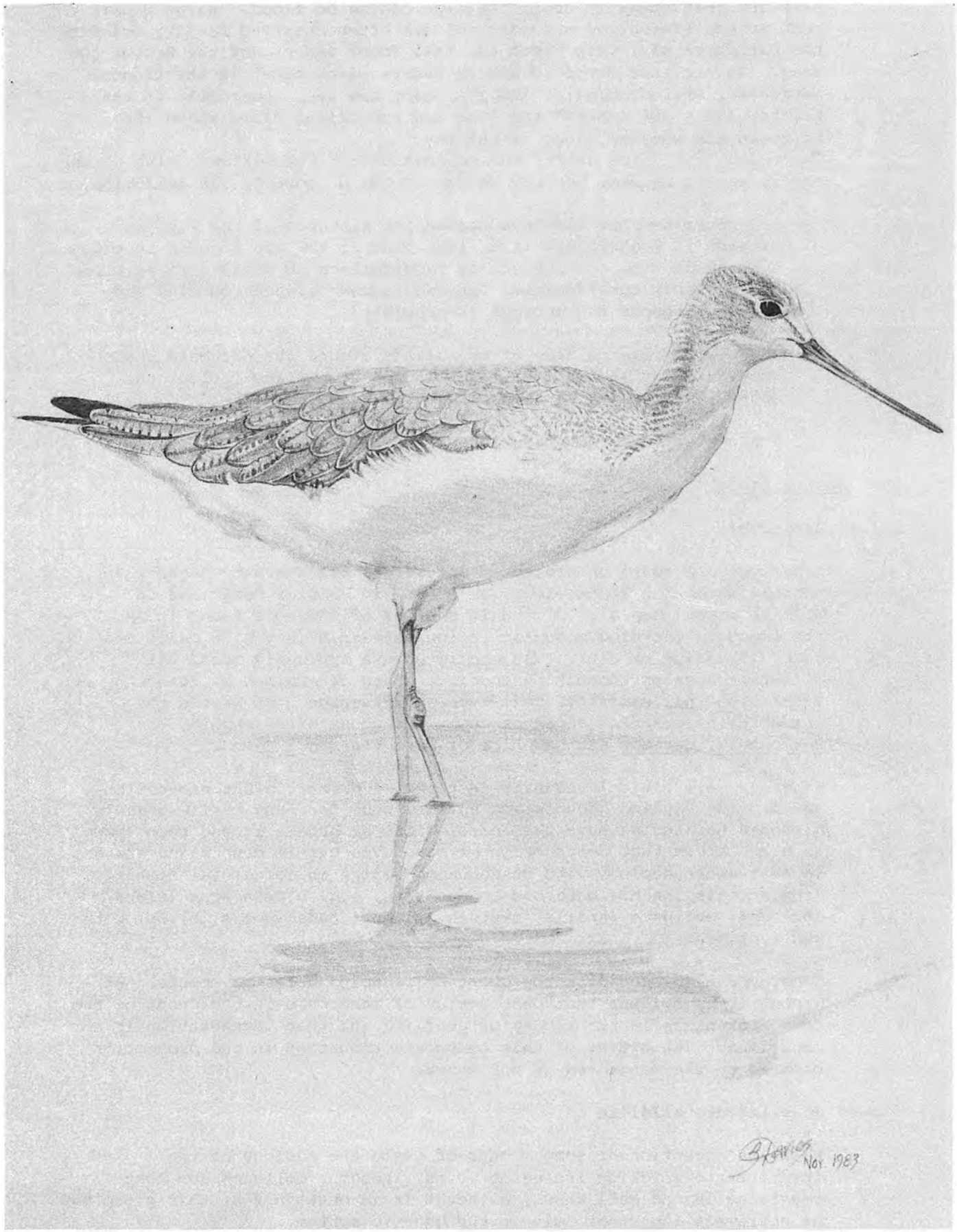



**FIGURE 2 WADING BIRDS (Whimberal)**

During low tide the waders appear to break into groups by species and size and feed actively until the tide begins to flood. Large waders such as eastern curlew and whimbrel are often observed feeding out from the mangroves near Crab Creek and Fall Point and around the Broome town area. As a result large to medium waders often roost in the flooded mangroves, whereas smaller species which are less restricted in their habits prefer the exposed shallows and supratidal flats along the northern and western sides of the bay.
The reason the birds prefer the beaches around the northern side of the bay is as yet unclear but may be due to one or more of the following:

- All other beaches within a reasonable distance of the feeding grounds in Roebuck Bay (i.e. less than 15 km) are flooded at tides over about 7 m. As the energy requirements of newly arrived birds are probably considerable, long distances between roosting and feeding grounds are avoided if possible.

- The beaches at the base of the cliffs around the northern shores provide cover and shelter (rocks), and camouflage (colour and rocks), and are close to mangroves at Crab Creek.

- Freshwater soaks may occur there.

## 2.4 Marine biota

### 2.4.1 Mangroves

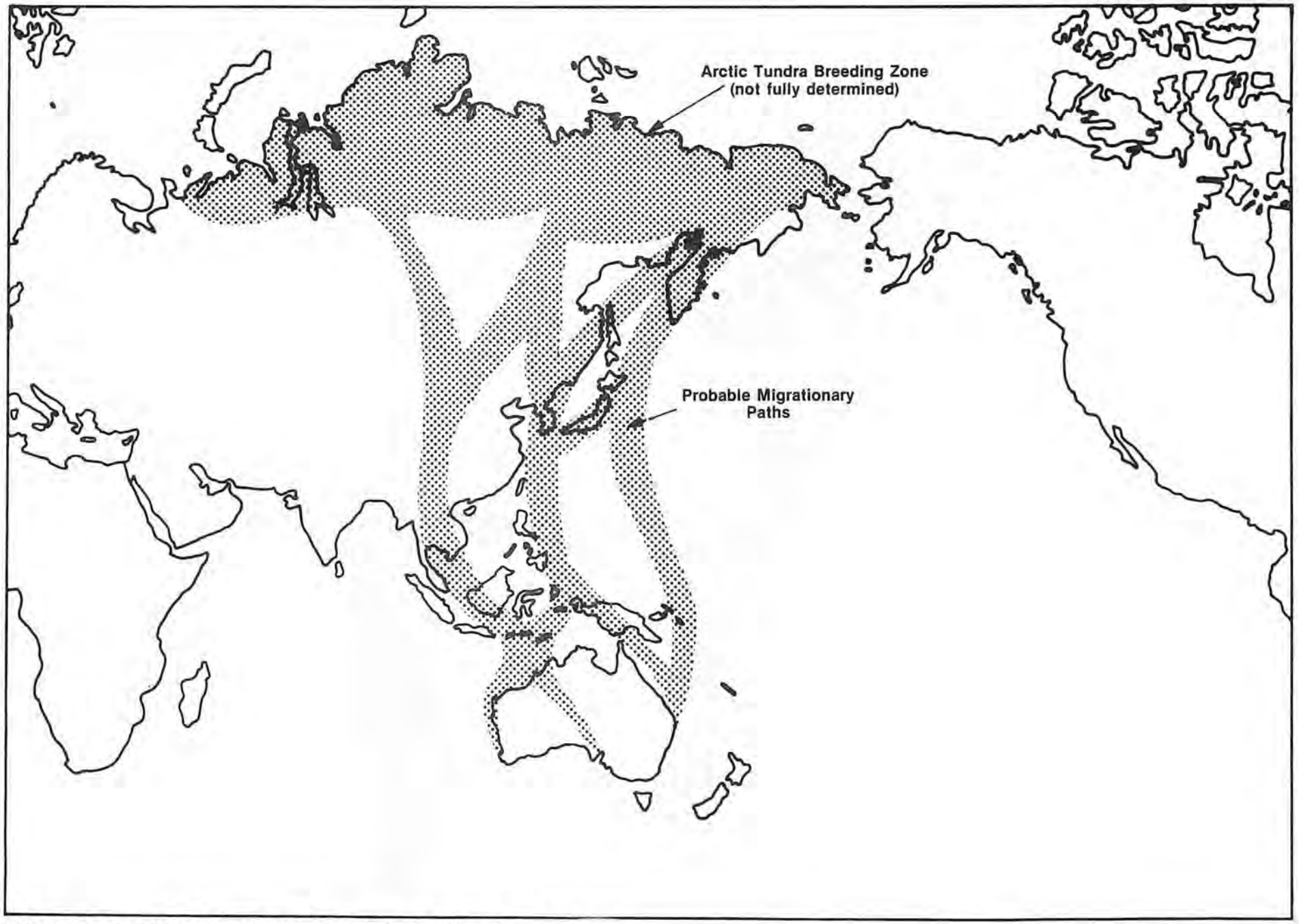
Mangroves are found on protected intertidal flats around Roebuck Bay, notably along the Broome townsite coast, in Dampier Creek and in Willies Creek (Map 6). Of the 16 species of mangrove found in WA, 13 are found in the biogeographic region between Eighty Mile Beach and Derby (Semeniuk et al.). The mangroves are typically zoned with different species inhabiting specific zones determined by frequency of tidal flooding, salinity, soil type and drainage. At Broome the characteristic zoning sequence comprises zones of Avicennia, Rhizophora, Ceriops and samphire or salt flats.

Mangroves are a vital resource in terms of primary plant production, and provide feeding grounds and nursery beds for many marine animals. Although no studies have been carried out at Broome it has been shown in other areas that destruction of mangroves can lead to major changes in near shore ecology with subsequent decline in commercial fishing. Many animals inhabit mangrove communities, e.g. crustaceans (crabs, shrimps), molluscs (snails, oysters, clams), mudskippers, birds, bats and reptiles.

Mangroves also stabilise the coast by reducing water movements. At Broome it is evident that destruction of mangroves in the front of the town took place in the heyday of pearling and that revegetation is now occurring. The effect of this temporary reduction in the protection offered by the mangroves is not known.

### 2.4.2 Invertebrate wildlife

With the exception of some groups of crabs the ecology of the invertebrate wildlife including worms, insects, molluscs and most crustacea is not well known, although it is certain that this group has an extremely important role in the aquatic system.




**MAP 5 BREEDING HABITAT AND MIGRATORY PATHS OF HOLARCTIC**

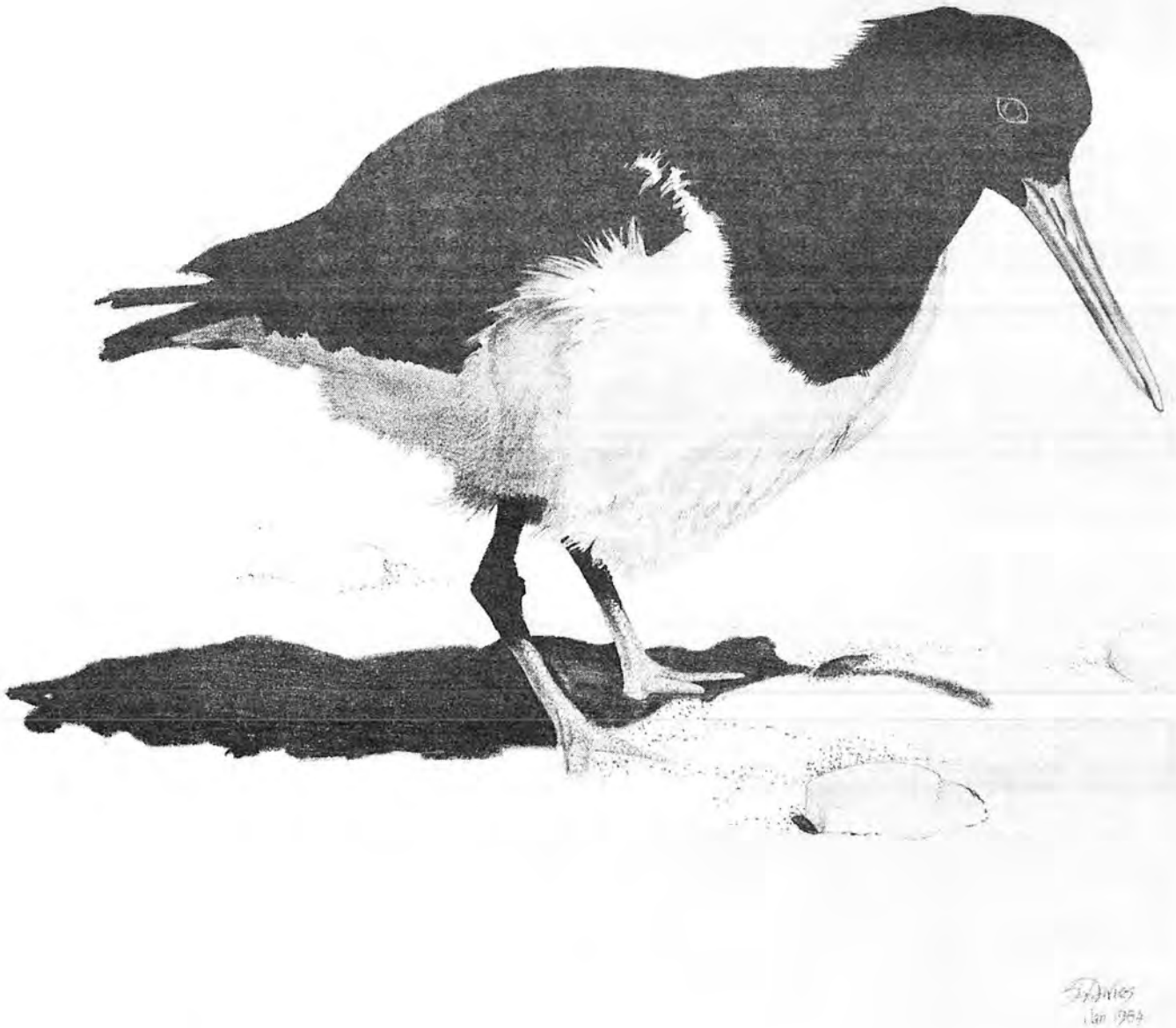


**FIGURE 3 WADING BIRDS (Pied Oyster Catcher)**

Shellfish: Shellfish are found on the sandy beaches, mudflats and rocky coasts around Broome. These animals are important as a source of food and for collection. The intertidal sand bars, mudflats and rocky outcrops provide an extemely diverse range of habitats. The consequent variety of shell species found at Broome is recognised worldwide and has resulted in the area becoming a major site for shell collectors. Little research into the effects of shell collecting has been carried out though it is recognised that the shellfish resource has diminished markedly over the last 5-10 years. This is mainly attributed to increasing disturbance and destruction of habitats by a more mobile population with greater access to the coast, and increased amateur and professional as well as commercial collecting.

The Broome coast and offshore sandflats are also habitats for oysters which support an industry producing shell, meat and pearls, although commercial pearling has declined and only several operators remain.

It is also evident from the number of middens along the cliffs and dunes of the Broome coast that shellfish have been, and still are, providing a source of food for the local inhabitants.

Crabs: The crab population in the Broome area have been examined by staff of the WA Museum with research currently centred on the Dampier Creek tidal flat.

Crabs are found in a variety of coastal landforms. The clean white sand, gently sloping beach and even surf zone of Cable Beach provide habitats for ghost crabs (Ocypode cataphthalma) (Photograph 12) while rocky headlands like those at Gantheaume Point and Riddell Beach support rock crabs and marine hermit crabs.

The shores of Roebuck Bay support populations of terrestrial hermit crabs at various locations while the mangrove fringes and beaches near the town are inhabited by ghost crabs (O. fabricii), fiddler crabs (Uca spp.), mangrove crabs (Macrophthalmus) and mud crabs (Scylla ferrata) the last of which is exploited as a human food source. Dampier and Crab Creeks and their associated intertidal and supratidal mudflats support a variety of fiddler crabs.

Of the 17 species of fiddler crabs present in Australia, nine are found on the tidal flats around Broome. The Dampier Creek mangrove complex has a full variety of habitats that are zoned largely according to frequency and duration of tidal inundation. The regularity and high range of the tides at Broome make this tidal flat unique in Australia as the crab habitat zones are more clearly defined than elsewhere. Apart from its worth as a mangrove habitat as discussed above (2.4.1), preservation of the tidal flat in its natural state is warranted for its scientific value alone.

### 2.4.3 Dugongs

A number of Broome inhabitants have expressed concern about an apparent decline in the dugong population in Roebuck Bay and a possible need for more positive moves to conserve this animal. However, the issue is complex and as effective conservation measures would have to extend beyond Roebuck Bay, dugongs are considered beyond the scope of this study. The matter will be referred to the Department of Fisheries and Wildlife.

# BROOME HARBOUR
1:18,000

Cables 1 0 5 10 Cables or 1 Sea Mile
Feet 1000 0 6000 Feet
Metres 500 250 0 1500 Metres

122° 13'

Mag Var 2°10'E(1974)

Slightly decreasing

Mag Var 2°10'E (1974)

SEE PLAN

## Key

**Mangals and Salt Flats**

**Major Wading Bird Habitats**

**Reefs**

**Depths** are in metres (under twenty-one in metres and decimetres) reduced approximately to ISLW (chart datum).

**Heights** are in metres. Underlined figures are drying heights in metres and decimetres, above chart datum; all other heights are above MHWS.

**Projection:** Transverse Mercator. Positions are based on the Australian Geodetic Datum, 1966.

**Authorities:** Public Works Department surveys to 1968, with additions from a R.A.N. survey of 1970 and British Admiralty surveys to 1883.

Tidal Levels referred to Datum of Soundings

| Place | Lat S | Long E | Heights in metres above datum MHWS | MHWN | MLWN | MLWS | Datum and remarks |
|---|---|---|---|---|---|---|---|
| Broome | 18°00' | 122°13' | 8·5 | 5·4 | 3·6 | 0·0 | 11·1m below a fixed mark on the face of a large rock (qdl), 165° from Bearton Hill |

Tidal Streams referred to HW at Broome

| | Hours | Dir | Rate (kn) Sp | Rate (kn) Np |
|---|---|---|---|---|
| Before HW | 6 | 085 | | |
| | 5 | 025 | | |
| | 4 | 000 | | |
| | 3 | 335 | | |
| | 2 | Variable | | |
| | 1 | 210 | | |
| HW | | 210 | | |
| After HW | 1 | 210 | | |
| | 2 | 210 | | |
| | 3 | 210 | | |
| | 4 | 205 | | |
| | 5 | 205 | | |
| | 6 | 085 | | |

NOTE The direction of the streams at Neaps at
3 hours before HW 058
2 hours before HW 127
5 hours after HW 111



**MAP 6 MARINE RESOURCES**

## 2.5 Culture and heritage

Planning and management strategies must take account of man-made resources as well as those of the natural environment.

### 2.5.1 The Broome "atmosphere"

Broome has a rich atmosphere deriving from its history as a pearling centre, its cosmopolitan population, the fact that it was bombed during World War 2, and its "tropical look", which sets it apart from the more sterile mining towns and other hot and dusty coastal towns of the north-west.

### 2.5.2 Aboriginal sites

Aboriginal people have inhabited the land within and around the town of Broome for many thousands of years. Some of their descendants still live in Broome, while others are dispersed throughout the Kimberley. They retain important links with the land and wish to see their sites protected.

