GOVERNMENT OF
WESTERN AUSTRALIA

Browse LNG Precinct




Browse Liquefied Natural Gas Precinct
Strategic Assessment Report

(Draft for Public Review)
December 2010

Appendix C-14

Perpendicular Head-North Head, Packer Island, Gourdon Bay and Coulomb Quondong Vegetation Assessment

PERPENDICULAR HEAD-NORTH HEAD, PACKER ISLAND, GOURDON BAY AND COULOMB-QUONDONG

VEGETATION ASSESSMENT

Prepared for

DEPARTMENT OF INDUSTRY AND RESOURCES

Job No 08.178

Report No RP003

env Australia

PERPENDICULAR HEAD-NORTH HEAD, PACKER ISLAND, GOURDON BAY AND COULOMB-QUONDONG

VEGETATION ASSESSMENT

Prepared for

DEPARTMENT OF INDUSTRY AND RESOURCES

Prepared by

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Date:	*24 October 2008*

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STATEMENT OF LIMITATIONS

Scope of Services

This environmental site assessment report ('the report') has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and ENV.Australia Pty Ltd (ENV) ('scope of services'). In some circumstances the scope of services may have been limited by factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, ENV has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ('the data'). Except as otherwise stated in the report, ENV has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. ENV will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to ENV.

Environmental Conclusions

In accordance with the scope of services, ENV has relied on the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, express or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and for no other party. ENV assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of ENV or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions, and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

ENV will not be liable to update or revise the report to take into account any events or circumstances occurring or facts becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report, nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

EXECUTIVE SUMMARY

ENV.Australia Pty Ltd was commissioned by the Department of Industry and Resources in May 2008 to undertake a vegetation assessment of Perpendicular Head-North Head, Packer Island, Gourdon Bay and Coulomb Point to Quondong Point ('Coulomb-Quondong'), as these areas are possible locations for the proposed construction of a liquefied natural gas hub. The objectives of this vegetation assessment were to describe and map all vegetation communities occurring in these four sites.

Description and mapping of vegetation communities was completed by ground surveys supplemented by low-level helicopter transects. Ground surveys at Perpendicular Head-North Head were conducted from 26-31 May 2008. The other three sites were ground surveyed from 11-26 June 2008, with helicopter transects for all four sites completed from 6-7 July 2008. A total of 35 person-days was invested in vegetation description and mapping.

Ten different vegetation community types were recorded across the four study areas: Mangroves, Coastal Communities, Supra Tidal Mudflats, Monsoon (Vine) Thicket, Coastal Heath, Coastal Swale Thicket, Mixed Shrubland Thicket, Pindan Shrubland, Pindan Woodland and Ephemeral Waters (freshwater lakes, claypans and stream beds). The most extensive community type was Pindan Woodland for the Packer Island, Perpendicular Head-North Head and Coulomb-Quondong survey areas, while Pindan Shrubland was the most extensive vegetation community type for the lower rainfall Gourdon Bay survey area.

Monsoon (Vine) Thicket, a Threatened Ecological Community, was recorded in three of the higher rainfall survey areas – Packer Island, Perpendicular Head-North Head, and Coulomb-Quondong. Weedong Lagoon, a freshwater lake of possible regional conservation significance, was recorded in the Perpendicular Head-North Head survey area.

1 INTRODUCTION

1.1 THE SURVEY

1.1.1 Objectives

ENV.Australia Pty Ltd ('ENV') was commissioned by the Department of Industry and Resources ('DOIR') in May 2008 to undertake a terrestrial biological survey of Perpendicular Head-North Head, Packer Island, Gourdon Bay and Coulomb Point to Quondong Point ('Coulomb-Quondong'), as these areas ('the survey areas') are possible locations for the proposed construction of a liquefied natural gas ('LNG') hub. The surveys were conducted in accordance with an access agreement between DOIR and the Kimberley Land Council ('KLC'). This biological assessment comprises the dry-season vegetation component of what is expected to be a comprehensive flora and vegetation survey, once the hub site has been selected. Flora and fauna data are provided in separate reports by ENV (ENV 2008a, b).

For the four survey areas, the objectives of this vegetation assessment were to:

- describe all vegetation communities;
- complete vegetation mapping; and
- document all vegetation communities of conservation significance.

The results of this survey will be used by DOIR to identify possible constraints posed by native vegetation to development in the survey areas. ENV understands that the biological survey areas are much larger than the areas likely to be directly impacted by the proposed Kimberley LNG hub, and that the chosen hub site will be positioned to avoid areas of conservation significance. The broader survey work was undertaken in an effort to understand the representation of the vegetation likely to be directly impacted. The survey work was conducted in the cooler, drier months of May, June and July, and therefore understorey flora species in the vegetation communities described were representative of dry season conditions, and therefore likely to be reduced in species richness.

1.1.2 Location

The Coulomb-Quondong, Perpendicular Head-North Head and Packer Island survey areas are approximately 66 km, 130 km and 163 km, respectively, north-east of Broome. The Gourdon Bay survey area is approximately 74 km south-west of Broome.

1.2 REGIONAL BIOGEOGRAPHY

The Dampier Peninsula extends to the north and west from a line extending approximately from Derby to Broome, in Western Australia. The survey areas are in the coastal westernmost portion of the Peninsula, which is bound by the Indian Ocean to the north and west, and Cape Leveque Road to the east. Most of the Dampier Peninsula is less than 120 m above sea level.

All survey areas are in the Dampierland biogeographic region, as per Thackway & Cresswell (1995), which is in the Northern Botanical Province (Beard 1990). Shepherd *et al*. (2002) give the area of Dampierland as 8 368 692 ha. This region typically consists of sandplain overlying semi-arid scrubland (or Pindan) of *Acacia* thickets and grassland. The survey areas are in the Torresian subtropical region, but it also lies close to the arid Eyrean sub-region. As a transitional zone between the two, it has unique flora associated with both bioregions (McKenzie 1983; *ecologia* Environment 2005a).