Some of their sites were and some still are used as camping places. The camps which are predominantly along the coast near freshwater sources are marked by large scatters of shellfish remains, often with associated stones which were used as implements in everyday life. Certain other environments were favoured for the collection of wild foods such as seed and fruit, and the provision of other requirements such as bark from particular types of trees. Some trees are scarred where toe holds have been cut for the collection of wild honey. Along the coast, stone fish traps were constructed to harvest fish on the falling tides.

Burial sites have been found marked by bones in the sand or wedged in rocky outcrops.

There are many places in the Kimberley (often natural features in the landscape) which are associated with Aboriginal mythology and beliefs, and which still feature in the songs and stories of Broome Aborigines. Some of these stories and songs form part of the traditional exchange system, and spread from Broome throughout the Kimberley, and even into the desert.

### 2.5.3 Historic sites - non-Aboriginal

The special atmosphere of Broome derives from its history as a pearling centre (between 1880 and 1920 the biggest in the world); its cosmopolitan population; the fact that it was bombed during World War 2; and its "tropical look" which sets it apart from the more sterile mining towns and the other hot and dusty coastal towns of the north-west.

Many historic sites and structures remain as evidence of Broome's colourful past and some of these are within or close to the area covered by this plan. These include Bedford Park, portions of Chinatown, Buccaneer Rock, Pioneer Cemetery, Customs House, the old jetty abutments at Mangrove Point and the wrecks of Dutch planes that were shot down in 1942. These sites have been examined by the Built Environment Committee of the National Trust of Australia (WA), with respect to obtaining an assessment of their historical value and

preparing recommendations about their possible classification and care. The locations of the historic sites are shown on aerial photographs 1-3.

## 3.0 EXISTING PLANNING AND MANAGEMENT CONTROLS

For the purposes of this plan it is necessary to examine not only land and water in the coastal strip but also adjacent and adjoining lands whose future use and management may affect the stability and quality of the coast.

### 3.1 Existing tenure

The study area comprises unvested, vested and leasehold Crown land, freehold, urban, rural, commercial and industrial land and a port area (Maps 7a, 7b, 7c, 8 and 9).

### 3.2 Existing zoning

Land in the study area has been assigned a land use zone in accordance with the Broome Town Planning Schemes Nos 2 and 3 as shown on Maps 10-12.

### 3.3 Existing management

The use of freehold land within and adjacent to the Broome townsite is controlled by Council through Town Planning Schemes 2 and 3.

There are extensive areas of vacant Crown land and Land Act reserves which are administered by the Department of Lands and Surveys. That authority is responsible for the day-to-day management of vacant Crown land, while reserves may be vested in a variety of authorities which care for, and use them, under specified conditions.

The Department of Lands and Surveys also provides special purpose leases for pastoral, residential, industrial, horticultural and other uses.

### 3.4 Existing facilities

A number of facilities have been developed in the study area providing services for local residents, industry and tourists.

#### 3.4.1 Roads

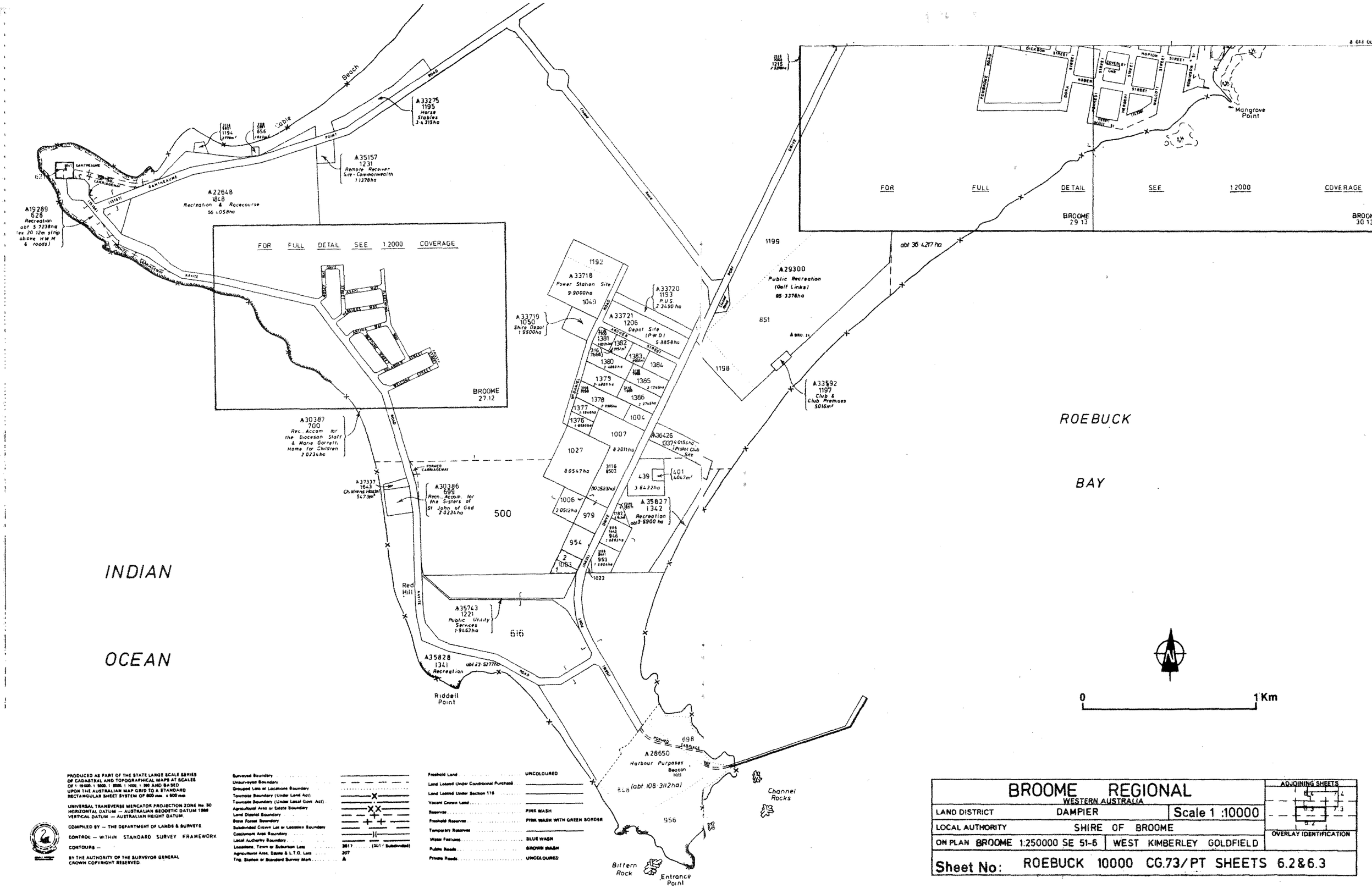
Much of the area is serviced by roads, streets and informal tracks which provide access to most of the coast. Existing roads, streets and tracks are shown on Maps 7-13.

#### 3.4.2 Car and trailer parking

Car parking is available at several locations around the foreshore, and Council and the Department of Marine and Harbours periodically upgrade facilities. Existing parking areas are shown on Map 13.

#### 3.4.3 Boat launching facilities

At present there are boat launching ramps near the port, Shire caravan park and at the end of Saville Street. In addition small boats are launched from a number of headlands around Roebuck Bay. The location of these facilities is shown on Map 13.




PRODUCED AS PART OF THE STATE LARGE SCALE SERIES OF CADASTRAL AND TOPOGRAPHICAL MAPS AT SCALES OF 1:10000, 1:5000, 1:2000, 1:1000, 1:500 AND 1:250 BASED UPON THE AUSTRALIAN MAP GRID TO A STANDARD RECTANGULAR SHEET SYSTEM OF 800 mm. x 500 mm.

UNIVERSAL TRANSVERSE MERCATOR PROJECTION ZONE No. 50
HORIZONTAL DATUM — AUSTRALIAN GEODETIC DATUM 1966
VERTICAL DATUM — AUSTRALIAN HEIGHT DATUM.

COMPILED BY — THE DEPARTMENT OF LANDS & SURVEYS.

CONTROL — WITHIN STANDARD SURVEY FRAMEWORK

CONTOURS —

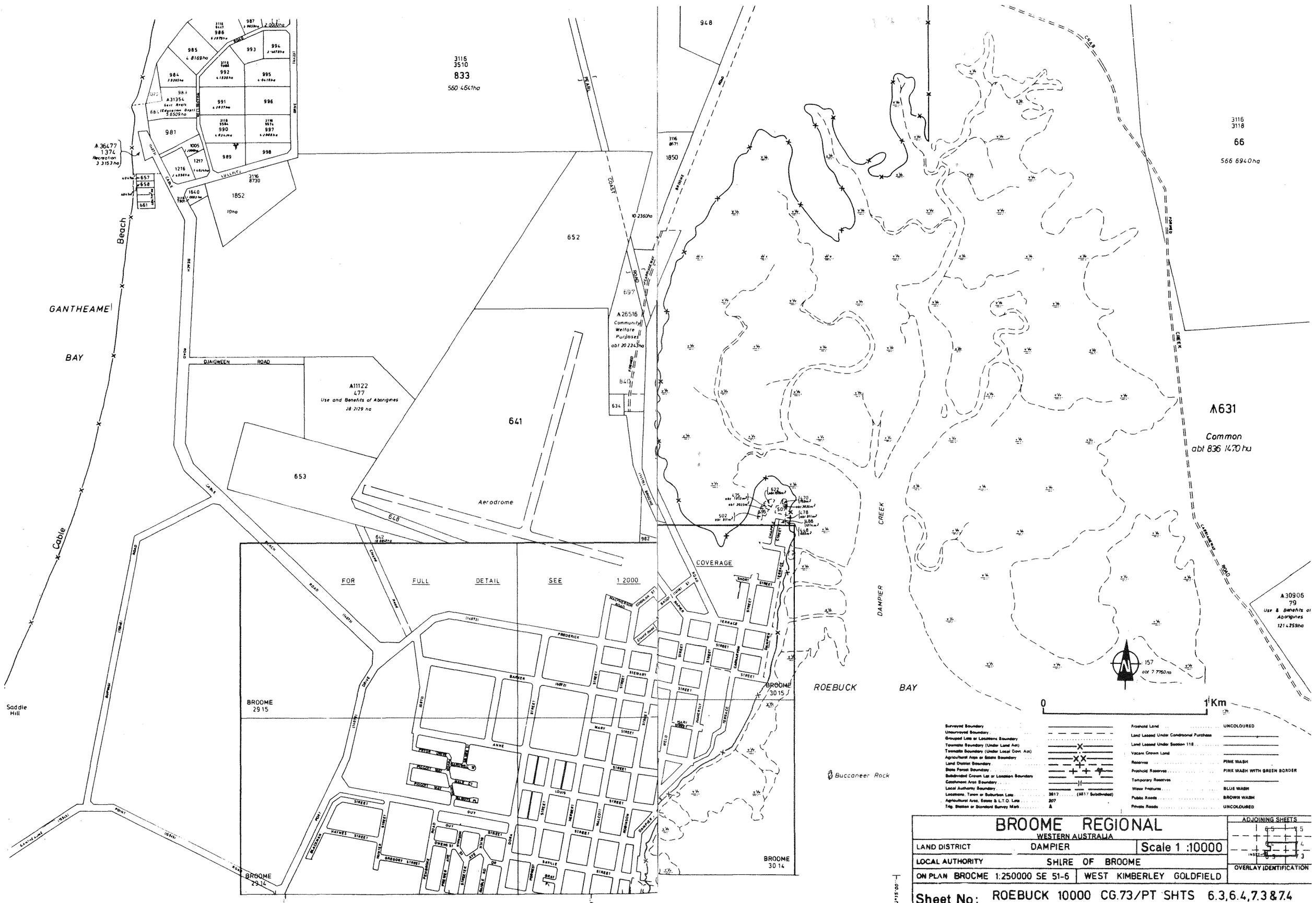
BY THE AUTHORITY OF THE SURVEYOR GENERAL
CROWN COPYRIGHT RESERVED.

| | |
|---|---|
| Surveyed Boundary | |
| Unsurveyed Boundary | |
| Grouped Lots or Locations Boundary | |
| Townsite Boundary (Under Land Act) | |
| Townsite Boundary (Under Local Govt. Act) | |
| Agricultural Area or Estate Boundary | |
| Land District Boundary | |
| State Forest Boundary | |
| Subdivided Crown Lot or Location Boundary | |
| Catchment Area Boundary | |
| Local Authority Boundary | |
| Locations, Town or Suburban Lots | 3617 (3617 Subdivided) |
| Agricultural Area, Essex & L.T.O. Lots | 207 |
| Trig. Station or Standard Survey Mark | A |

| | |
|---|---|
| Freehold Land | UNCOLOURED |
| Land Leased Under Conditional Purchase | |
| Land Leased Under Section 116 | |
| Vacant Crown Land | |
| Reserves | PINK WASH |
| Freehold Reserves | PINK WASH WITH GREEN BORDER |
| Temporary Reserves | |
| Water Features | BLUE WASH |
| Public Roads | BROWN WASH |
| Private Roads | UNCOLOURED |

**MAP 7a EXISTING TENURE**

| | |
|---|---|
| **BROOME REGIONAL** WESTERN AUSTRALIA | ADJOINING SHEETS |
| LAND DISTRICT: DAMPIER | Scale 1 :10000 |
| LOCAL AUTHORITY: SHIRE OF BROOME | |
| ON PLAN BROOME 1:250000 SE 51-6 | WEST KIMBERLEY GOLDFIELD |
| Sheet No: ROEBUCK 10000 CG.73/PT SHEETS 6.2&6.3 | OVERLAY IDENTIFICATION |



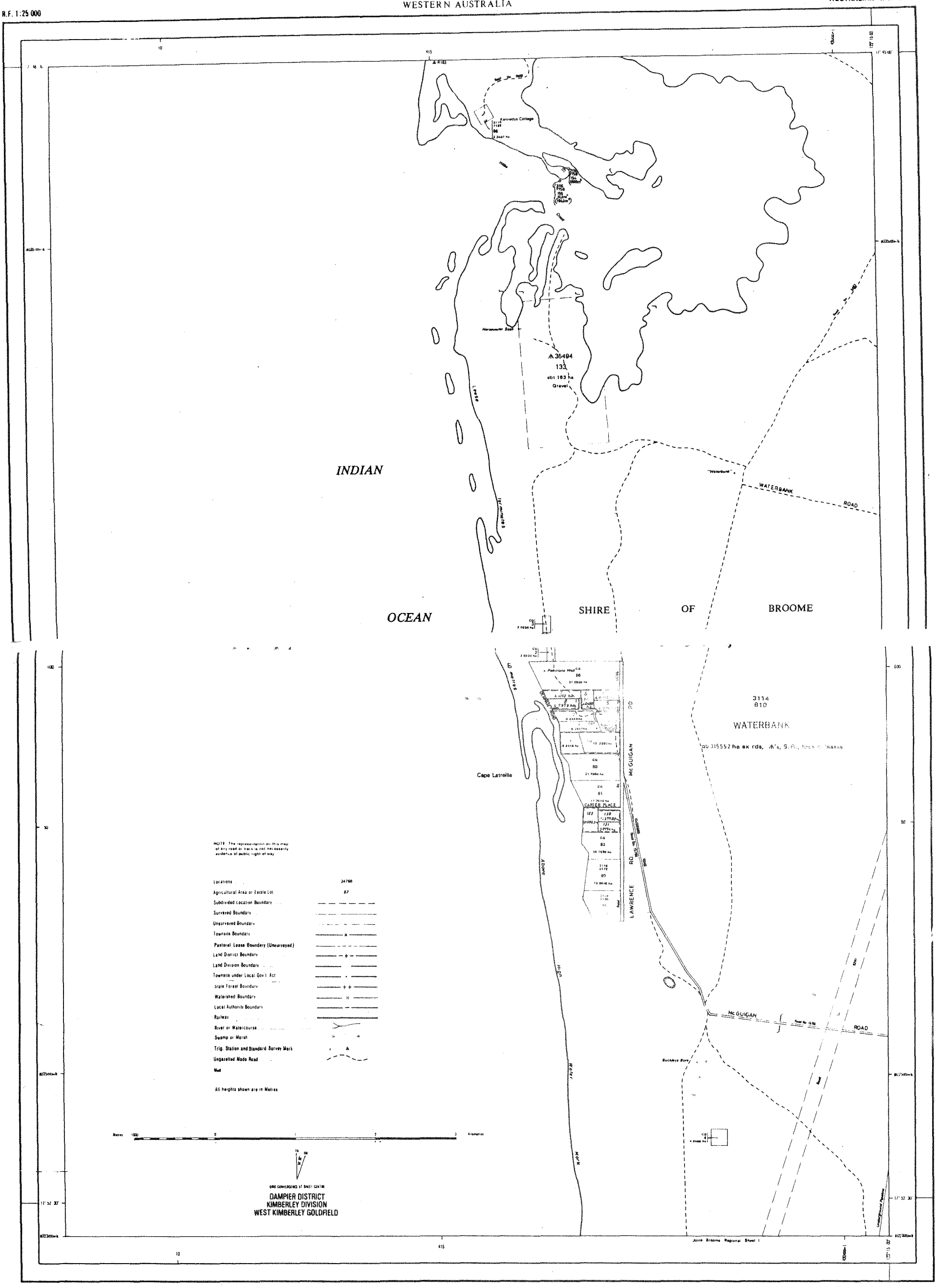

**MAP 7b EXISTING TENURE**

# BROOME N.E. & PT S.E.

WESTERN AUSTRALIA

R.F. 1:25 000

AUSTRALIAN MAP GRID




**MAP 8 EXISTING TENURE**

R.F. 1:25 000

# ROEBUCK
WESTERN

# PLAINS S.W.
AUSTRALIA

AUSTRALIAN MAP GRID

BROOME REG. SHT. 1 1:10000
CG 73/PT. SHTS. 6.4, 6.5, 7.4 & 7.5

BROOME REG. SHT. 2 1:10000
CG 73/PT. SHTS. 6.3, 6.4, 7.3 & 7.4

SHIRE OF BROOME

PATTERSON S WELL

CRAB CREEK

CRAB CREEK ROAD

Fishermans Bend

Telegraph Line

Survey

3118
3118
66
566.8940 ha

631
Common
obl 836.1470 ha

3118
5375
81
819.0938 ha

30906
79
121.4259 ha
For Use & Benefit
of the Aborigines

A 35493
132
32.4784 ha
Grant

723
258.9988 ha
Water & Stopping Place

Tagarana Bore

Cockle Waif

Salt Plains

Tidal Mud Flats

Mork

terminates

CREEK

40 metres

ROAD

Above

High

Water

Fall Point

Lease

ROEBUCK

BAY

NOTE. The representation on this map of any road or track is not necessarily evidence of public right of way

| | |
|---|---|
| Locations | 24785 |
| Agricultural Area or Estate Lot | 67 |
| Subdivided Location Boundary | |
| Surveyed Boundary | |
| Unsurveyed Boundary | |
| Townsite Boundary | |
| Pastoral Lease Boundary (Unsurveyed) | |
| Land District Boundary | |
| Land Division Boundary | |
| Townsite under Local Gov't Act | |
| State Forest Boundary | |
| Watershed Boundary | |
| Local Authority Boundary | |
| Railway | |
| River or Watercourse | |
| Swamp or Marsh | |
| Trig. Station and Standard Survey Mark | |
| Ungazetted Made Road | |
| Mud | |

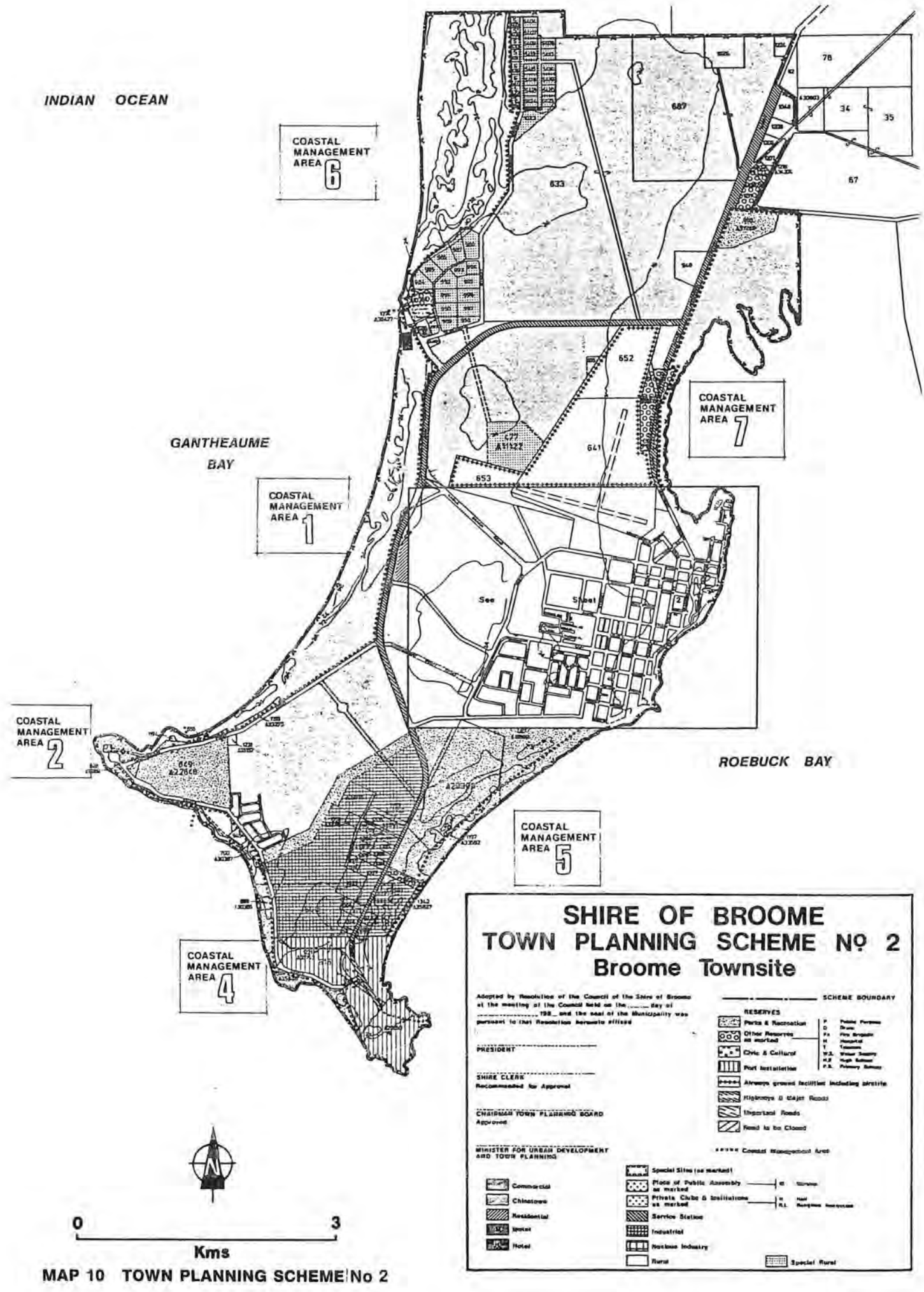
All heights shown are in Metres

Metres 1000 0 1 2 3 Kilometres

GRID CONVERGENCE AT SHEET CENTRE

DAMPIER DISTRICT
KIMBERLEY DIVISION
WEST KIMBERLEY GOLDFIELD

**MAP 9 EXISTING TENURE**




# SHIRE OF BROOME
## TOWN PLANNING SCHEME No 2
## Broome Townsite

Adopted by Resolution of the Council of the Shire of Broome at the meeting of the Council held on the ..... day of ..... 19..... and the seal of the Municipality was pursuant to that Resolution hereunto affixed

PRESIDENT

SHIRE CLERK
Recommended for Approval

CHAIRMAN TOWN PLANNING BOARD
Approved

MINISTER FOR URBAN DEVELOPMENT AND TOWN PLANNING

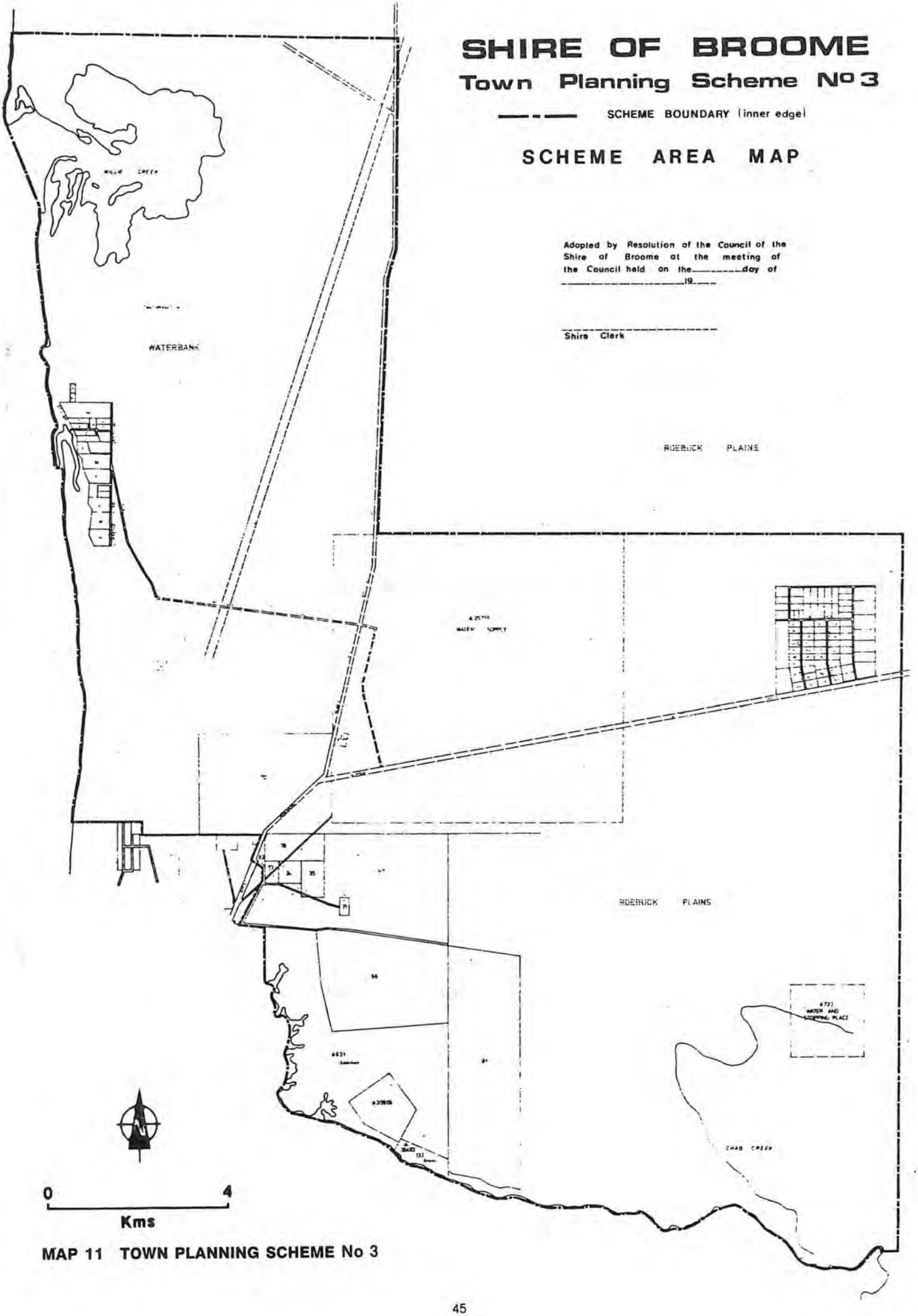
SCHEME BOUNDARY

RESERVES
- Parks & Recreation
- Other Reserves as marked
- Civic & Cultural
- Port Installation
- Airways ground facilities including airstrip
- Highways & Major Roads
- Important Roads
- Road to be Closed

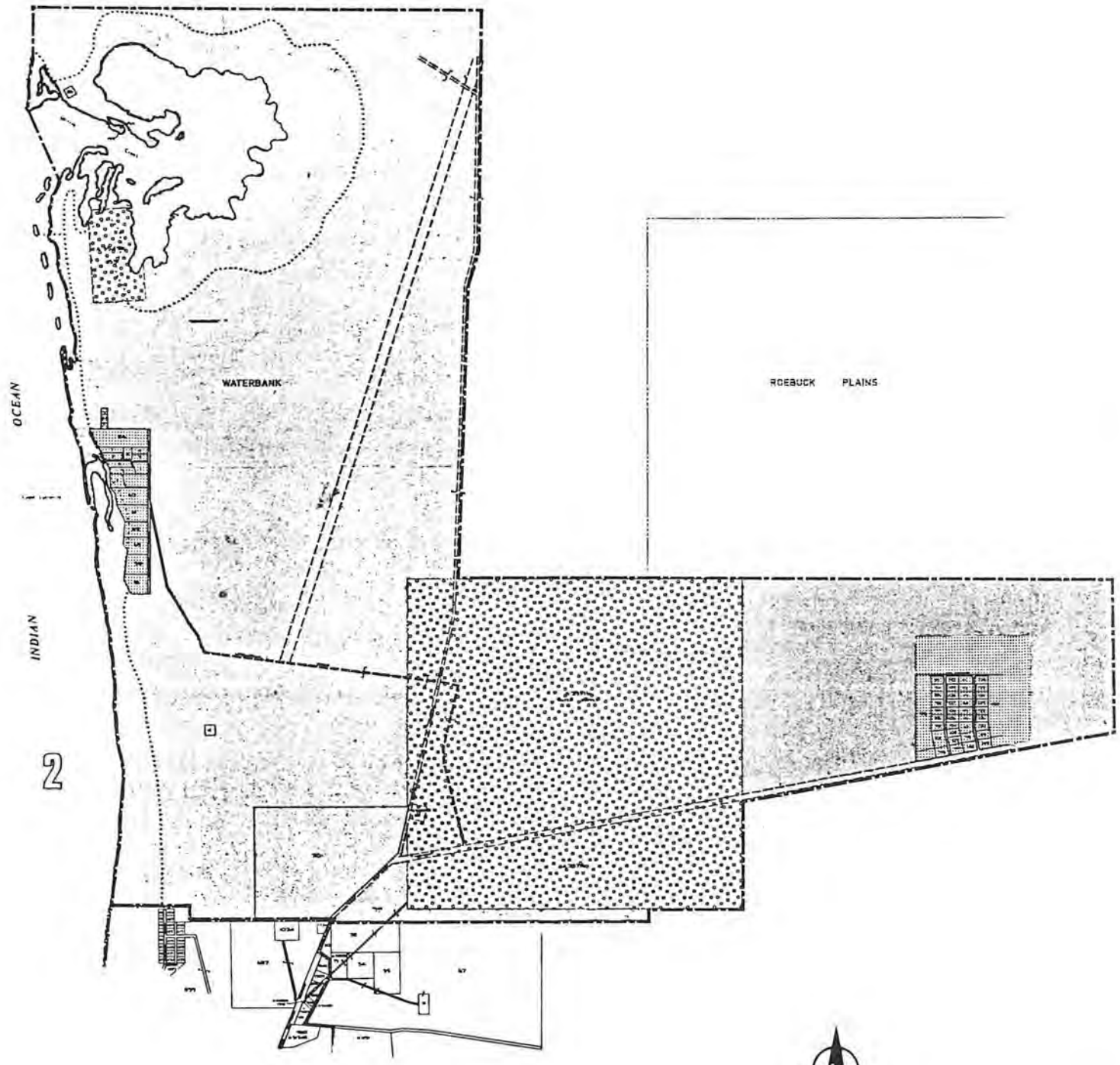
Coastal Management Area

- Commercial
- Chinatown
- Residential
- Market
- Hotel
- Special Sites (as marked)
- Place of Public Assembly as marked
- Private Clubs & Institutions as marked
- Service Station
- Industrial
- Noxious Industry
- Rural
- Special Rural

MAP 10 TOWN PLANNING SCHEME No 2




**MAP 11 TOWN PLANNING SCHEME No 3**




SCHEME MAP

ZONES

Rural

Special Rural

RESERVES

As marked

Coastal Management Areas

Adopted by Resolution of the Council of the Shire of Broome at the meeting of the Council held on the ....day of .....19....and the seal of the Municipality was pursuant to that Resolution hereunto affixed

President

Shire Clerk

Recommended for Approval

Approved

Chairman Town Planning Board

Minister for Urban Development and Town Planning

# SHIRE OF BROOME
## Town Planning Scheme No 3

SCHEME BOUNDARY (inner edge)

**MAP 12 TOWN PLANNING SCHEME No 3**

### 3.4.4 Beach access for pedestrians

Pedestrians obtain access to the beaches of Roebuck Bay from a number of locations while steps and paths currently provide access to Cable Beach near Bali Hai. Access to Riddell Beach is restricted to a few points. The upgrading of pedestrian access to all beaches would be desirable.

### 3.4.5 Jetties

At present there is a large jetty associated with the port facility. (Photograph 11) This structure is used for port operation and provides a berth with associated loading facilities. The port jetty is also a valuable recreation resource for amateur anglers and sightseers. A private facility (Streeters jetty) for pearling luggers provides access to Dampier Creek in Chinatown.

In addition the remains of the abutment for the original harbour jetty exist near the southern end of Robinson Street. This structure is also used by anglers and sightseers.

### 3.4.6 Parks and toilet facilities

Formal parkland with toilets and barbecues has been developed on the foreshore near Bali Hai at Cable Beach. In addition a small parkland with playground equipment exists near the Shire caravan park at the southern end of Robinson Street.

### 3.4.7 Tourist facilities and accommodation

Tourist facilities and accommodation have been developed at a number of locations near the study area and include the Roebuck Hotel and Mangrove Hotel in Dampier Terrace, Continental Hotel in Weld Street and the Tropicana Motel in Robinson Street. Caravan parks exist at Bali Hai near Cable Beach and on Reserve 17132 at the southern end of Walcott Street (Map 13).

## 3.5 Use pressures

Coastal and adjacent areas in the Broome Shire are subject to a number of use pressures, which are increasing with the growth of the resident and tourist population. It is important to collect information about existing and likely coastal land use pressure in order to make effective provision for these demands.

### 3.5.1 Population growth

The number of permanent residents in Broome increased from 4079 in 1976 to 4869 in 1981, an increase of 19.3%. This growth in population has increased recreational demand on the coast for bathing, surfing, fishing, boat launching and nature study as well as demand for private seaside accommodation. There are additional pressures associated with the provision of land for housing, the location of roads and the disposal of domestic waste. Any increase in industry activity will stimulate demand for port facilities, industrial land, quarry products and waste disposal sites.

### 3.5.2 Tourism

Broome is an important tourist centre and tourism is an integral part of the region's economy. The Shire has many of the attributes found in other popular coastal tourist resorts throughout the world, including a warm to hot climate, fine beaches associated with clear blue waters. In addition the environment is relatively free of natural dangers, crime, political instability, and disease which detract from other parts of the world which may otherwise be popular.

In the past Broome's relative isolation has limited growth of the tourist industry but recent upgrading of the Port Hedland-Broome road has made the town more accessible, and the planned upgrading of the Broome-Kununurra link will continue this trend.

The Western Australian Government Department of Tourism (WADT) has undertaken studies of past, existing and projected visitor use of caravan parks, hotels, motels and guest houses, in Broome and other parts of the Kimberley.

This work predicts that there will be a steady increase (10% per annum) in the number of tourists visiting Broome and in the demand for accommodation. The coastal zone appears to be the main attraction, being used by 66% of residents and visited by 62% of tourists. While the majority (80%) of the town's population agrees that tourism is important, a significant proportion (24%) considers that visitors lead to overcrowding and that the town's facilities cannot cope with the tourist influx. For these reasons it is important that proper planning be undertaken to cater for the tourist trade while minimising the impact of tourists on the coastline and resident population.

### 3.5.3 Holiday accommodation

Associated with the projected growth of the tourist population is a requirement for more accommodation. The WADT survey indicates that caravan parks are preferred by non-business visitors as other forms of accommodation (hotel and motels) are too expensive; this suggests a growing demand for low to moderately priced accommodation (caravan park, chalets or flats). There have already been several applications to develop sophisticated forms of accommodation (hotel/motel) in the coastal zone, and more are likely. The WADT predicts that the number of powered caravan sites in the town will need to increase from the present 300 to 650 by 1990, requiring the development of two or three additional caravan parks. As tourism in Broome is seasonal, with 50% occupancy exceeded only between June and September, accommodation shortfall during this peak period may be met by allowing overflow onto adjacent lands that have been set aside for the purpose, rather than by increasing formal accommodation to cater for peak usage. Such management would require the approval of the Public Health Department.

### 3.5.4 Access

The demand for greater access to the coast is increasing due to a growing population and availability of off-road vehicles. The consequent creation of vehicle tracks and pedestrian paths in the coastal zone has greatly increased the likelihood of soil erosion problems.

### 3.5.5 Small boat launching

The high tidal range at Broome restricts the launching and retrieval of small boats. Three small boat launching ramps have been developed in the townsite and several natural launching areas exist on Roebuck Bay. As there is a potential conflict between boat owners using the town beach launching ramp and bathers the use of the other launching ramps should be encouraged.

### 3.5.6 Shell collecting

Professional and amateur shell collectors use reefs in the shallow waters around Broome as a source of live shells and fossils. The long term effect of this activity is not understood but it is a matter of concern, and warrants monitoring and investigation.

### 3.5.7 Aboriginal food gathering

Aboriginal people continue to use the coastal environment as a source of wild foods, including fish, shellfish, native fruits and berries, and wild honey, all of which are important elements in their diet.

### 3.5.8 Botanical gardens

The Broome Botanical Society has prepared a submission seeking approval to establish two botanical garden annexes within the study area. These include an area of remnant rain forest on vacant Crown land behind the Cable Beach sand dunes near the intersection of Gupingi and Gantheaume Point Roads. The other site is on the Waterbank Station.