1.3 CLIMATE

The nearest relevant available climatic data (Bureau of Meteorology [BOM]) is from Broome Airport, Cape Leveque and Bidyadanga weather stations. The Cape Leveque station is in the northern section of the Dampier Peninsula, 206 km north-east of Broome, while the Bidyadanga station is in the southern section of the Peninsula, 95 km south-west of Broome. The Broome station is considered representative of the central sections of the Dampier Peninsula. The climatic data most relevant to the Gourdon Bay survey area is from the Bidyadanga weather station, while the Broome station is representative of the Coulomb-Quondong survey area, and the Cape Leveque station is representative of the Perpendicular Head-North Head and Packer Island survey areas.

The climate for Broome and the Dampier Peninsula is tropical, with hot and humid summers and warm winters (Graphs 1a, b, c). The wet season lasts typically from December to March, and the dry for the rest of the year. Long-term minimum temperatures at Cape Leveque (Graph 1b) are 2-3 degrees warmer and maximum temperatures 1-2 degrees cooler than for Broome (Graph 1a) and Bidyadanga (Graph 1c), but otherwise the temperature ranges are similar for all three weather stations. Median annual rainfall for Broome is 533.4 mm, 506.6 mm for Bidyadanga and 768.6 mm for Cape Leveque, although there is considerable variation from year to year (BOM 2008). There is a gradient of increasing rainfall from south to north on the Dampier Peninsula. Most rainfall is associated with thunderstorms and tropical lows or cyclones. Evaporation is high.

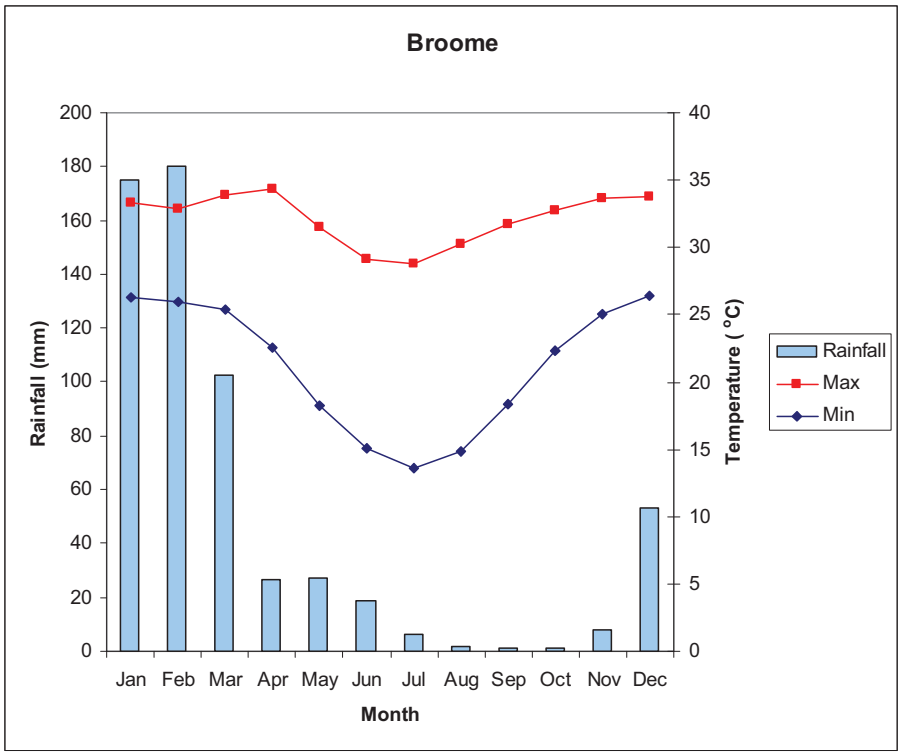

Figure 2a: Average Monthly Rainfall and Maximum and Minimum Temperatures for Broome Airport (BOM 2008)

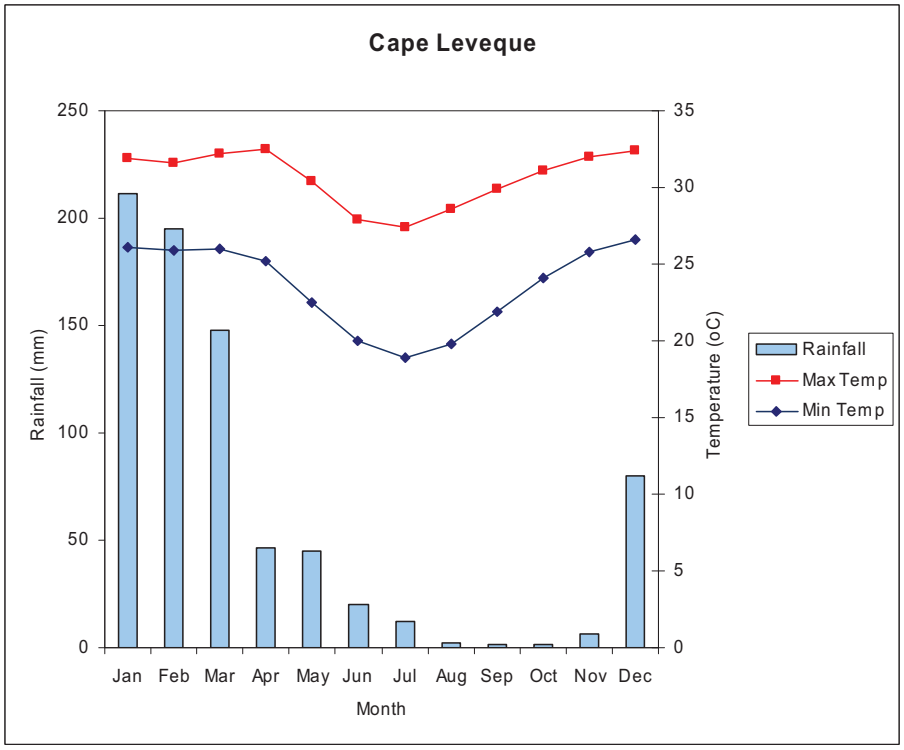

Figure 2b: Average Monthly Rainfall and Maximum and Minimum Temperatures for Cape Leveque (BOM 2008)