The submission proposes that these areas of interesting vegetation be protected by an appropriate reservation as shown on Map 14b. Later development of the area would include the provision of access landscaping and supplementary planting where appropriate.

### 3.5.9 Commercial fishing

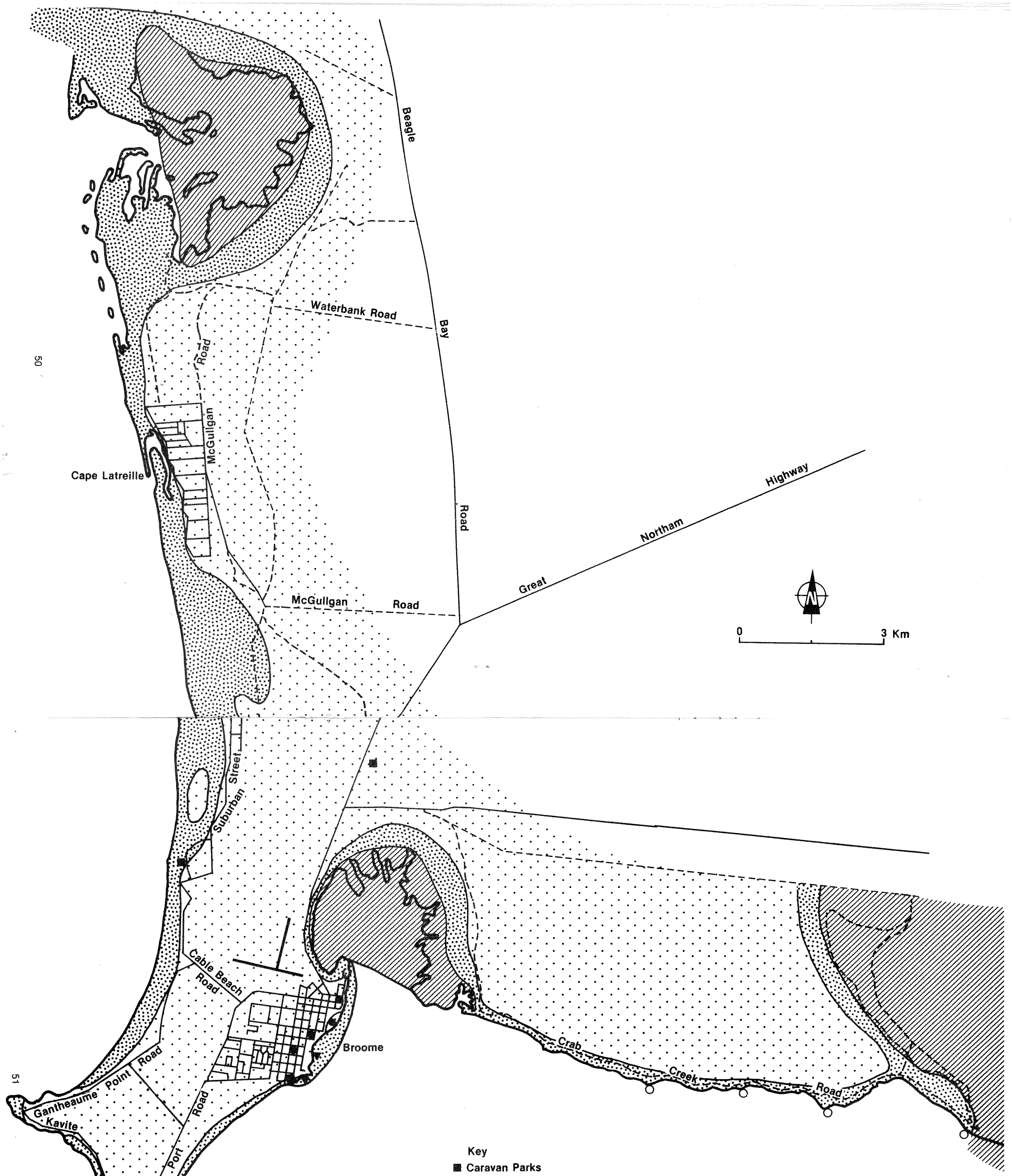
The major commercial fisheries in the area involve the culture of pearl oysters and the capture of approximately 100 tonnes of threadfin salmon per year. These operations depend on limiting exploitation to sustainable levels and the maintenance of a balanced ecosystem.

### 3.5.10 Mining and quarrying

Various parts of the coastline in the Broome Shire have been quarried for building gravel and road base materials and this has caused environmental problems in some locations. The areas of major concern are the old gravel pits along Crab Creek Road and the pits located on sand dunes around the coast of the Broome Peninsula. In addition, a number of other locations are covered by mining tenements and may be exploited in the future. The sites of past, current and proposed mining and quarrying activities are identified on Map 4(a-c).

### 3.5.11 Port development

While the port is outside the area of the Town Planning Scheme, its presence and the activities associated with it have potential for affecting coastal areas. It is considered essential that effective communications between Council, the Department of Marine and Harbours and DCE be maintained.




Note: The unit boundaries shown on this map are diagramatic and precise boundaries should be determined by site survey.

**MAP 13 CAPABILITY UNITS AND ROADS, BOAT LAUNCHING AREAS AND TOURIST ACCOMMODATION**

### 3.5.12 Rubbish dumping and littering

Rubbish has accumulated at various locations around the Broome Peninsula. The worst area is the foreshore between the meatworks and Napier Terrace, but a number of other locations also cause concern. (Photograph 12 )

12. Town Foreshore

### 3.5.13 Shack construction and illegal camping

Shacks and illegal camps which occur at a number of locations around the foreshore could create health and social problems. These activities appear to result from a lack of public housing and the unwillingness of some visitors to pay fees at recognised camping areas.

### 3.5.14 Horse training

Racehorses are kept in stables and yards behind the Cable Beach sand dune system and sometimes trained on the beach. Management plans should include provision for long term accommodation and use.

## 3.6 Assessment of management needs

The effective management of coastal areas has not always been achieved in the past for a number of reasons. The Department of Lands and Surveys is responsible for leased, vested and unvested Crown land but has limited resources to undertake management.

Council manages and develops a number of reserves on the foreshore but inadequate funding and limited expertise can result in inappropriate works occurring.

If land is vested in other agencies care must be taken to ensure they have the information and resources required to care for the area adequately.

When tourist facilities are developed which utilise natural features such as attractive sections of coastline, funding for the management of the natural resources involved should be regarded as a normal management cost. Without funding and management degradation of the resources providing the attraction will occur.

At present access to much of the coast is informal though Council has attempted, notably behind Cable Beach, to limit access to defined paths. Rationalisation of roads and access to suitable sites needs to be undertaken in order to allow use of coastal resources while minimising environmental degradation and its associated management costs.

At present little management consideration is given to quarry extraction, wildlife habitat preservation, shell collecting, Aboriginal sites, waste disposal (industrial, domestic and stormwater) and underground water. To avoid problems at a later date these issues need to be considered now.

## 3.7 Management issues

### 3.7.1 Mangroves

Mangroves usually grow between high spring tide and mean sea level. The term mangrove refers to individual tree or bush species, while a mangrove plant community is called a mangal.

Mangroves belong to a variety of plant families which have common features such as pneumatophores, which are root outgrowths that function in aeration, and seeds which germinate while attached to the parent plant. These features almost certainly are adaptations which assist the plants to survive in a harsh environment (Semeniuk 1978 p.2).

Mangroves grow best in areas with warm climates, protected shores, salt water, muddy substrates and a high tidal range. All of these attributes are found in Roebuck Bay and Willies Creek. Mangroves are typically zoned (i.e. different species occur in various locations determined by the frequency of flooding by tidal waters, soil type, soil salinity, drainage, slope, plant interactions and animal interactions). Naturally many of these factors are interrelated. Where environmental factors are well differentiated along a shore with a gentle gradient there will be a tendency for development of distinct broad zones as occur in Dampier and Willies Creeks (Semeniuk 1972 p.5).

Mangrove trees have been widely used for timber (many pearling luggers were built of mangrove wood) and fire wood but in the last decade or so there has been a gradual realisation that many natural coastal resources may depend on the survival of the mangrove ecosystem. There is now a considerble body of scientific evidence that mangroves play an important role in supporting a wide range of marine life in the near shore waters, and in sustaining coastal fisheries.

Life in the mangrove community involves an interaction between plants, marine animals and terrestrial fauna. Mangroves provide the basis for the food chains involving various marine and terrestrial organisms in the form of leaf litter and other plant detritus on the ground, and for the insect, bird and bat populations in the form of leaves, flowers and fruits. Mangroves also provide the habitat for many other organisms such as algae and diatoms which are primary links in food chains (Semeniuk et al. 1978).

The animals that are associated with mangroves span a wide range of invertebrate and vertebrate groups. This fauna is often distributed in distinct zones related to frequency of tidal flooding, soil type, salinity, and the type of surrounding plant community. Many of the animals exploit the mangal as habitat, nursery grounds or source of food.

Fauna in mangroves may be distinguished as either resident or temporary. Resident fauna includes ground-dwelling surface animals such as hermit crabs, mud whelks and other snails; burrowing organisms such as crabs, shrimps and worms; tree-dwellers such as encrusting oysters and barnacles, wandering snails, boring Teredo ("ship worm"), and a host of insects, birds and bats which use mangrove foliage as habitat and derive food from leaves, flowers and fruit. Mangroves provide vital feeding grounds for the temporary fauna which is made up of free-swimming animals such as fish and crustaceans that invade the mangal environment at high tide, and of terrestrial animals such as birds, reptiles and mammals that invade the area at low tide. Additionally, numerous fish and crustacean species (notably banana prawns) use the mangrove environment as a nursery.

Thus, in terms of plant primary production, feeding grounds and nursery beds, mangroves are a vital resource. It has been shown that the destruction of mangroves can lead to a major change in near shore ecology with the subsequent decline of commercial fishing. Studies have shown that in some coastal waters 70-80% of fish caught commercially were linked to food chains that depended on mangroves. Consequent on mangrove loss is the dislocation of the food chain accompanied by the inevitable loss or severe depletion of organisms within the chain. Destruction of mangroves also results in loss of habitats for a large range of terrestrial organisms such as insects, birds and bats. Removal of even part, such as a particular zone, has detrimental effects on the ecosystem since those birds and insects that are very selective in their feeding are lost (Semeniuk et al. 1978).

Mangroves also help to stablise coast lines and protect them from storm attack by absorbing wave energy, slowing down currents and protecting the substrate against erosion. Where mangroves have been removed, coastlines that once experienced moderate shore erosion have undergone greater erosion (Semeniuk et al. 1978). The Broome shoreline is eroding near the Council caravan park and north of the old jetty abutment and, while there may be no relationship, mangroves have been removed from that area.

For preservation of natural habitats, protection from coastal erosion, and sustenance of offshore fisheries, careful management of the mangrove habitats is essential. It must be recognised that the tidal flats in front, and the supratidal flats behind, are important to the mangrove system.

In WA protection of tidal wetlands is covered by three acts: the Fisheries Act, the Fauna Conservation Act and the Rights in Water and Irrigation Act. These acts prohibit deposition of filth and refuse, discharge of wastes into waters where fish or fishing grounds are likely to be, and removal or disturbance of the ecosystem as well as interference with water supply. At this stage rather than declare the mangroves sanctuaries or marine parks as is required under the various Acts, Council should recognise the importance of the mangroves and through planning policy implement a strategy to preserve them by avoiding incompatible land use of adjacent areas.

### 3.7.2 Quarrying

As Broome has few reserves of building sand and aggregate except along the shoreline, there is pressure to quarry in the coastal zone. The prized coarse beach sands which are not abundant are probably not critical to shoreline stability as in most cases the shoreline is defined by a backing pindan cliff. However, removal of beach sands will result in loss of any beach and more rapid erosion of the pindan - the rate is unknown.

The prized lateritic gravel with outcrops along the sea cliffs east of Dampier Creek and around Gantheaume Point is in greater supply. Large scale disturbance has taken place in an effort to quarry these deposits. Apart from visual impact there is probably no harm being done. A deposit in front of the Mangrove Motel is in a more sensitive location as removal of the rocks and disturbance of the mangroves will lead to greater erosion of the shore. Again the potential rate is not known but considering the nearby developments, quarrying this limited deposit would not be wise, unless on a scale small enough to allow for natural revegetation by mangroves.

The Pleistocene dune sands which are not greatly prized as a building material are quarried at numerous locations (Riddell Beach, abbattoirs, Mangrove Motel). As the dunes mostly lie over pindan, their removal probably does not affect shoreline erosion rates. There are numerous large deposits well away from the shore that could be quarried with no effect (e.g. in port area; north of Bali Hai adjacent to the northern tidal flats).

Though not highly prized the Holocene dunes are quarried south of Bali Hai. In view of the possible sensitivity of Cable Beach this should be stopped as proximity to town is the only major asset of this deposit.

### 3.7.3 Coastal processes

Unlike many sandy coasts there does not appear to be a major source of sand-size material feeding any of the beaches around Broome. Most of the beach and dune sand is probably re-worked pindan or Pleistocene material with a small contribution of carbonate from contemporary or Holocene shells. It is also evident that not a lot of sand has come ashore during the Holocene and that there is not a lot of sand available for transport onshore in the future. Consequently the dominant contemporary shoreline processes tend to be erosive with the result that most of the shoreline is eroding, leading to formation of vertical pindan cliffs with narrow red-stained beaches punctuated by rocky outcrops and with erosion products transported away from Gantheaume Point toward Willies and Crab Creek respectively. As there does not appear to be any reason for this scenario to change, the white sandy beach along Cable Beach must be regarded as a temporary and "fragile" feature. In order to preserve this valuable resource, care must be taken to avoid exacerbating loss of sand from the area. The normal short term recycling of sand during storms and the retention of a store of sand in the dune system should be recognised. Quarrying of dune sand should not be allowed and revegetation of worn areas should be a matter of priority. Relevant government agencies can provide advice in this regard.

Coastal development should take account of the worst possible combination of cyclonic winds, storm surge and storm waves, although such events may be rare. Despite the mild prevailing conditions it

should not be forgotten that it is usually the rare high energy event which shapes or destroys coastal features (and developments). The possibility of a high tide with combined storm surge and storm waves must be considered if any development is to be located close to the coast.

### 3.7.4 Migrant wading birds

As a signatory to international treaties on protection of migrant birds, Australia has an obligation to ensure careful management of habitats used by these birds. At present there is no management of these areas. With increasing tourism, management and control of access will become urgent. Advice from relevant government departments should be sought on the areas that need management and on suggested techniques.

### 3.7.5 Dampier Creek tidal flat

The regular tidal cycles experienced at Broome and the consequent well zoned habitats of the fiddler crabs on the Dampier Creek tidal flat are unique in Australia. Therefore, apart from its worth as a mangrove habitat, preservation of this tidal flat ecosystem in its natural condition should be considered. Increased drainage, discharge, earth moving, mangrove clearing or access on the tidal flats should be discouraged, prevented or carefully managed.

### 3.7.6 Culture and heritage

With increasing pressure for growth, Broome is in danger of losing its atmosphere. Already new residential developments which lack the character of the older suburbs are proliferating. Unspoilt beaches and nearby coastal lands are being developed and construction of buildings that detract from the open, clean and untouched feeling has already taken place. Valuable and scarce coastal land is being used for activities that could take place elsewhere. Rationalisation of these issues is required.

### 3.7.7 Aboriginal sites

All sites of importance to Aboriginal people are protected under the Aboriginal Heritage Act, 1972-1980. The Act makes provision for the preservation of places and objects customarily used by, or traditional to Aborigines. Any development in Broome which is likely to disturb these sites will necessitate an application in writing to the Trustees of the WA Museum. The Trustees are responsible to the Minister for Youth and Community Services for the administration of the legislation.

Where tourist development will affect the natural environment it is essential to seek advice to protect sites and other places of importance to Aboriginal people. It is difficult for a developer to know whether an area of land contains significant Aboriginal sites and it is therefore most important that the relevant Aboriginal people and organisations are notified of developments well in advance.

Before developments occur Council should consult with local Aboriginal communities and the Registrar of Aboriginal Sites at the WA Museum.

## 3.8 Opportunities and constraints

Broome has a number of resources which offer opportunities to provide for human needs while the nature of the environment limits or constrains the

level of use that can occur without a loss of natural values or high management costs. Recognising constraints as well as opportunities is vital to effective resource management.

Unlike some other areas, Broome has been subject to relatively little development pressure. Although exploitation of natural resources has occurred, use patterns are not deeply entrenched. However, there is already evidence of conflict between users, and some environmental problems. This management plan will assist in guiding future use of resources and establishing appropriate use patterns.

### 3.8.1 Resources (opportunities)

The study area has the following significant resources:

- a small but prosperous town based on tourism, agriculture and commercial fishing;
- a management infrastructure based on the Shire of Broome, and various State and Commonwealth authorities;
- a rich history with associated sites, a cosmopolitan population and a tropical easy-going atmosphere;
- a developing system of roads and other services that provides access from the rest of the State and the Northern Territory;
- a well developed airport;
- an existing port, jetties and safe moorings for small boats;
- varied coastal scenery including attractive sandy beaches and dunes, clear blue waters, tidal creeks and flats and mangroves;
- a rich natural ecosystem which provides abundant fish and wildlife resources;
- natural food resources which are utilised by the Aboriginal people;
- attractive semi-arid and sub-tropical vegetation which contrasts with the arid hinterland of much of the north-west of the State; and
- good reserves of potable underground water.

### 3.8.2 Constraints

Use constraints which influence planning and management in the Broome area include:

. existing use patterns and planning procedures;

. potential conflict between resident and tourist populations for local resources;

. the great distance from other population centres with management and technical expertise;

. a seasonal climate with occasional very heavy rainfall and hurricane force winds;

- an irregular rainfall which makes stormwater drainage and the establishment of vegetation difficult;
- pindan soils and sand dune systems which depend upon vegetation for their stability;
- a large tidal range which creates coastal engineering problems;
- high building costs which threaten to prevent continuation of the Broome-style construction;
- a naturally eroding coastline on which areas suitable for recreation are limited;
- infrequent cyclonic winds and wave attack which affect coastal structures;
- limited development and management funding.

## 4.0 PLANNING AND MANAGEMENT POLICIES, OBJECTIVES AND STRATEGIES

The purpose of management planning is to achieve a systematic and co-ordinated approach to planning, management and development that takes into account the natural environment as well as human uses and needs. The process involves consideration of an area's natural attributes and its capacity to support particular uses as well as recognising the potential impact of natural forces on man-made deveopments. Implicit in the approach is the allocation of appropriate uses to areas capable of sustaining those uses without degradation of the environment or the development.

### 4.1 Policies

As the coastal zone is a limited resource and a major goal of coastal management is to protect natural systems, Council should adopt the following policies:

- only uses that depend on a coastal location shall be permitted in the coastal zone;
- the coastal ecosystem will be maintained in as near to natural condition as possible.

### 4.2 Objectives

To assist in achieving the policies in 4.1, Council should pursue the following objectives:

- maintain existing terrestrial and marine systems coastal processes, landscapes and cultural assets;
- protect and maintain groundwater resources and seawater quality;
- provide for a wide range of appropriate recreational use;
- preserve the Broome atmosphere;
- protect Aboriginal sites;
- encourage and cater for tourism;

- provide for appropriate industrial and commercial activities;

- develop a public education programme.

## 4.3 Planning and management strategies

Council will adopt the following strategies to achieve the policies and objectives outlined above.

### 4.3.1 Allocation of coastal areas for a use

Before any area in the coastal zone is allocated for a particular use the proponent must demonstrate that the use requires a coastal location. Only uses which can be accommodated without degradation or increased maintenance costs will be permitted, unless there is a benefit to be gained that overrides these costs.

### 4.3.2 Resource units

In order to provide a guide to potential uses of the coast the coastal area has been classified into three broad units based on importance to the ecosystem and its capacity to absorb development of use, which are shown on Map 14.

Development unit: Areas which can be developed or used with normal levels of caution and with minimal impact.

Management unit: Sensitive areas with particular ecological, cultural or recreational importance, the development and use of which must be strictly controlled or managed. Development is usually expensive (in both capital and maintenance) and special precautions must be taken to avoid flooding, drainage or erosion problems and to manage human use pressure. Any development or use proposals should be preceded by special planning.

Preservation unit: Areas vital to preservation of the ecosystem, which are intolerant of development and must be preserved and protected from most human activities.

Within this broad land use capability guide, more specific land use zoning and management strategies can be applied.

## 4.4 Planning framework

### 4.4.1 Priorities

Any planned use of a coastal resource should take account of the long term effect on natural ecosystems, landscape, coastal processes and groundwater resources. Priorities for allocation of land uses and financial resources should be based on long term planning not on ad hoc responses to development applications.

### 4.4.2 Funding

Each year a budget item will be created providing for management of resources in the coastal zone under Council's control. Applications for grants from appropriate agencies will be made as the need arises and in the light of the long term plan.

### 4.4.3 Supervision and policing

Council shall employ rangers to investigate and report on management requirements in areas vested in Council and other areas in the coastal zone. Rangers will enforce regulations when appropriate.

### 4.4.4 Land use zoning

Land use within the development unit in or near the coastal area will be zoned to avoid conflicts between incompatible use pressures and users. Basically the zoning recommended in the Broome Town Planning Schemes 2 and 3 is endorsed with exceptions outlined in the plans for the seven coastal management areas.

## 4.5 Access

Though the rationalisation and upgrading of the road, track, carpark and pedestrian path systems, public access to the coast will be controlled and maintenance costs and environmental damage minimised.

Major roads will be restricted to the development unit with appropriately located minor roads providing access to or through the management unit. Tracks in appropriate locations will be upgraded, others will be closed and revegetated. Road and track access to the preservation unit will not be permitted.

Changes to the alignment of Crab Creek, Kavite and Gantheaume Roads will be required to allow more space along the coast for tourism and recreation.

### 4.5.1 Off-road vehicles

Off-road vehicles are frequently used on Broome beaches. Their use may be permitted in the coastal zone providing operators use properly constructed tracks when available, keep off sand dunes and avoid conflict with other beach users. Vehicles may be used between low tide level and the foredune without environmental damage providing proper access to the beach exists. Vehicles should not be used near popular bathing beaches. Use of off-road vehicles can best be controlled by:

- the provision of adequate access to popular points, involving the staged development of the roads, tracks, carparks and footpaths;
- education of the public by providing adequate information concerning the access system and the need to conserve the coastal environment;
- implementation of the provisions of the Control of Vehicles - Off-road Areas Act, 1978.

The coastal management areas as defined in the town planning should be declared a prohibited area for all motor vehicles, with the exception of the designated vehicle access roads, tracks and carparks, and some parts of Cable Beach between low tide level and the foredune.

Four-wheel drive vehicles could obtain access to Cable Beach through the management unit immediately south of Waterback Station, without causing environmental problems. The development of this access route would avoid conflicts with beach users further south.

Use of the access system should be monitored to enable an objective appraisal of existing and potential needs and compliance with regulations.

4.5.2 Carparks

The location and design of carparks significantly influences which areas of the coast are used by people. They can be used as an effective management tool for guiding people into areas best able to sustain use pressure.

Carparks can be sited near beaches, fishing spots, launching ramps and scenic areas, provided account is taken of limiting factors such as sand dune stability, the presence of pindan cliffs or roosting sites of migratory birds, and the existence of industrial development. Carpark locations are shown on Maps 14(a-c).

The design of carparks will affect their construction and maintenance cost and their impact upon the landscape. Diagrams showing recommended typical design for carparks is shown in Appendix ....

4.5.3 Pedestrian access

Random pedestrian access will not be permitted in either management or preservation units though controlled access through management units will be permitted. Pedestrian access will be determined by carpark locations and control will be achieved by the provision of formal fenced pathways and signposting. Major pedestrian access points to the coast are shown on Maps 14 (a-c).

4.5.4 Launching facilities

Development of boat launching facilities which will make boating safe and more pleasant will be encouraged at suitable locations.

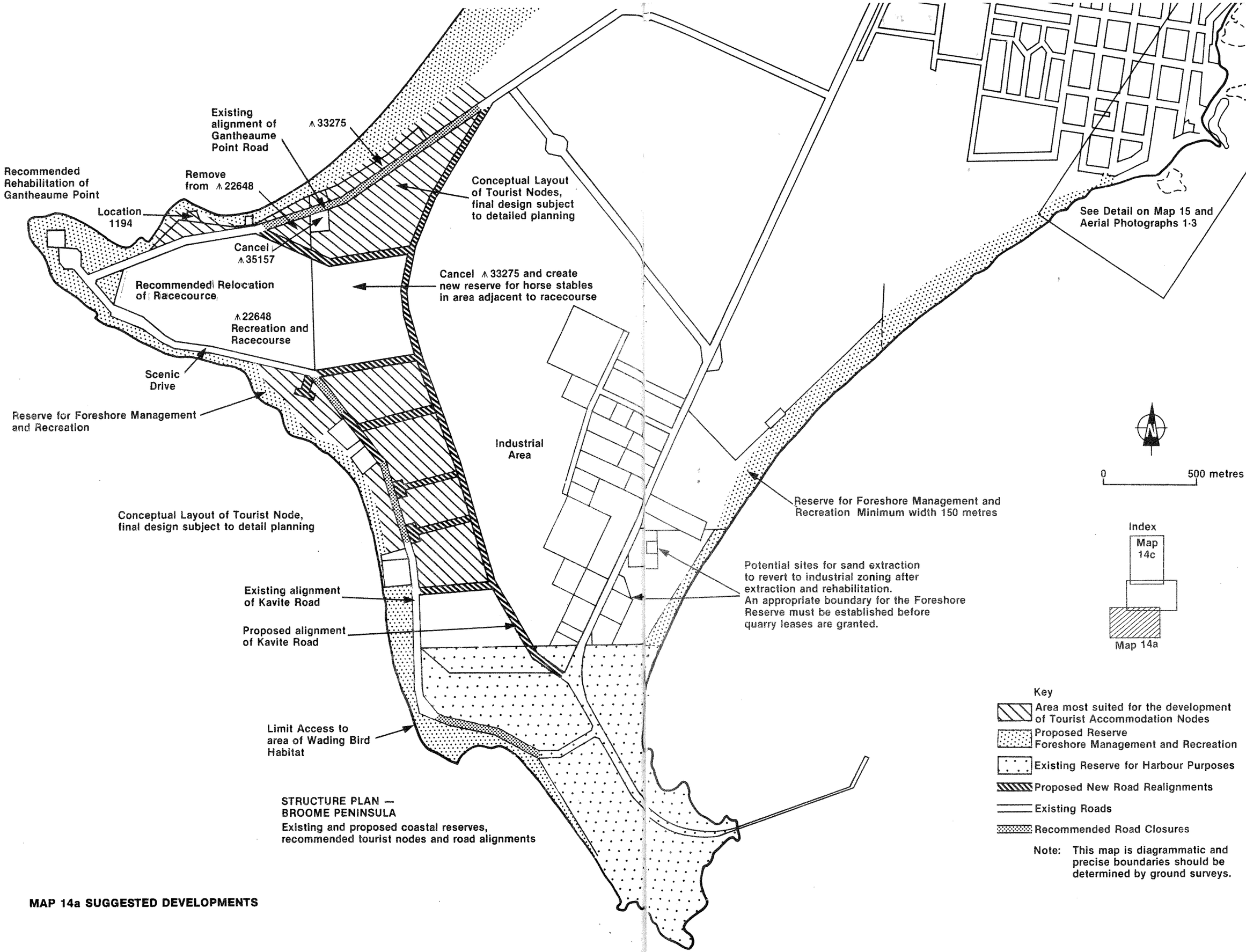
4.6 Developments

Tourist, urban, industrial and commercial developments will generally be restricted to the development unit. Location of tourist facilities and the management unit under special circumstances and appropriate conditions may be allowed.

Development nodes rather than ribbons will be encouraged to isolate management problems in the adjacent management units. Where possible, a buffer zone will be provided between developed areas and management units where uses that do not encourage coastal access are accommodated, e.g. playing fields, golf courses, botanical reserves etc.

Active recreation areas will be restricted to the development unit, e.g. race course, playing fields, ORV tracks and rifle range. Controlled passive recreation will be permitted in the management unit and facilities provided as appropriate, e.g. paths, seats, tables, lookouts etc.

Bearing in mind the tourist potential of Broome preservation of the landscape which is an integral part of the Broome character is an important planning and management factor.




**MAP 14a SUGGESTED DEVELOPMENTS**

Reserve for Foreshore Management and Recreation minimum width 100 metres

Key

- Areas most suited for the development of Tourist Accommodtion Nodes
- Proposed Reserve Foreshore Management and Recreation
- Existing Reserve for Harbour Purposes
- Proposed New Road Realignments
- Existing Roads
- Recommended Road Closures

Note: This map is diagrammatic and precise boundaries should be determined by ground surveys.

Index

Map 14c

Map 14b

Map 14a

Area suitable fo tourist development as specified in tex

Reserve for Foreshore Management and Recreation. Control and manage access

Recommended Reserve for Parkland

N

0 500 metres

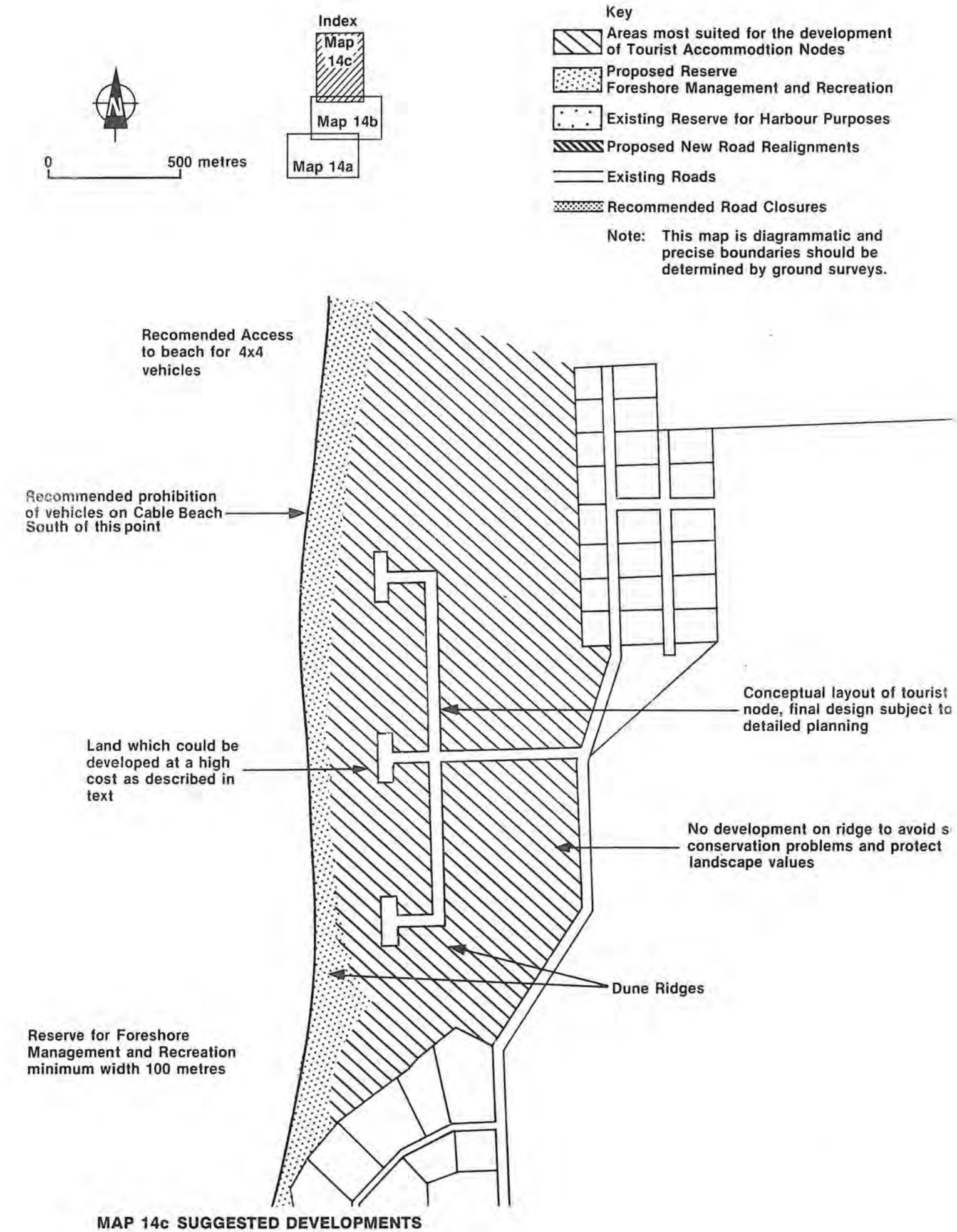
Recommended Reserve for Botanic Gardens and Preservation of Flora

Recommended Reserve for playing fields

Reserve for Foreshore Management and Recreation. Limit and control access

Presevation area — limit access

MAP 14b SUGGESTED DEVELOPMENTS




**MAP 14c SUGGESTED DEVELOPMENTS**

## 4.7 Tourism

Tourism will be encouraged and provided for in a manner that avoids both conflict with residents and environmental degradation. Existing services will be upgraded (litter control, access, shade, tables, chairs etc.) and properly managed.

### 4.7.1 Accommodation

The expected increase and the seasonal nature of tourism, and the type of tourist determine to some extent the accommodation requirements of the future. The WADT studies show that more low and medium cost accommodation will be required in the next five years. Apart from the peak season, adequate caravan park, chalet and hotel/motel accommodation exists.

Hotels/motels: Development of appropriately located, designed, landscaped and managed hotels/motels will be encouraged. In general these facilities would be located in the development unit.

Chalets and Flats: Development of appropriately located, designed, managed chalets and flats, possibly associated with other types of accommodation, will be encouraged. Ideally these will be located in the development unit although parts of the management unit may be suitable.

Caravan parks: The development of caravan parks, possibly associated with chalets and flats, and with provision for overflow facilities will be encouraged. These facilities may occur in the development unit and some parts of the management unit.

Camping: Development of landscaped and managed camping areas possibly associated with caravan parks, will be encouraged. Development of camping areas adjacent to, or intermixed with, existing or proposed caravan parks will be preferred. No informal camping will be allowed.

## 4.8 Siting and design of tourist facilities

The siting of tourist accommodation is a complex issue. Wherever possible facilities should be in attractive locations, with ready access to a safe swimming beach or pleasant views as this tends to extend the average length of stay of visitors, improve the viability of the enterprise and provide extra revenue for the town. Generally, holiday accommodation should be within the townsite as defined in the Town Planning Scheme, or close to it, to reduce servicing costs, avoid fragmentation of the town and improve the overall viability of industries serving tourists. In addition, the centralisation of development would reduce the impact of development on the natural amenity of more remote areas.

Ideally a node developed for tourism near a beach should include:

- a foreshore reserve which will protect the beach and any associated sand dune systems and enable natural coastal processes to occur without threatening developments;

- an area of public parkland which can be improved as the need arises;

- a public access system comprising roads, carparks and properly fenced paths to the beach;

- an area for appropriate holiday accommodation.

Design of such tourist nodes should improve access to popular sites and ensure that people moving between the beach and the parkland, carparks and holiday accommodation do not need to cross any road. This may require the realignment of roads in some locations. Suggested typical designs for tourist development nodes are shown on Figure 2.

Location of suggested tourist nodes Map 14(a-c) shows a number of sites which are considered suitable for tourist accommodation purposes after considering sand dune stability, aesthetics, wildlife and vegetation, beach quality and the location of existing improvements. The cost of servicing these areas requires further consideration.

Town Foreshore: The existing Shire caravan park could be extended into the vacant area adjacent to the meatworks, but this would require some redevelopment of the site. This would increase the capacity and profitability of the Shire park and could provide a considerable number of additional caravan sites in the short term.

A small area of land should be retained as public open space between the caravan park and the meatworks to act as a buffer against noise and odour when the meatworks is in operation and to provide continuing public access between Scott Street and the foreshore if the present meatworks site is redeveloped.

A large portion of the southern end of Reserve 31340 could also be incorporated into the Shire's Caravan Park. (Photograph 13) However, while this would significantly increase the park's capacity, it would also increase management costs. (See Map 15 and aerial photographs 1-3.)

Riddell Beach: Some areas near Riddell Beach could readily be developed for holiday accommodation, while others would be more difficult because of sand dune instability problems, or the existence of pindan cliffs. In addition, portions of Riddell Beach provide valuable migratory bird roosts during the summer. If this area were to be used it would be desirable to realign Kavite Road to provide more space between the road and beach and to allow greater control of access to the coast. The most suitable location for tourist use is shown on Map 14a and typical design and layout are shown on Figure 2.

Gantheaume Point: Areas north-east of Gantheume could be used for holiday accommodation although some problems exist.

The sand dunes on Cable Beach which form an integral part of the coastal system, are potentially unstable and concentrations of people should be carefully located. The land surrounding location 1194 is stable and could be used although any development would have to be carefully designed to protect the landscape integrity of the point and Cable Beach.

The best use of the area could occur if the Gantheaume Point Road were realigned and the existing stables relocated as shown on Map 14a.

Cable Beach (Bali Hai area): Holiday accommodation exists in this area at the Bali Hai Caravan Park and the Education Department camp on Reserve 31354, Suburban Road. More accommodation could be developed south of Bali Hai with little environmental impact if proper coastal management works are undertaken to protect the sand dune system, as shown on Figure 2.