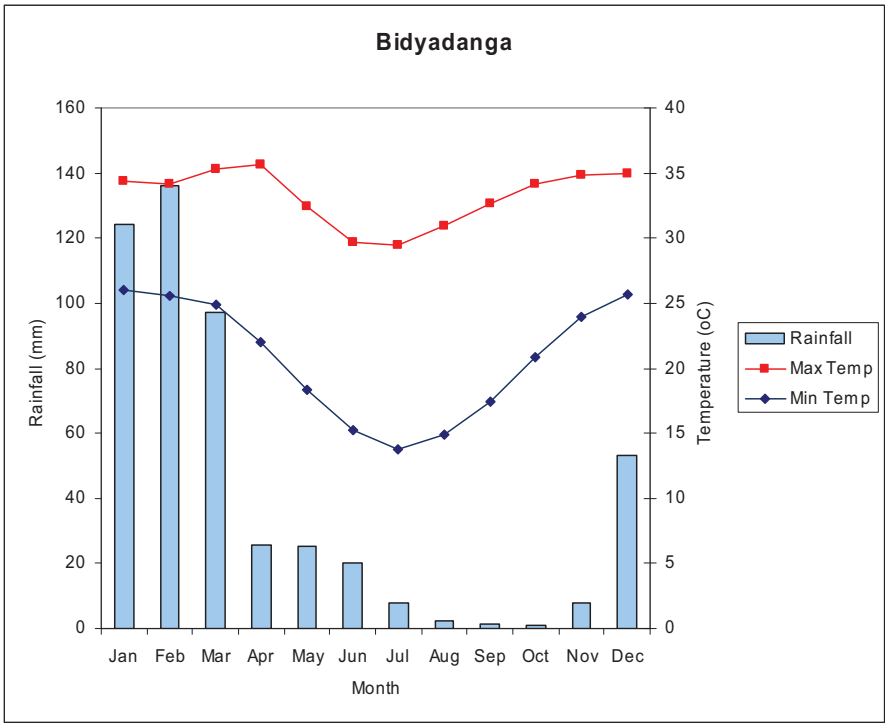

Figure 2c: Average Monthly Rainfall and Maximum and Minimum Temperatures for Bidyadanga (BOM 2008)

1.4 PREVIOUS BIOLOGICAL SURVEYS

There have been few detailed biological surveys of the Dampier Peninsula. *ecologia* Environment (2004) produced a flora report of an area just to the east of the Cape Leveque Road, while Kenneally *et al.* (1996) provided a useful general description of the natural history of the Broome area, with comments on flora, and noting the variety of the coastal flora communities. This report also commented on the unique status of the area as a transitional zone between Western Australia's desert and tropical zones. A further report by *ecologia* Environment (2005b) provided an assessment of environmental constraints applying to a gas plant development on the western side of the Dampier Peninsula. A field flora assessment (ENV 2008a) and desktop biological assessment was also completed recently by ENV (2008c).

2 METHODOLOGY

2.1 FIELD SURVEY

Description and mapping of vegetation communities was completed by ground surveys, supplemented by low-level helicopter transects. Ground surveys at Perpendicular Head-North Head were conducted from 26-31 May 2008. The other three sites were ground-surveyed from 11-26 June 2008, with helicopter transects for all four sites completed from 6-7 July 2008. A total of 35 person-days was invested in vegetation description and mapping. Representative photographs were taken of each vegetation community type at each survey area.

Field mapping was carried out using GPS (Magellan) and GIS (OziExplorer and Microstation V7.0) hardware and software. The details of each site were interpreted, and vegetation communities were then described. The boundaries of the vegetation communities were drawn over an aerial photograph with the aid of GPS coordinates taken throughout the field survey. The vegetation communities were then digitised and produced as manipulable electronic mapping data using Microstation V7.0.

2.1.1 Vegetation Survey Limitations and Constraints

It is important to note the specific constraints imposed on individual surveys. Constraints are often difficult to predict, as is the extent to which they influence survey outcomes. Survey constraints of the vegetation survey are detailed in Table 1.

Table 1: Limitations and Constraints Associated with the Vegetation Assessment

Variable	Impact on Survey Outcomes
Access Problems	Some areas were inaccessible for ground surveys, and therefore unable to be adequately surveyed, as they were sites of Aboriginal cultural significance. These areas were mapped aerially, without ground-truthing.
Experience levels	The botanists who executed these surveys were practitioners suitably qualified in their respective fields: • Mr Kevin Kenneally (vegetation mapping) • Mr Tim Willing (vegetation mapping) • Ms Rebecca McIntyre (report preparation)
Timing, weather, season.	Ground surveys at Perpendicular Head-North Head were conducted from 26-31 May 2008. The other three sites were ground surveyed from 11-26 June 2008, with helicopter transects for all four sites completed from 6-7 July 2008. This vegetation survey was conducted during the Kimberley dry season.

Variable	Impact on Survey Outcomes
	Rainfall was 2.2 mm for the Broome airport weather station in the three-month period April-June, and 6.4 mm at the Cape Leveque station, while no rain fell at Bidyadanga. Vegetation composition changes over time, with flora species having specific growing periods, especially annuals and ephemerals (some plants lasting for a markedly brief time, some only a day or two after rains). Furthermore, anthropogenic disturbance from fire is common on the Dampier Peninsula, and can remove or restructure vegetation communities. Therefore the results of future vegetation studies in the survey areas may differ from the results of this survey.

2.2 VEGETATION MAPS

Field mapping was carried out using GPS (Magellan) and GIS (OziExplorer and Microstation V7.0) hardware and software. Vegetation communities were described using field data and with reference to Beard (1979), Gibson (1983a, b & c) and Kenneally *et al.* (1996). The boundaries of the vegetation communities were then defined using ACRES Landsat 7 mosaics provided for each survey area by the Department of Environment and Conservation ('DEC') and the Environmental Protection Authority ('EPA'). The vegetation communities were then digitised and produced as manipulable electronic mapping data using Microstation V7.0. ESRI shape files were created with ARCView 9.2.

3 RESULTS & DISCUSSION

3.1 VEGETATION COMMUNITY TYPES

Ten vegetation community types were recorded in the survey areas: Mangroves, Coastal Communities, Supra Tidal Mudflats, Monsoon (Vine) Thicket, Coastal Heath, Coastal Swale Thicket, Mixed Shrubland Thicket, Pindan Shrubland, Pindan Woodland and Ephemeral Waters (freshwater lakes, claypans and stream beds). The occurrence of each vegetation community type by survey area is indicated in Table 2 and mapped in Figures 1-5.

Table 2: Vegetation Community Types Recorded by Survey Area

Vegetation Community Types	Packer Island	Perpendicular Head-North Head	Coulomb-Quondong	Gourdon Bay
Mangroves	✓	✓		✓
Coastal Communities	✓	✓	✓	✓
Supra Tidal Mudflat	✓	✓		✓
Monsoon (Vine) Thicket	✓	✓	✓	
Coastal Heath	✓	✓	✓	✓
Coastal Swale Thicket				✓
Mixed Shrubland Thicket	✓	✓		
Pindan Shrubland				✓
Pindan Woodland	✓	✓	✓	
Ephemeral Waters	✓	✓	✓	✓

Mangrove

Up to 12 species of mangrove have been recorded from the Dampier Peninsula, with large stands recorded in sheltered embayments at Chile Creek, Packer Island, Tappers Inlet and Port Smith. They usually occur between the spring tide

mark and mean sea level. In the study areas, the most common species is *Avicennia marina*. On the seaward margin *Sonneratia alba* is common, often mixed with the columnar *Camptostemon schultzii*. The central zone typically features *Rhizophora stylosa,* with its characteristic arching prop-roots. This species sometimes shelters roosting colonies of flying foxes. The landward mangrove fringe is often dominated by *Ceriops tagal* and stunted *Avicennia marina*.

Coastal Communities

All the study areas have well-developed coastal beaches backed by extensive, often mobile, white Holocene sand dunes. Sparsely vegetated mobile foredunes usually feature *Spinifex longifolius*, along with the sedges *Fimbristylis cymosa* and *F. sericea*. Beach creepers include *Ipomoea pes-caprae* and *Canavalia rosea*. At Gourdon Bay stabilised dunes are dominated by *Acacia bivenosa* with scattered *Crotalaria cunninghamii*, while between Quondong and Coulomb Point only the latter species is found. In coastal areas at Mercedes Cove, Middle Lagoon, Quondong and Gourdon Bay, introduced Buffel Grass (**Cenchrus ciliaris*) is expanding into native dune vegetation.

At Packer Island, outcrops of karst travertine feature sinkholes. Overlying loose sands support patches of *Pandanus spiralis*, as well as shrubs of localised strand species such as *Pemphis acidula* and *Scaevola sericea*. *Spinifex longifolius* is the most common grass. There are also limestone outcrops at Chile Head, Tappers Inlet and North Head, typically supporting *Spinifex longifolius*. Localised patches of *Pandanus spiralis* are also prominent on sandstone cliffs near Middle Lagoon. Along the southern shore of Gourdon Bay and around the tidal entrance to Port Smith there are large areas of exposed limestone pavement, bare of vegetation. Less exposed limestone ridges further inland are invariably dominated by *Acacia bivenosa*.

Supra Tidal Mudflats

Broad tidal mudflats often occur behind mangroves featuring expanses of hypersaline non-vegetated areas fringed with a low samphire shrub community, grading into saline grasslands. These areas are subject to freshwater inundation during the wet season. Typical species include the succulent samphires (*Tecticornia* spp.) and the chenopods *Neobassia astrocarpa* and *Suaeda arbusculoides.* Other typical species include *Sesuvium portulacastrum* and *Hemichroa diandra.* The saline grasslands are dominated by saltwater couch (*Sporobolus virginicus*) and rice grass (*Xerochloa imberbis*). At Port Smith, the landward transition zone is marked by a belt of the grey-leaved shrub *Pluchea tetranthera.*

Monsoon (Vine) Thicket

These discontinuous belts of vine thickets are found behind coastal dunes north of Broome, and are particularly well-developed at James Price Point. They vary from semi-deciduous thickets (around Broome) to closed evergreen forests north of Pender Bay. At the northern end of the Dampier Peninsula the patches become larger with a better structure and greater diversity of species. Towards the southern end of their range the patches are more scattered and open. They often form a mosaic with ghost gums (*Corymbia bella* and *C. flavescens*) and the paperbark (*Melaleuca dealbata*). Vine thickets contain many fleshy-fruited plants, providing an important food resource for wildlife such as Agile Wallabies, Bats, Bower-birds and Fruit-doves. They are also an important traditional resource for Aboriginal people. Northward through Quondong to James Price Point, there is a significant belt of vine thickets notable for the evergreen trees *Terminalia petiolaris, Diospyros humilis, Mimusops elengi*, *Celtis australiensis*, *Melaleuca dealbata a*nd, more rarely, the conservation Priority 4 species *Pittosporum moluccanum* at James Price Point. Vine thicket trees of note on the northern Peninsula include the banyan fig (*Ficus virens*) and the wild apple (*Syzygium eucalyptoides* subsp. *bleeseri*). Species confined to localised populations include *Cupaniopsis anacardioides* (e.g. at Chile Creek) and *Diospyros maritima* near Emeriau Point. Vines are an important component of the Peninsula thickets, and include *Abrus precatorius, Gymnanthera oblonga, Marsdenia cinerascens, Jacquemontia paniculata* and *Tinospora smilacina.* The introduced wild passionfruit *(*Passiflora foetida)* is ubiquitous throughout the area.