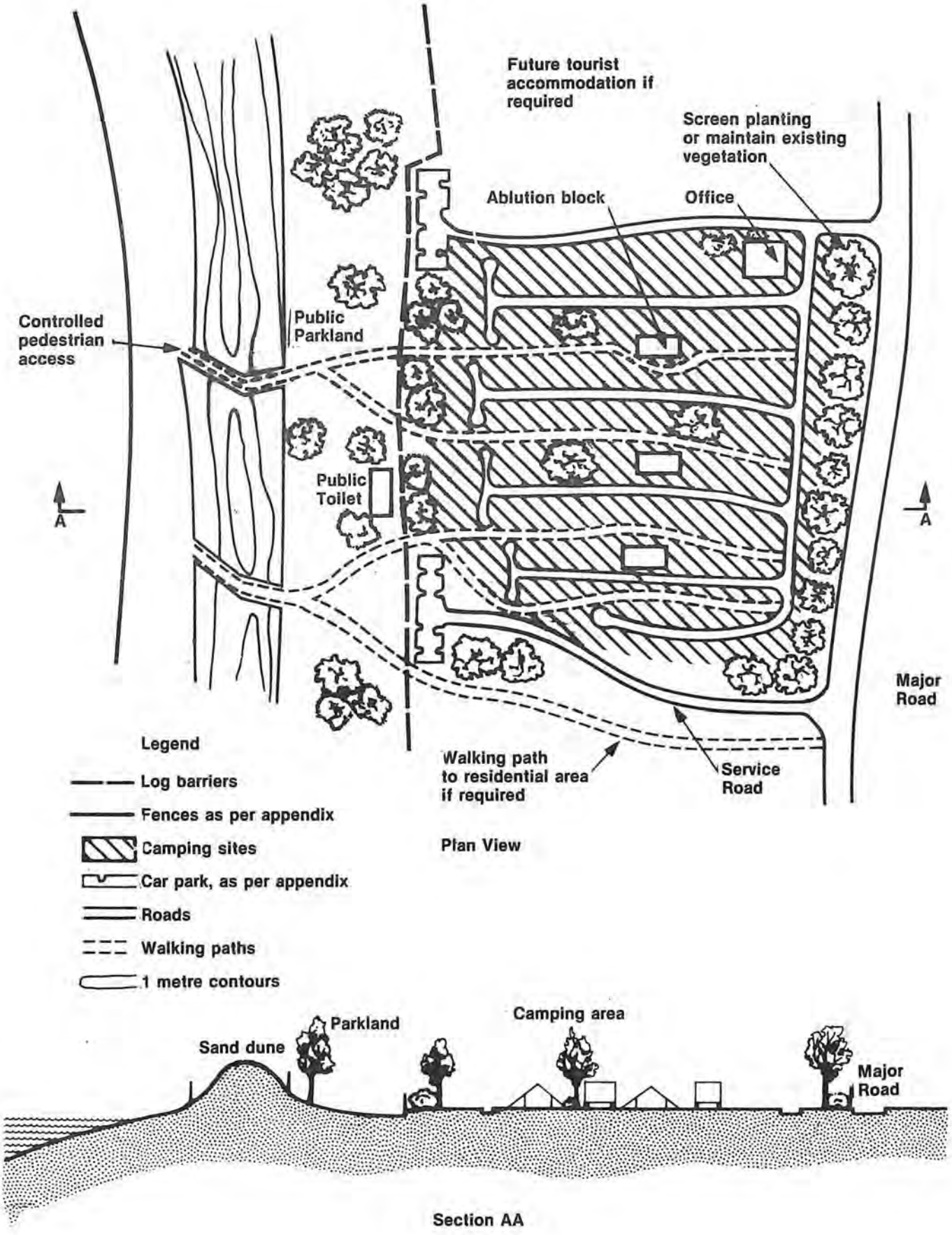
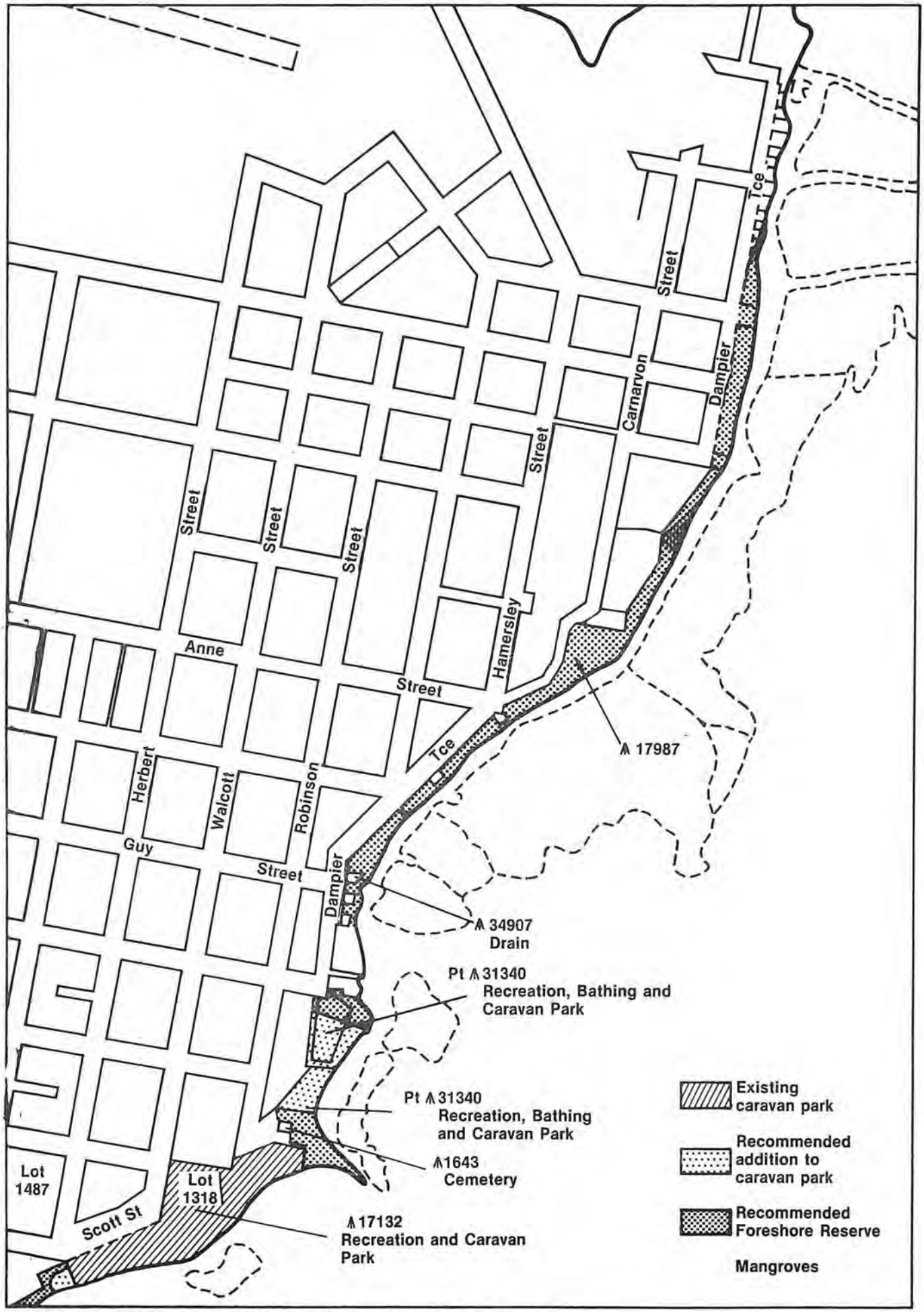



**FIGURE 4 TYPICAL DIAGRAM — TOURIST DEVELOPMENT NODE**




**MAP 15 BROOME FORESHORE — RECOMMENDED RESERVE**

13. Townsite Foreshore with portion of reserve 31340 in the background. This area could be used as parkland or form an extension to the caravan park.

North Cable Beach: North of Bali Hai a large area of relatively flat and stable land lies within a series of dune ridges (see Map 14c). This land is close to the beach, supports a community of large trees and provides an attractive area for development. A detailed study is required to determine the limits of development in this area.

The stabilisation and development of the area would be relatively expensive and any proposal to use it should be accompanied by a foreshore stabilisation plan to be approved by the Commissioner of Soil Conservation and funded by the proponent. (See Figure 5.)

4.9 Urban development

Residential development of coastal land will be limited and not encouraged.

4.10 Industrial and commercial development

Suitably designed, landscaped and located industrial and commercial developments shall only be permitted in the coastal zone if the use is appropriate to the location and if the impact on adjacent management units is acceptable.

4.11 Picnic areas

Development of low-key passive recreation areas and facilities (seating, barbecues, shade trees) at appropriate locations will be encouraged. These can be located in management units.

Areas of parkland and picnic ares could be upgraded or created in parts of the study area. Such a programme would be a long term project with works occurring as demand arises and funds become available.

Management Recommendations (Section A-H)

NOTE: Recommendations should be considered in context of text.

A-B Beach

B-C Reserve for Foreshore Management and Recreation. Should be no less than 100 metres wide. Improvements should be publicly owned and expendable because of storm damage risk. Revegetate and provide controlled access. Rebuild foredune and revegetate primary dunes and provide access to the beach.

C-D Possible development area. This area could be used for low cost expendable developments such as parking areas with tourist facilities as shown on Figure 4.

D-F Area recommended for high capital developments.

F-H With the exception of limited access system development should not occur on the ridge (F-H) to avoid erosion and protect the landscape.

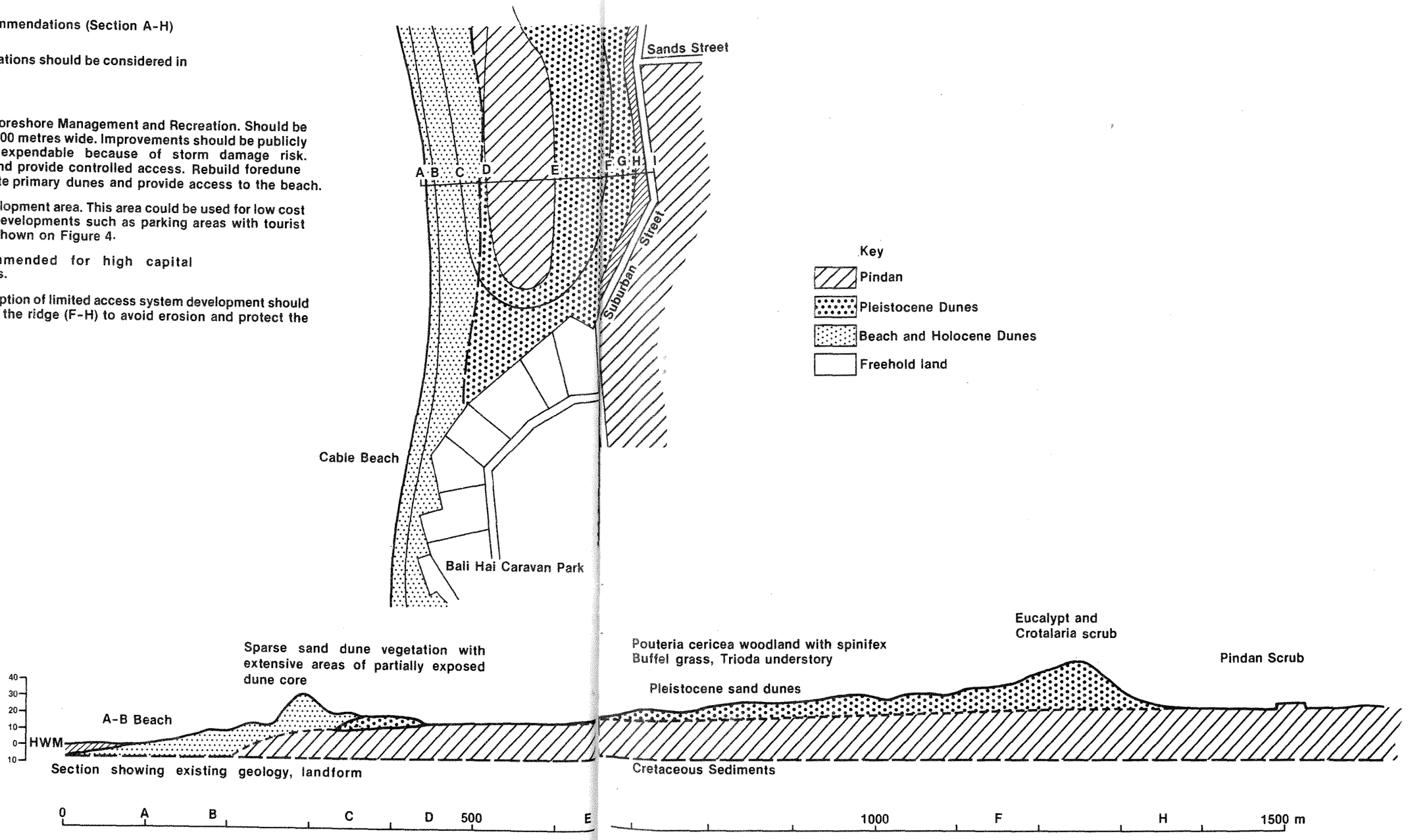



**FIGURE 5 GEOLOGY AND TOPOGRAPHY — UPPER CABLE BEACH AREA**

4.12 Recreational use

Recreational activities which cause least disturbance to natural ecosystems, tourists and residents (i.e. swimming, walking, bird watching, picnics) will be encouraged and catered for in preference to activities that cause more disturbance (ORVs, shooting etc.)

4.13 Landscape management

The coast is a visual resource and only developments which are in harmony with the landscape of the coastal zone will be permitted.

The Broome coastal landscape has many valuable components including established vegetation which would be difficult to replace without considerable expense. The value of coastal vistas can be reduced by careless development, but appropriate structures may contribute to the area's character. Maintenance of landscape values requires several operations including:

Revegetation by planting: Trees and shrubs to provide shade, maintain a tropical atmosphere and improve the amenity of the area. Bearing in mind the tourist potential of Broome, preservation of the landscape which is a major part of the "Broome atmosphere", is an important planning and management factor. Landscaping of newly developed areas should be in sympathy with the existing townscape.

Preserving the seascape by protecting and improving the coastal landscape around Broome. This requires an analysis of existing scenic areas and the rationalisation of features which reduce their appeal. This approach requires further investigation and some other suggested improvements are shown on Figure 6.

Beach management: Beach management programmes will be implemented on popular beaches to ensure that environmental degradation and interruption of coastal process in preservation and management units is minimised while providing residents and visitors with convenient access to, and use of, the beach. This is discussed further in Section 5.

4.14 Soil conservation

Natural soil erosion caused by the wind and the sea has been a major influence in shaping the land forms which exist along the coast today. Man's activities may also produce erosion because the sandy and pindan soils of the area become mobile if the protective vegetation is removed.

Erosion degrades the landscape and creates engineering problems when roads become impassable because of drift sands and gullying. When foredunes erode, beach sands become mobile and blow inland, burying the vegetation and man's improvements. In addition when sand is lost from the beach, the beach sand cycle is interrupted, increasing the risk of sea erosion and reducing the area and amenity of the beach.

Where pindan soils erode they muddy and colour the beach and nearby waters, reducing their amenity and recreational values.

Poor soil fertility, relatively low rainfall, high temperatures and the excessive drainage in drift sands makes the revegetation of eroding areas difficult and expensive, therefore the prevention of erosion is important.

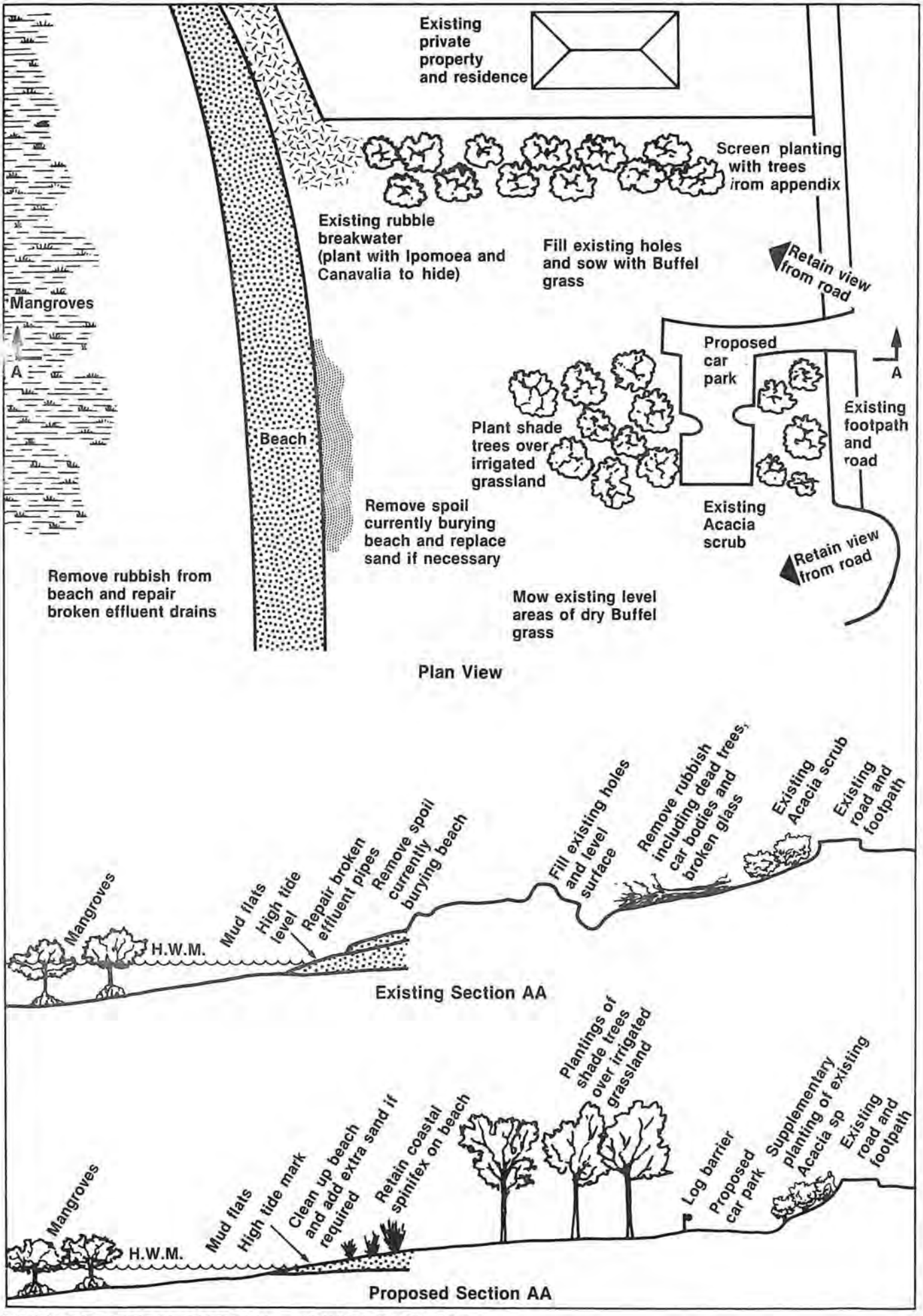



**FIGURE 6 TYPICAL DIAGRAM — TOWN FORESHORE**

The control of erosion in the area is the responsibility of the Shire of Broome. The Department of Agriculture will provide advice if required.