Coastal Heath

These heathlands occur as linear bands, typically on exposed coastal cliffs (e.g. Emeriau Point, Flat Rock to James Price Point and Gourdon Bay), and are dominated by low, wind-pruned shrubs such as *Acacia monticola* and *A. tumida* (north of Broome) or *A. stellaticeps* (south at Gourdon Bay). In the northern study sites they occur on pindan soils or ferruginised sandstone. In the south around Cape Du Boulay (east side of Gourdon Bay), they occur on ferruginised gravels and sandstone.

Coastal Swale Thicket

This community is always associated with relict pink Pleistocene sand dunes, which in the survey area are confined to swales around Gourdon Bay. The assemblage is dominated by deciduous tree species, including *Bauhinia cunninghamii, Gyrocarpus americanus* and *Terminalia ferdinandiana* with the locally important bushfood *Marsdenia viridiflora* as a climber. This community occupies the same niche as the vine thicket to the north of Broome, but lacks the species diversity and assemblage structure of these communities.

Mixed Shrubland Thicket

This community was mapped only northward of Beagle Bay. It includes dense thickets dominated by *Acacia tumida* on coastal dunes at Chile Creek, an area known locally as Byerugun Scrub, and on the landward side of Packer Island. This community also occurs as an extensive complex mosaic of mixed *Acacia* species (*A. colei, A. monticola* and *A. tumida*) with *Calytrix exstipulata*, *Hakea arborescens* and *H. macrocarpa* on ferruginised sandstone behind cliffs at Perpendicular Head-North Head.

Pindan Shrubland

Pindan is the ubiquitous vegetation that dominates red sandplains south and north of Broome. As a shrubland, this community reflects a semi-arid habitat (annual rainfall under 500 mm), and was mapped only at Gourdon Bay. It is dominated by mixed *Acacia* species (particularly *A. eriopoda* and *A. monticola*) with widely scattered ghost gums (*Corymbia flavescens*) near the coast and widely scattered bloodwoods (*Corymbia dampieri* and *C. zygophylla*) inland. The tree *Bauhinia cunninghamii* is widespread. The principal grasses are soft spinifex (*Triodia bitextura*) and ribbon grass (*Chrysopogon pallidus*). Thickets of *Grevillea wickhamii* are notable opposite the Port Smith Caravan Park. Close to Nygah Nygah community *Acacia monticola* forms dense thickets, in contrast to most of the eastern inland survey area, which has been severely impacted by repeated burning, leading to a near absence of wattles.

Pindan Woodland

This community of the Dampier Peninsula dominates inland sandplains, developed over red and yellow soils with an annual rainfall over 500 mm. Tree cover is relatively dense, with an upper layer of eucalypts *(E. miniata, E. tectifica)*, bloodwoods *(Corymbia dampieri)* and/or ghost gums *(Corymbia bella, C. flavescens).* A variably dense understorey of wattles includes *Acacia eriopoda, A. tumida, A. monticola, A. platycarpa* and *A. colei.* Grass species are similar to those in the pindan shrubland, but also include annual S*orghum, Heteropogon* and *Cymbopogon.* Many areas surveyed (e.g. south of Lombadina, east of Quondong) had been severely impacted by repeated fires. Also, vast areas of Darwin Woollybutt (*Eucalyptus miniata*) east of Packer Island and south of Weedong Lagoon had been defoliated, apparently by insect attack, and this warrants further investigation.

Ephemeral Waters

These represent a mosaic of communities subject to ephemeral freshwater flooding and/or ponding. They include stands of *Melaleuca alsophila* that adjoin supra tidal mudflats, as well as *Lophostemon grandiflorus* and *Melaleuca dealbata* communities in areas behind coastal sand dunes that are subject to seasonal inundation. This ponding is often the result of coastal dunes truncating

drainage lines. North of Chile Creek, minor seepage areas feature dragon tree *(Sesbania formosa)*, while seepages at the base of coastal dunes near Tjilbata Creek support the tree *Timonius timon*. Weedong Lagoon is unique in the area surveyed, as it may contain water for some years before drying. The lake is characterised by fringing bulrush (*Typha domingensis*), with sedge beds of *Eleocharis dulcis* with **Lippia nodiflora* on the wetter edges. Other features include a modified claypan (Flow Dam) and creek beds that occur in the study area only near Coulomb Point. Here, drainage lines are dominated by *Melaleuca alsophila, Pandanus spiralis* and *Eucalyptus camaldulensis*.

3.2 VEGETATION MAPPING BY SURVEY AREA

Packer Island

Eight vegetation community types were recorded in the Packer Island survey area (Table 2). The most extensive community type was Pindan Woodland of *Eucalyptus tectifica* and *E. miniata* (Figure 1).

Perpendicular Head-North Head

Eight vegetation community types were recorded in the Perpendicular Head-North Head survey area (Table 2). The most extensive community type was Pindan Woodland of *Eucalyptus miniata, E. tectifica, Corymbia flavescens* and *C. dampieri* (Figure 2).