Recommendations

In accordance with the recommendations of the Commissioner of Soil Conservation, Council adopt a long term programme to stabilise eroding areas and reduce activities which may contribute to erosion. Some elements of this programme are described below.

. The foredune stabilisation programme which has been undertaken on Cable Beach should continue. This work could be funded by the Community Employment Programme, with assistance from DCE. Prison labour could be used.

. The mining of foredunes should be prohibited because of possible future erosion risk. Quarries should be closed and the pits reshaped and sown with Buffel grass seed at the rate of 4 kg/ha. Seed should be allowed to mature for six months before sowing. It should be sown dry and treated with Lindane to prevent ants harvesting the seed. Fertiliser should be applied in the form of superphosphate at the rate of 100 kg/ha. The seed should be sown on the surface and lightly covered with soil by harrowing or hand raking.

  New pits should be sited after consultation with the Commissioner for Soil Conservation.

  Gravel pits between the Crab Creek Road and Roebuck Bay result in the siltation of beaches and a loss of amenity. If possible, gravel extraction should be limited to pits further from the coast and existing pits should be stabilised by the reshaping of batter slopes and erosion gullies and sown with Buffel grass as outlined above.

. Usually erosion can be prevented if the vegetation cover is maintained and roads, carparks and beach access systems are well designed and carefully constructed.

  When vegetation is removed to allow development, areas of bare soil must be surfaced with gravel or revegetated. Where pedestrians require access from carparks or camping areas to beaches, properly designed beach access systems are required. Normally these will include clearly defined and fenced pathways which protect dune vegetation from trampling. When paths cross sandy slopes they should be surfaced with gravel or a board and chain pathway. On steep slopes steps may be required.

  Fences are best constructed of pine log rails which provide an effective but aesthetically acceptable barrier. Some situations may require a stronger barrier and agricultural type fences should be used.

  Signs discouraging people from driving vehicles from the beach onto the sand dune system should be erected at selected points along the foreshore.

  When private interests develop sites near the coast for tourist purposes they should contribute to the cost of stabilising and protecting the sand dune system.

## 4.15 Fire management

The vegetation of Australia has evolved in the presence of fire and plants use a variety of strategies to survive burning. Some plants regenerate vegetatively from parts of their roots and stems, while others recover by means of seeds stored on the plant or in the soil. However, sand dune communities recover slowly after fire and the erosion risk is high until the vegetation recovers, which may take several years. The danger of erosion is higher if the area is subject to intensive public use. As a result it is considered that management should attempt to exclude bushfire from the dune areas and if fire does occur it should be confined.

Recommendations

The following programme is recommended to reduce the risk of widespread damage by fire.

- The lighting of fires in coastal management areas should be prohibited except in properly constructed fire places.
- The public education programme should include information concerning the danger of fire in the area, and the responsibilities of people in relation to the lighting of fires.
- The roads, tracks and carparks in the area can be used as fire breaks, and the appropriate location of fire breaks should be considered when locating roads.
- The Shire should develop its fire fighting capacity by periodically obtaining and upgrading equipment. Provision should be made for training Council staff in fire fighting techniques.
- A fire management plan for the Broome townsite should be prepared in co-operation with the Bush Fires Board and surrounding landholders. The plan should specifically exclude burning off in the foreshore reserves under the provision of Section 21 of the Bush Fires Act.

## 4.16 Wildlife management and research

As outlined in Section 3.0 the Broome district supports wildlife habitats of international, national and regional significance and significant commercial fish stocks. Further research is required before the life history and requirements of these animals can be identified properly.

However, it is known that the important wading bird populations which use the district each year can be assisted if unnecessary disturbance by people is avoided. This can be achieved by retaining natural vegetation cover between coastal roads and the beach, and by limiting public access to areas frequently inhabited by the birds.

Recommendations

- That Council develop the coastal access system which will minimise the disturbance of wading birds.
- That DCE investigate the impact of shell collecting on mollusc populations.

. That the Department of Fisheries and Wildlife or the CSIRO Division of Wildlife Research undertake research into the dugong population of the region.

4.17 Shellfish

The status of shellfish populations is of concern, and more information is required before positive management proposals can be made.

Recommendations

. Council and DCE will endeavour to arrange research to determine the number of commercial and amateur collectors, their methods and timing, location of collection sites and species involved.

. Advice will be sought from the WA Museum and Fisheries and Wildlife Department about the feasibility of establishing marine reserves.

4.18 Waste and garbage disposal

The presence of rubbish litter and liquid wastes reduces the amenity of coastal areas. Council will continue to upgrade services required to control these problems.

Recommendation

. A system of garbage collection and waste disposal will be developed to ensure that litter and pollution of resources is minimised.

4.19 Drainage

Stormwater drainage should not be discharged directly into a preservation unit. Where possible, developments should be planned so that sufficient space is left for natural treatment by soil fertilisation and vegetated purification.

Recommendations

. All discharge points should be identified by Council and information about the volume and content of effluents should be collected.

. Solid waste disposal sites should be located away from preservation and management units and away from water drainage courses.

4.20 Conservation

Preservation units will be set aside to preserve and conserve nature flora and fauna for their environmental, scientific, commercial or recreational values.

Where possible, preservation units will be set within a buffer zone or management unit. Areas warranting special preservation are shown on Map 14.

Recommendation

. That Council approach the Minister for Lands seeking his approval to create reserves over areas of special value and which should then be vested in appropriate agencies.

4.21 Public education

The Council's public education programme could be part of a wider proposal for the region, the objectives being to guide visitors, interpret the natural features and to influence the behaviour of people.

Recommendations

. That with assistance from DCE, Council will inform local residents and visitors about the natural and man-made attractions of the district, where to find them and how to use them in an appropriate manner, by -

. preparing a pamphlet containing details of roads, paths, boat launching areas, fishing spots, caravan parks, beaches, wildlife and picnic areas, cultural and natural attractions; the pamphlet should also contain information about the proper use of vehicles and boats in the district;

. encouraging the Shire Ranger to develop his interperative skills to assist in his public education role;

. erection of well designed signs at appropriate locations;

. continuing contact between Shire staff and the public.

4.22 Mangroves

The mangrove communities are recognised as important coastal resources worthy of conservation.

Recommendations

. Disposal of wastes (liquid and solid), quarrying and clearing of vegetation will be avoided in the mangals and adjacent tidal flats.

. Where possible increased discharge of stormwater into Dampier Creek tidal flat will also be avoided.

. Care will be taken to ensure that land uses adjacent to mangrove communities will not be incompatible with the mangrove environment.

4.23 Broome townsite, off-shore waters management

As outlined in Section 3.4 the waters of Roebuck Bay are used by commercial and amateur fishing boat owners, yachtsmen and anglers and bathers. This multiple use can create user conflicts between boat owners and bathers at Town Beach, and use should be rationalised at that point.

Recommendations

That separate zones for swimmers and boat users be established at Town Beach, with bathers using the southern half of the beach and boat owners the northern half. This can be achieved by using the Navigable Waters Regulations, of the West Australian Marine Act.

## 5.0 PLANNING AND MANAGEMENT STRATEGIES FOR SPECIFIC COASTAL MANAGEMENT AREAS

### 5.1 Coastal management area 1

Coastal management area 1 covers Cable Beach south of Bali Hai. The major feature is a long white sandy beach which links two basement outcrops at Gantheaume Point and Bali Hai and is backed by partly vegetated and stabilised transgressive dunes. The beach is popular with residents and tourists and pressure for access to all paths of the beach is increasing. Near Bali Hai sub division of coastal land has been allowed for caravan park, recreation camp and for private residential and horticultural purposes. To the south legal and illegal horse-training facilities lie adjacent to the dunes. A coast-parallel road skirts the inland margin of the dunes for the length of the beach. The pindan plain, which is obscured beneath the dunes, is cliffed at Bali Hai and near Gantheaume Point.

As Cable Beach is one of the prime tourist attractions at Broome, pressure for more accommodation and access to the beach has increased. The land south of Bali Hai is suitable for carparks and beach access as is similar land at the southern extremity. The pindan adjacent and inland of the dunes is well vegetated and is suitable for camping, botanical gardens and picnic sites. Playing fields on this land would provide a buffer between the residential development and the dunes.

Maps 7-15 show existing roads, land tenure, use and zoning with proposed land classification, roads, tracks, carparks and pedestrian access points, land tenure and zoning. Works that are required include:

- creation of a foreshore reserve for the purposes of controlling access in the dune areas and to enable soil conservation measures to be implemented;
- realignment of the coastal road;
- relocation of Reserve 33275 for horse stables;
- downgrading of the loop road to Gantheaume Point;
- resumption of two freehold blocks at Gantheaume Point to foreshore reserve;
- zoning of land between the coast road and foreshore reserve for purposes of active recreation (i.e. playing fields, golf), future carparks, picnic areas and beach access related activities, botanical gardens and tourist development;
- realignment, revegetation and formalising of drainage and access in the gully at Bali Hai;
- closure and rehabilitation of the Hill 22 quarry;
- implementating a dune stabilisation programme.

### 5.2 Coastal management area 2

Coastal management area 2 covers Gantheaume Point where the coast comprises a cliffed pindan plain that is fronted by basement platforms of

various widths. At high tide the red cliffs contrast with deep turquoise waters while at low tide dinosaur footprints 130 million years old are exposed. The coast provides many spectacular lookout points. The hinterland comprises a race course reserve. The lands on either side of the loop road are a recreation reserve that has been downgraded due to quarrying for laterite and pedestrian pressure around the point. The coastal lands in this area which have access to the southern end of Cable Beach and to the beach at Riddell Bay, as well as potential for coastal walks, will come under pressure as a result of increased tourism and a requirement for new coastal accommodation. Maps 7-15 show existing roads, tracks, tenure and zoning, as well as proposed land units, roads, tracks, carparks, pedestrian access points, foreshore reserves, tenure and zoning. Proposed works that are required include:

- downgrading of the loop road to Gantheaume Point;
- re-shaping and revegetating of the quarried areas;
- provision of carparks and pathways to allow public access to the cliffs and to scenic vantage points;
- resumption of freehold land;
- vesting of Reserve 19289 in Council for purposes of foreshore management and recreation;
- relocation of the race course away from the coast. This need not take place now but should be seen as inevitable once other desirable and suitable coastal lands have been fully utilised for appropriate uses. A race course is not dependent on a coastal location and should not be located in the coastal zone. The site is appropriate for low-key camping, caravan park, chalets or for hotels and motels, fun-parks etc.;
- repair of the model dinosaur's footprint and development of associated interpretative material to improve its tourism and educational value;
- rezoning of part of the Crown reserve at the southern end of Cable Beach for the purposes of tourist development.

## 5.3 Coastal management area 3

Coastal management area 3 takes in the coast around the Broome township. Major features include a belt of tidal flats and mangroves near the entrance to Dampier Creek, a coarse sandy beach that fronts a low pindan cliff along most of the coast and a large dune and lookout hill. The pindan hinterland is generally lowlying (less than 10 m) and is subject to flooding. The coast is eroding, and is subject to cyclonic winds, waves and storm surge and as such is an important buffer zone. Most of the near coastal land has been developed with uses varying from residential, commercial and industrial (pearling and meat industry) to quarrying, carparks and motels.

Currently the coastal strip that extends from the Pioneer Cemetery in the south to the intersection of Napier Terrace in the north comprises vacant Crown land and a number of reserves between Dampier Terrace and Roebuck Bay. While landscaping has occurred in some locations this piece of foreshore, which is valuable both as a buffer against storm attack and a recreational resource, is generally neglected and detracts from the appearance of the town. The narrow coarse sandy beach that exists at

high tide has been buried at a number of sites by earthworks and the mangroves have been cleared and degraded.

As well as providing protection the Dampier Terrace esplanade could be made much more useful to local people including children and more attractive to tourists by a modest programme of improvements.

Maps 7-15 show existing roads, land tenure, use and zoning with proposed land classification, roads, carparks, pedestrian access point, land tenure and zoning. Works that are required in the area include:

- creation of a foreshore reserve to formalise management requirements and to enable control access;
- initiation of a foreshore improvement plan to upgrade areas of foreshore for residential and tourist use, and implementation of beach protection measures to upgrade the zone as a buffer against storm attack;
- upgrading of the townscape to enhance the Broome character and to improve the quality of the landscape.

To preserve Broome's atmosphere, a landscape management plan should be prepared with four basic components:

- town foreshore and beach reserve parks
- road verges
- supplementary planting
- residential planting

This plan contains a number of recommendations relating to the town foreshore and proposed beach reserve landscaping. However the other components have not been analysed in any detail and require further assessment.

### 5.3.1 Foreshore improvement

A detailed foreshore plan should be prepared in consultation with Council, DCE, PWD and Soil Conservation Service. Work could be staged to provide a substantial initial improvement cheaply. More costly works could spread over a longer period which would result in a continual upgrading of the area.

This would include surface grading, grassing and planting of appropriate tree species, and removal of rubbish from the foreshore reserve. Initially all rubbish should be removed, the entire area graded and sown with dryland grass species. Irrigated lawn and plantations containing suitable tree species would be located on important areas and expanded as funds become available.

All plantings would be undertaken in consultation with staff from the Broome Nursery. A typical landscape plan is shown on Figure 4 and suitable tree species are listed in Appendix 2.

### 5.3.2 Beach protection and replenishment

The beach adjacent to the foreshore reserve has been affected by past earthworks and improvements could be undertaken as a part of the proposed foreshore landscaping.

It may be feasible to improve the amenity of the foreshore further by increasing the beach area by way of a sand replenishment programme. The cost of such works would depend upon the availability of sand and the need for any associated engineering works. The project would involve removing spoil which covers areas of the natural beach as part of the foreshore and landscaping programme, as outlined in Section 5.3.1. It would be desirable to seek the advice of the Harbours and Rivers Branch of Public Works Department about the feasibility of a beach sand replenishment programme.

### 5.3.3 Upgrading the townscape

Past tree and shrub plantings in the older parts of Broome have contributed to the character of the landscape. Future planting in old and new areas should be in sympathy with this character. Trees and shrubs may be planted to:

- give edge definition to open space;
- enclose appropriate spaces at various locations;
- improve shade and shelter for the town's inhabitants and visitors;
- provide more privacy in residential areas by creating screens and partitions;
- add to the green tropical character of Broome which is an important tourist attraction;
- upgrade the appearance of the town by providing visual relief and softening the starkness of man-made surrounds.

It is most important to select appropriate plant species in any landscape programme, and the harsh tropical coastal environment of Broome makes this even more important.

## 5.4 Coastal management area 4

Coastal management area 4 covers Riddell Beach. The major features are red pindan coastal cliffs and two shallow bays linking basement outcrops at Gantheaume, Riddell and Entrance Points. Sandy beaches which front the pindan cliffs are generally narrow and red-stained, though a white sandy beach backed by a foredune does exist in front of the children's hostel. Dunes perched on top of the pindan cliffs south of the hostel reserve have been quarried in the past disturbing vegetation and providing random access to the beach. The beaches provide an important summertime roosting habitat for migrant waders. Near Riddell Point the coast road runs very close to a steep though stabilised dune. Further north the road runs approximately 100 m inland. The coastal strip is a Crown reserve with several small reserves vested in charitable organisations. To the north, subdivision of the hinterland has been approved though development has not taken place as yet. Because the coast is robust the area could provide opportunity for appropriate development; it is adjacent to the beach and is not far from Cable Beach to the north. Maps 7-14 show existing roads, land tenure, use and zoning with proposed land classification, roads, tracks, carparks and pedestrian access points, land tenure and zoning. Proposed works that are required include:

Meatworks

STREET

Proposed Extension
To Caravan Park

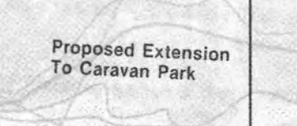
Existing Caravan Park

Proposed Foreshore
Reserve

High Water Mark

ROEBUCK

Index




**TOWN FORESHORE**



Customs House
(Historic Site)

Proposed Parkland

Proposed Extension
To Caravan park

Pioneer Cemetary

Existing Parkland

Town Beach

Launching Ramp

MANGROVE POINT

STREET

DAMPIER

Continental Hotel

10

NOSNIBOR

Proposed Foreshore Reserve (Parkland)

lot 1323

34907

Carpark

Bedford Park (Historic Park)

TERR

Proposed Foreshore Reserve (parkland as per Figure 6. )

Remove rubbish from Beach and repair broken effluent drains

High Water Mark

lot 451

lot 601

STREET

STREET

17987

Key

Major View

Index

1

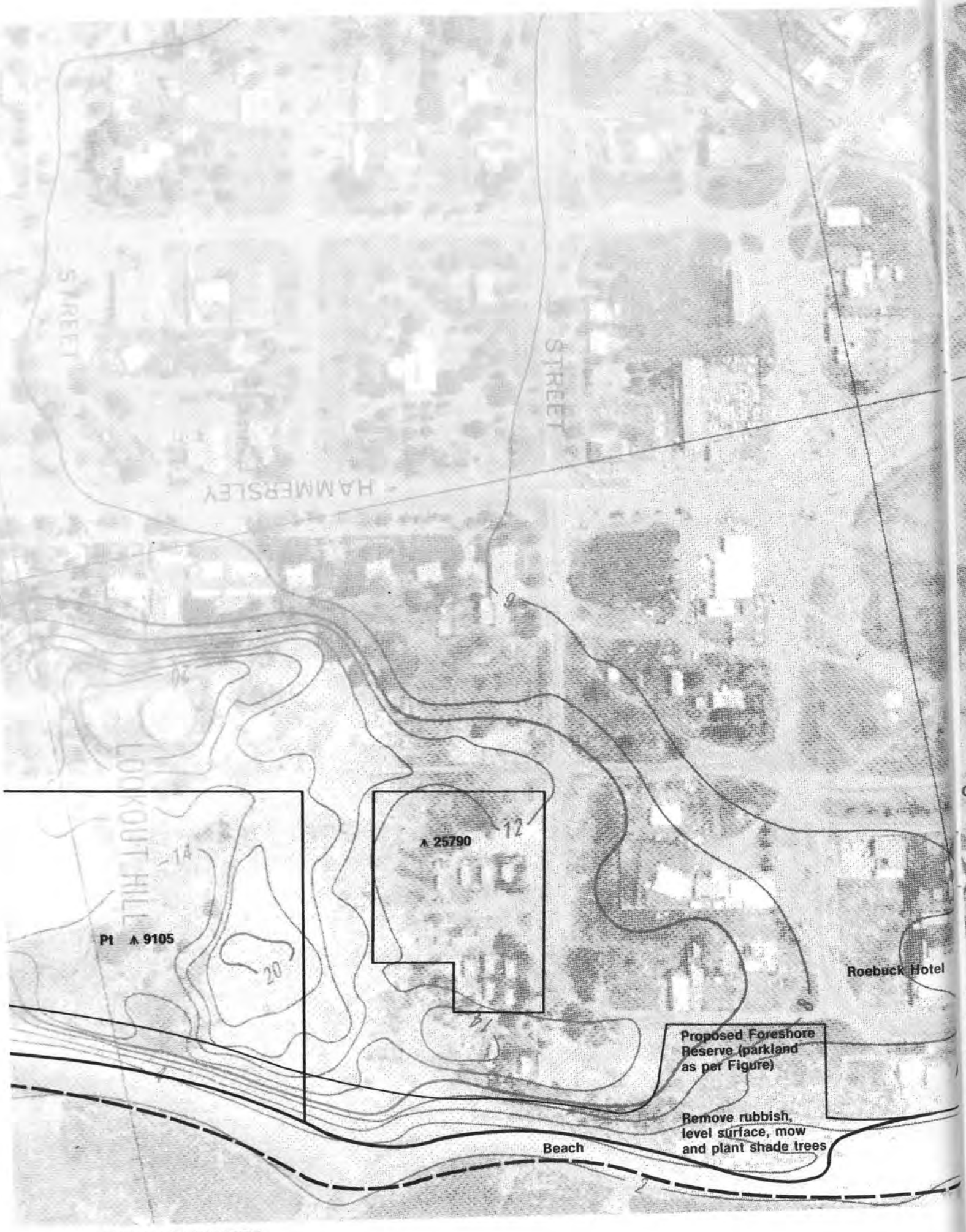
2

3

Mangrove Motel

Pt 9105

TOWN FORESHORE




TOWN FORESHORE



- creation of a foreshore reserve for the purposes of controlling access to the coastline;

- realignment of the coastal road inland and provision of road access to the coast;

- rezoning of industrial and Crown land adjacent to Riddell Beach for tourist development;

- closure of the southern extremity of Kavite Road to limit access to the migrant wading bird roosting beaches. Appropriate signposts should be erected.