Coulomb – Quondong

Five vegetation community types were recorded in the Coulomb-Quondong survey area (Table 2). The most extensive community type was Pindan Woodland of *Eucalyptus miniata, Acacia monticola, A. eriopoda* and *Corymbia dampieri* (Figures 3 & 4).

Gourdon Bay

Seven vegetation community types were recorded in the Gourdon Bay survey area (Table 2). The most extensive community type was Pindan Shrubland of *Corymbia flavescens, C. dampieri* and *C. zygophylla* (Figure 5).

3.3 VEGETATION COMMUNITIES OF CONSERVATION SIGNIFICANCE

3.3.1 Threatened Ecological Communities

Monsoon (Vine) Thicket is a Threatened Ecological Community ('TEC') that was recorded in three of the survey areas – Packer Island, Perpendicular Head-North Head, and Coulomb-Quondong. This community type was most extensive at Coulomb-Quondong, particularly in a large continuous section in back-dunes

between James Price Point and Quondong Point (Figures 3 & 4). Smaller areas were recorded in back-dunes and adjacent to Mixed Shrubland Thicket and Mangroves at Perpendicular Head-North Head and in a larger area extending south from Packer Island.

3.3.2 Communities of Possible Conservation Significance

Weedong Lagoon, in the eastern section of the Perpendicular Head-North Head survey area, is a unique habitat for the Dampier Peninsula in that it is a large freshwater body that may retain water across multiple dry seasons (K. Kenneally, pers. comm.). The lagoon is characterised by fringing bulrush (*Typha domingensis*) and sedge beds of *Eleocharis dulcis* with **Lippia nodiflora* on the wetter edges. While Weedong Lagoon is not listed as a TEC or as a Priority Ecological Community (PEC), it is of possible conservation significance for the Dampier Peninsula.