## 5.5 Coastal management area 5

Coastal management area 5 covers the coast between Broome townsite and the harbour. A major feature is a gently curved bay linking basement outcrops near Entrance Point and at the Council caravan park. A band of dunes that thins towards Broome lies inland of a coastal pindan cliff. The beach is not particularly attractive and access to the shore is limited as the pindan hinterland is zoned for golfing and industrial uses. The remainder of the land is Crown land with the exception of a narrow strip of foreshore reserve along part of the coast. The road between Broome and the harbour lies several hundred metres inland. The area is not popular and is not in any great danger of erosion. The presence of a major deposit of sand which could be quarried is perhaps the major asset. Due to its proximity to the harbour and the industrial zones, this area should be zoned industrial. Maps 7-15 show existing roads, land tenure, use and zoning with proposed land classification, roads, tracks, carparks, boat launching sites and pedestrian access points, land tenure and zoning. Works that are required in the area include:

- creation of a foreshore reserve for the purposes of controlling access in the dune area;

- zoning of the inland margin of the dunes for extractive industries under the supervision of the Commissioner of Soil Conservation. At completion of quarrying the lands should convert to industrial zoning;

- rezoning of land adjacent to the golf course to industrial (after quarrying) in exchange for industrial land rezoned for tourist development in coastal management area 4.

## 5.6 Coastal management area 6

Coastal management area 6 covers Cable Beach between Bali Hai and Willies Creek. The major features of this area are the continuation of the sandy beach, a wide zone of mostly vegetated sand dunes and a broken chain of nearshore limestone reefs. At present use is limited to the beach immediately north of Bali Hai though vehicle access can be gained near Coconut Well and Willies Creek. Near Bali Hai a subdivision of the pindan plain and the inland dune ridge for horticultural blocks has occurred. Further north on Waterbank Station the hinterland comprises an abandoned tidal flat. Near Coconut Well the pindan plain, which has also been subdivided, is close to the coast. Roads are limited to Suburban Road near Bali Hai and near Coconut Well. There is no coast-parallel road in the area. The area may offer one of the best development opportunities near Broome. Not only is the beach wide, white and sandy

with dunes subdued and well vegetated but a window of pindan which forms the bottom of a coast-parallel hollow offers a protected and safe site for development. With careful planning and management the southern portion could be developed as tourist node. There is also the opportunity in the future to construct a coast-parallel road to provide access to the north and so take the pressure off southern Cable Beach. Maps 7-15 show existing roads, land tenure, use and zoning with proposed land classification, roads, tracks, carparks, pedestrian access points, land tenure and zoning. Works that are required in the area include:

. a more detailed study of land capability in the area;

. creation of a foreshore reserve to control access in dune areas and enable soil conservation works;

. implementation of a dune stabilisation programme where appropriate;

. signposting clearly use-categories of the beach, i.e. for swimming, no dogs, no vehicle access, no nude bathing etc., to avoid conflict between users;

. zoning of land in the dune hollow for potential tourist development;

. rezoning of parts of the freehold lots that lie within the foreshore reserve (i.e. above the 20 m contour), so that any development is subject to Council approval and to the satisfaction of the Commissioner of Soil Conservation.

## 5.7 Coastal management area 7

Coastal management area 7 comprises the coast between Dampier and Crab Creeks. Major features are Dampier Creek tidal flat and mangroves, a broken but generally straight coast of pindan cliffs fronted by narrow red-stained beaches terminating in a narrow curved sandy spit at Crab Creek and a large supratidal tidal flat and mangrove system. Dampier Creek is utilised at present as a lugger harbour and much of the cliff coast has been quarried for laterite. The rest of the coast is only occasionally used by illegal campers, squatters and visitors. There has been no development of coastal land apart from the area around the western margin of Dampier Creek. Access is provided by a coast parallel track which is within metres of the cliff top in some places. The coast has two habitats vital to the ecosystem, Dampier Creek and Crab Creek, while the sandy beaches are important for migrant waders. There appears to be limited opportunity for tourist development due to the lack of sandy beach though the pindan hinterland would provide a safe site for near coastal developments. The land east of Dampier Creek is at present reserved for the use and benefit of Aborigines. Maps 7-15 show existing roads, land tenure, use and zoning with proposed land classification, roads, tracks, carparks, boat launching sites and pedestrian access points, land tenure and zoning. Works that are required in the area include:

. creation of a foreshore reserve for the purposes of controlling access to the cliffed coast;

. realignment of the coast-parallel track;

. provision of formalised access tracks and carparks and lookouts, beach access and boat launching sites;

- consolidation of the interests of the Aboriginal people in accordance with Aboriginal Land Inquiry;

- closure of all tracks around Dampier Creek tidal flat to ensure protection of the tidal flat and mangrove system;

- rationalisation of the laterite quarrying operations along this coast; although no pressure exists at the moment, consideration should be given to future laterite quarrying;

- construction of a formalised carpark and access track to the sandy beach at Crab Creek;

- elimination of access tracks along parts of the coast that are important to the migrant waders.

5.8 Port area

Although not included in the Town Planning Scheme, management recommendations for the port area should be included in this plan. The port area includes a rocky and cliffed coast with a 24 m high sand dune (Beacon Hill). The rocky coast near Entrance Point offers one of the few good boat launching sites and the coast and wharf are popular fishing spots. The area has been extensively modified during construction of the grain terminal and other harbour-related storage facilities. Further north the land is flat apart from the dune belts along both the Riddell and Roebuck coasts. Although it is expected that harbour works require extensive modification of landscapes there is no need to affect the coastal landscape. Conversely harbour works can suffer from natural processes that lead to continual maintenance. The dunes in the area, excluding those in the foreshore reserve, would be available for quarrying. Maps 7-15 show existing roads in the harbour area as well as proposed land classification, roads and tracks and pedestrian access points. Works that are required in the area include:

- creation of a foreshore reserve for the purposes of maintaining the integrity of the dune areas and also coastal landscapes. This reserve would be vested in the Department of Marine and Harbours though works would require the consent of Council, Soil Conservation Service and DCE;

- realignment of Kavite Road and closure of the southern extremity of the road which provides access to the southern end of Riddell Beach;

- provision of access to and upgrading of Entrance Point boat launching site.

## 6.0 PROPOSED RESEARCH

It is clear from this report that there is much to learn about the natural environment at Broome. From experience and results of studies elsewhere, parallels between Broome and other environments can be drawn that enable management decisions to be made. Further research will probably not change the direction of management but may change emphasis and priority. Management proposals on protecting the integrity of the dune/vegetation system, mangrove/tidal flats system, wading bird habitats, have been made in the light of existing knowledge. In order to refine management techniques further research into the effects of shellfish collecting, drainage discharge into mangroves and protection of wading bird habitats is warranted if funds can be

found. Of more immediate concern to Broome is the status of Cable Beach which, as previously mentioned, is probably a temporary and fragile anomaly. Establishing how temporary and how fragile in the light of its tourist potential appears to be a priority. The following research programme is recommended:

- The first priority is to establish the bedrock and pindan profile beneath Cable Beach and its immediate hinterland. This can be done by hand or power drilling and will enable an estimate of the thickness and volume of Holocene sands and the proximity of a pindan cliff, if any, behind the beach. Hopefully, the Holocene sands will prove to be thick and the pindan well covered. If not, action to preserve what sand there is should be taken and the Council alerted.

- The amount of sand offshore which is still available to come onshore can be estimated by grab sampling and seabed coring (scuba and slip hammer). This would give some idea of the potential for natural sand addition to south Cable Beach.

An estimation of longshore transport on Cable Beach could be made by drilling and dating the beach ridges at Willies Creek. If the dating is successful the volume of sand in the ridges can be estimated and the rate of accumulation of sand calculated. This will put the volume of sand at south Cable Beach into perspective in relation to annual rates of transport to the north. If this research is carried out, a quantitative estimate of the sediment transport budget will be possible. This should give a good idea of the potential 'stability' and 'length of life' of Cable Beach.

The rate of erosion of the pindan cliffs around the coast should be measured. A number of steel pipes or rods could be hammered into the cliffs around the coast and the amount of exposure of the rod measured by a local resident every month or so for the next few years. This will help in determining the actual range of erosion rates of the pindan cliffs at a variety of locations around the coast.

## 7.0 IMPLEMENTATION

Implementation of this Coastal Management Plan, which will enable a co-ordinated approach to planning and management, is primarily the responsibility of the Broome Shire Council. The first step in implementation is to consider this Draft Plan. The second is to process comments from Council, residents and other interested bodies involved in planning and management at Broome, so that a final Management Plan can be prepared. The third step is to adopt the final Management Plan and any recommendations and proposals it may contain.

### 7.1 Role of the State Government

As set out in the Government Position Paper on Coastal Management, the State Government is committed to sound planning and management of the WA coast. A Coastal Management Co-ordinating Committee has been set up and its functions are outlined on page ....

Various government authorities can provide advice and financial assistance for management of the coast.

## 7.2 Role of local Government

Coastal management plans are generally prepared by or in conjunction with the local authority who can provide and co-ordinate local public participation. Local authorities can fulfil an important role in the management of coastal lands provided that they are given technical assistance and financial incentives. In many cases this is advantageous as the local authority has local knowledge, equipment on site, an existing land management role, and an established liaison with State government departments. One of the important aims of this Management Plan has been to provide a guide to potential uses of various land areas and to recommend management strategies in the coastal zone so that the Broome Shire Council can become involved in management of lands under its jurisdiction.

## 7.3 Funding

Finance is required to implement land management programmes. Currently much of this cost is being borne by the Shire, with occasional assistance from State government departments. Hopefully the Coastal Management Co-ordinating Committee will be able to co-ordinate applications for finance through various government departments so that adequate and long term funding can be ensured.

As the question of funding is difficult, proposals that require only administrative changes (i.e. reserve vestings) can be addressed immediately.

As for proposals that do require funding, the existing system of shire management funding, supplemented by grants from appropriate government departments in the context of a long term plan, should prove sufficient to initiate management and development proposals for areas under most pressure.

In the present climate of tourist promotion and unemployment relief, the two bodies that should be approached immediately are the State Tourist Commission and the Commonwealth Department of Labour and Industry. Other State government departments that do provide grants include: the Department of Youth, Sport and Recreation (community sport and recreation facilities fund); Main Roads Department (tourist road grants); DCE (beach management grants); Department of Agriculture (soil conservation grants); PWD (foreshore and erosion repair grants). As mentioned in the introduction to this report, experience indicates that applications for funding are likely to be more successful if presented in the context of a long term management plan. The fact that a Coastal Management Plan has been prepared and accepted by Council should assist these agencies in making funds available.

## 7.4 Crown land vesting

The implementation of this plan would require changes to the vesting of many areas of Crown land. These will be outlined in the final report after comments in the draft have been considered.

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## APPENDIX I WILDLIFE-BROOME CRAB CREEK AREA

### Wading Birds

Beach Thick-knee
Pied Oystercatcher
Sooty Oystercatcher
Grey Plover
Lesser Golden Player
Mongolian Plover
Large Sand Plover
Oriental Plover
Redcapped Pluver
Blackwinged Stilt
Ruddy Turnstone
Eastern Curley
Whimbrel
Greytailed Tatler
Common Sandpiper
Greenshank
Terek Sandpiper
Blacktailed Godwit
Bartailed Godwit
Red Knot
Great Knot
Sharptailed Sandpiper
Rednecked Stint
Curlew Sandpiper
Sanderling

### Animal species known from mangroves

#### MAMMALS

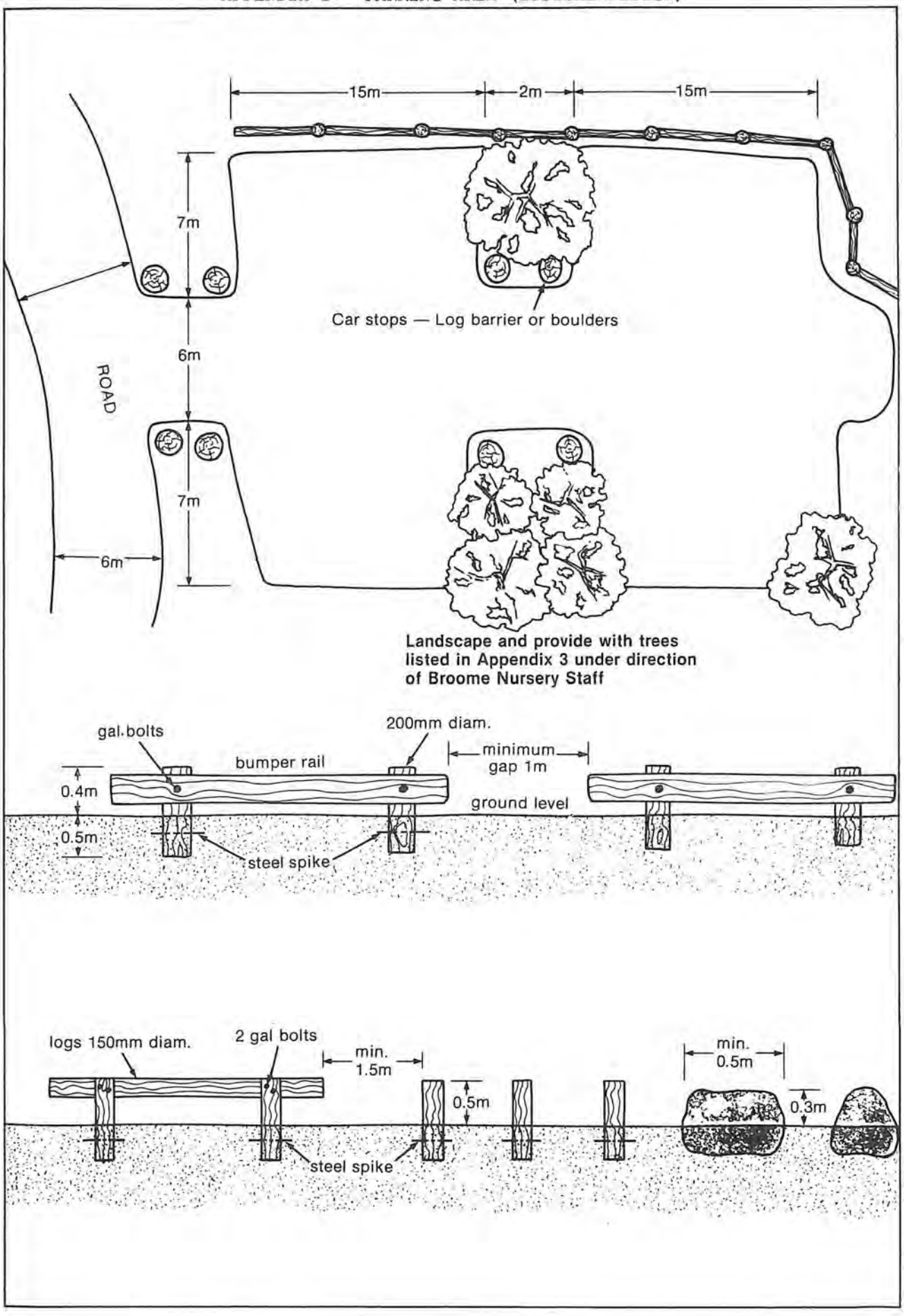
*Trichosurus arnhemensis* Northern bush pollum
*Pteropus scapulatus* Red Flying Fox
*P. alecto* Black Flying Fox
*Taphorous flaviventus* Yellow Bellied Bat
*Chaerephon folsensis* Northern Mastiff Bat
*Mormoptems loriae** 
*Chalinolobus nigrogriseus* Hoary Bat
*Nycticeius greyi* Little Broad-nosed Bat
*Nyctophilus arnhemensis* Long-eared Bat

#### BIRDS

Mangrove Heron*
Sacred Ibis
Osprey
Brahminy Kite
Little Tern
Bar Shouldered Dove
Sacred Kingfisher
Mangrove Kingfisher*
Mangrove Golden Whistler*
Mangrove Grey Fantail*
Broad-billed Flycatcher*
Mangrove Flyeater*
Dusky Flyeater*
Variagated Fairy-wren
Yellow White-eye* (almost)
Brown Honeyeater
Red-headed Honeyeater*
Little Friar Bird*
White-breasted Wood Swallow

* Mangrove endemic

APPENDIX 2 PARKING AREA (TYPICAL DESIGN)



APPENDIX 3 ADAPTED FROM BROOME NURSERY PLANT LIST

Shrubs

Cassia species, shrubs from 1 m. to 3 m., all bushy with yellow flowers, hardy, and quick growing, 5 different species.

Acacia species, wattles all northern native shrubs from 2 m. to 4 m., drought resistant, lemon, white and yellow flowering, 15 different species.

Climbers and Ground Covers

Ipomea braziliensis, used as a ground cover or climber, mauve flowers.

Fruiting Trees and Shrubs

Anacardium occidentale, cashew nut tree. Ornamental tree with an edible vitamin filled apple; the nut is toxic until treated, hardy salt tolerant to 12 m.

Ornamental Shade Trees

Alstonia scholaris, cheesewood ornamental shade tree to 12 m.

Brachychiton paradoxum, Kimberley kurrajong, red flowers, tree to 8 m.

B. gregorii, desert kurrajong, attractive

B. trichosiphon, kurrajong

Calophyllum inophyllum, Indian oil nut tree

Cassia fistula, golden shower

Casuarina equisetifolia, sheoak

Instia bijuga, Moluccan ironwood

Melaleuca leucadendron, paperbark tree

Terminalia arostrata, weeping nutwood

T. petiolaris, native blackberry

T. species