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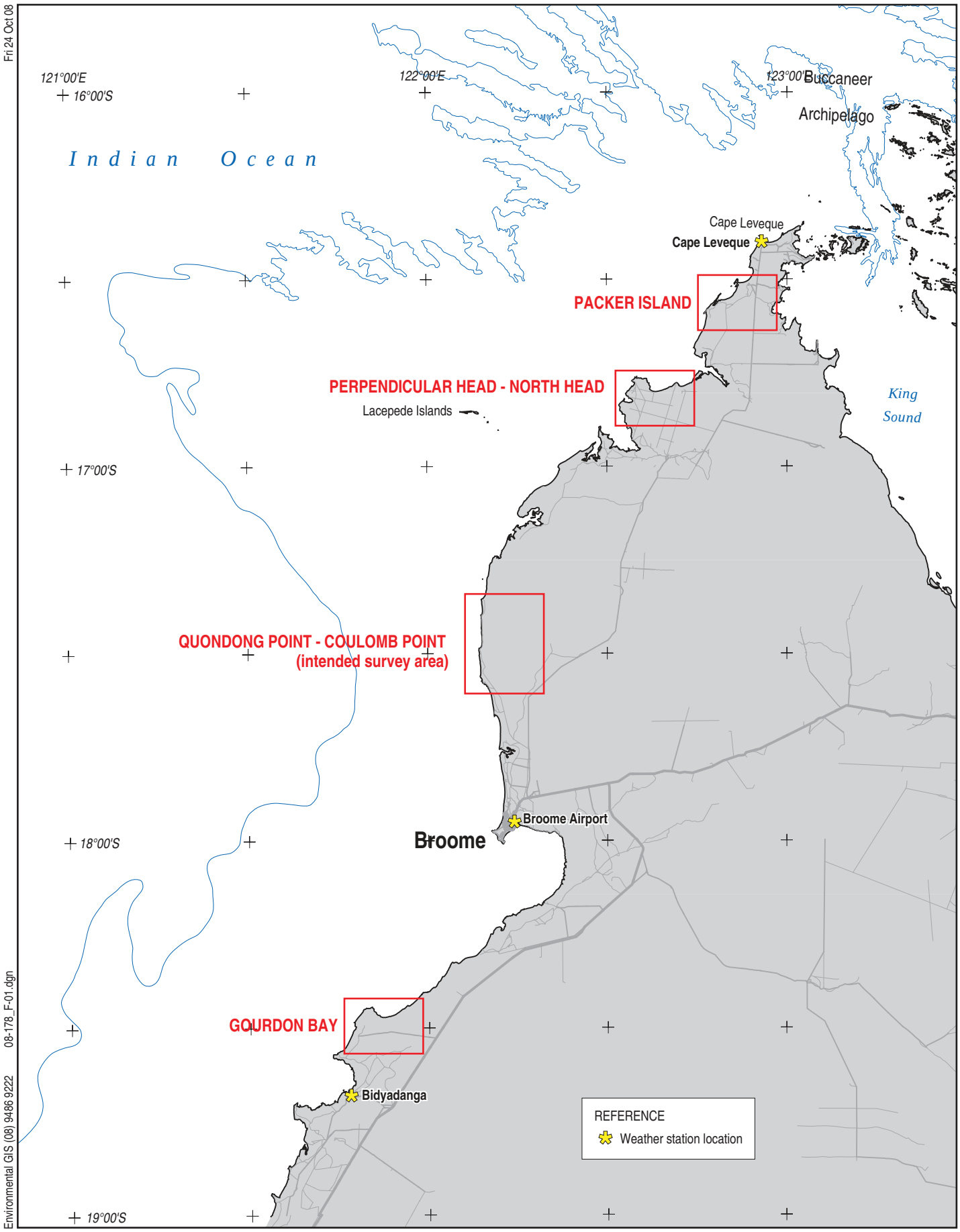
FIGURES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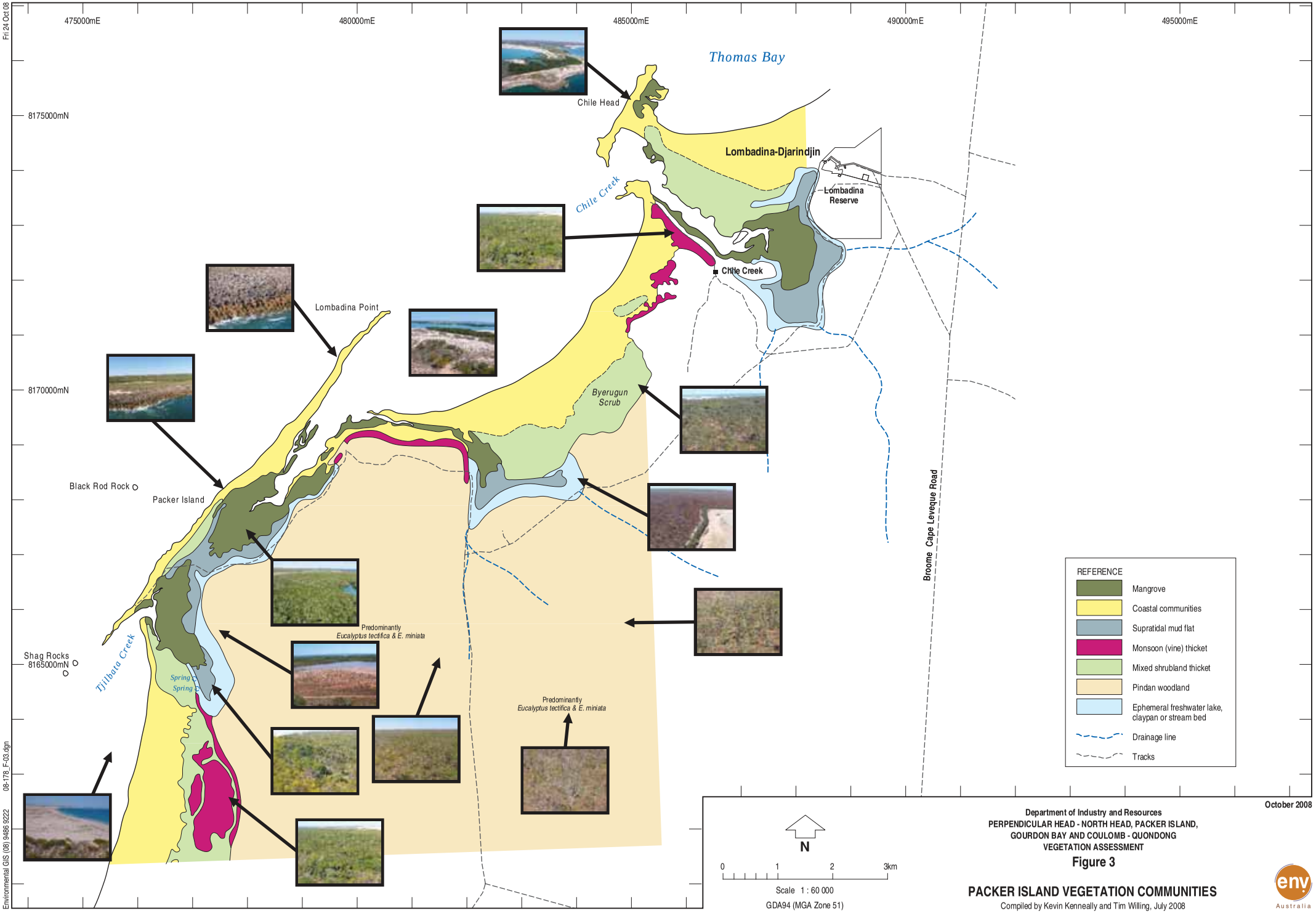
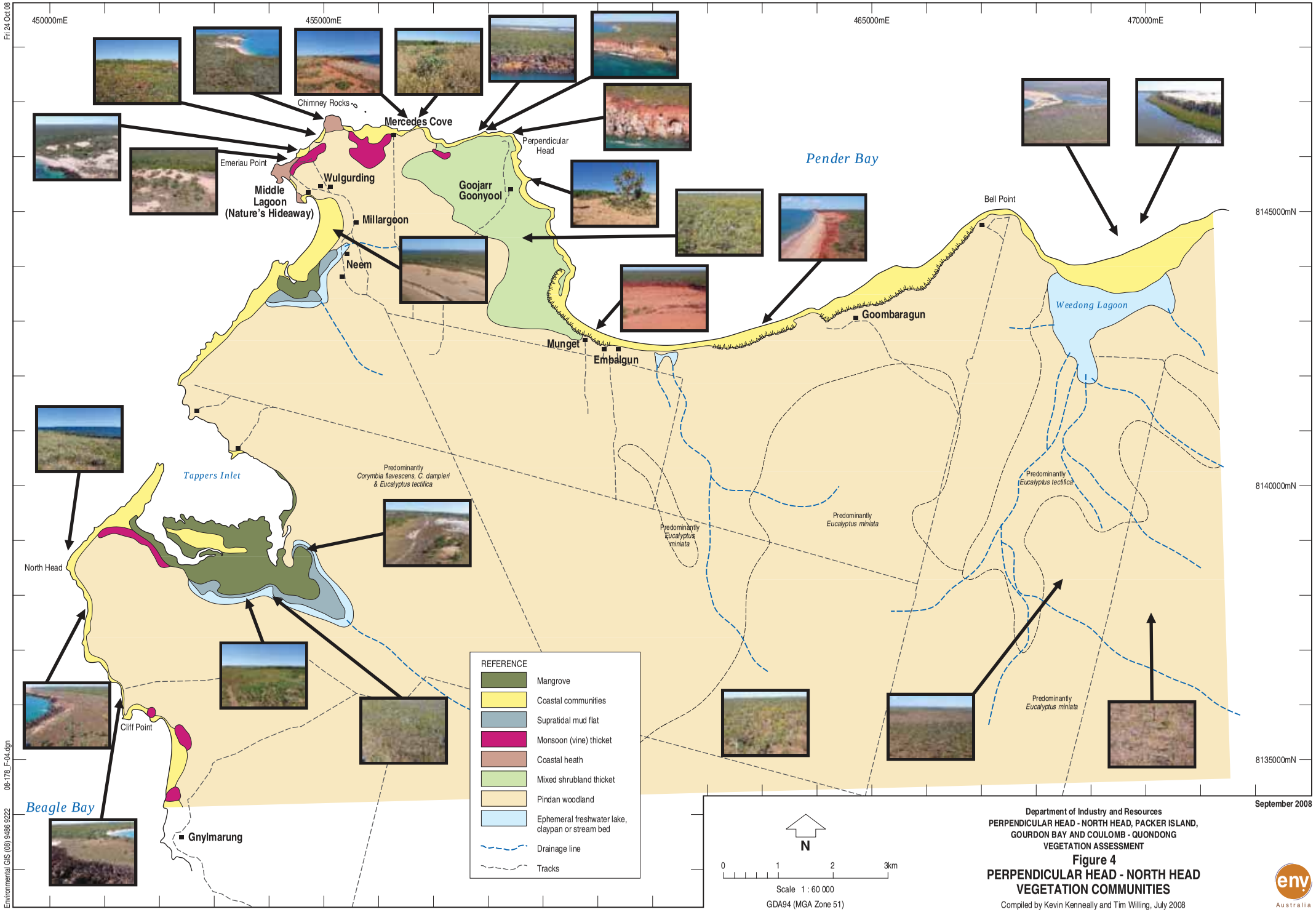
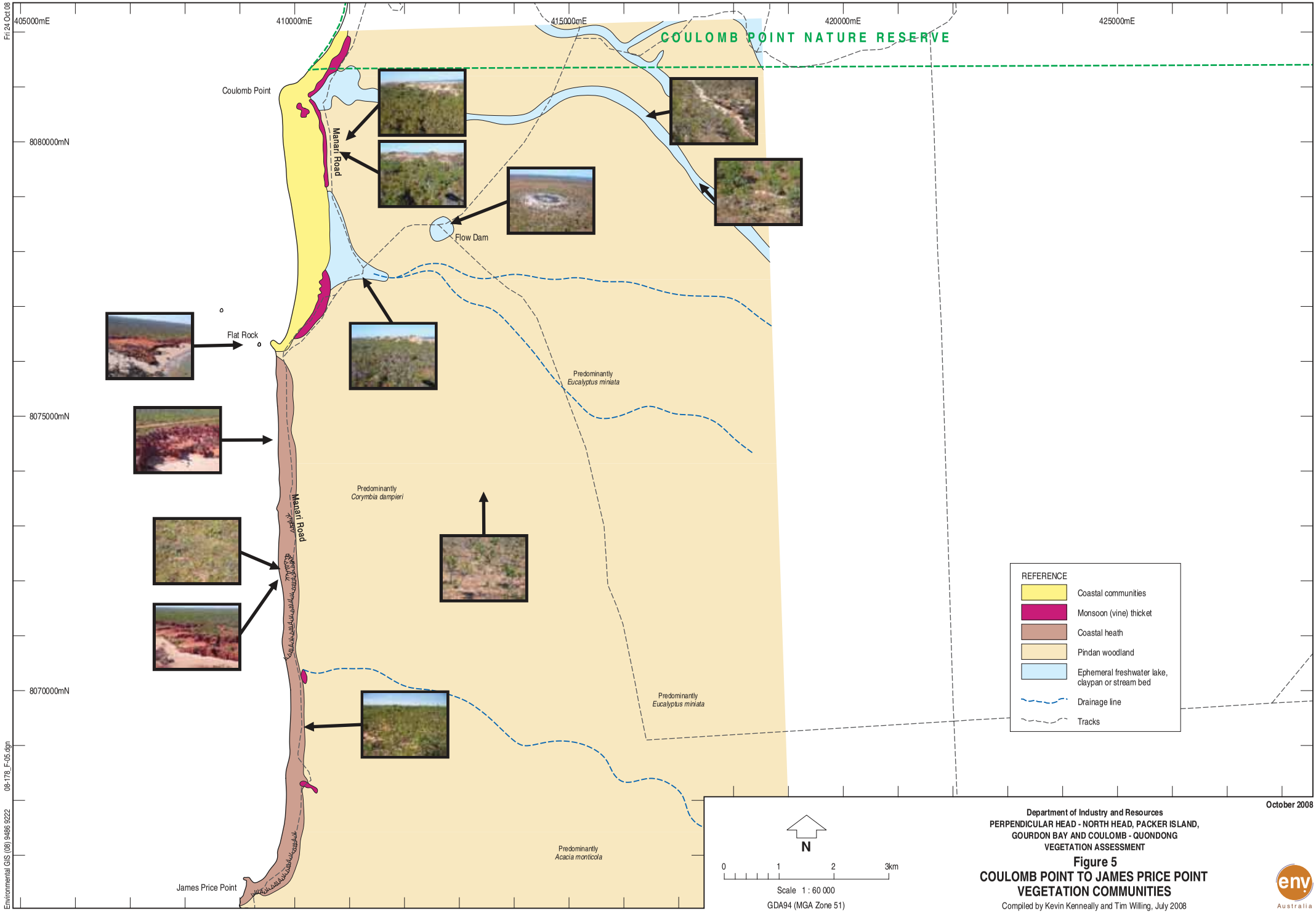
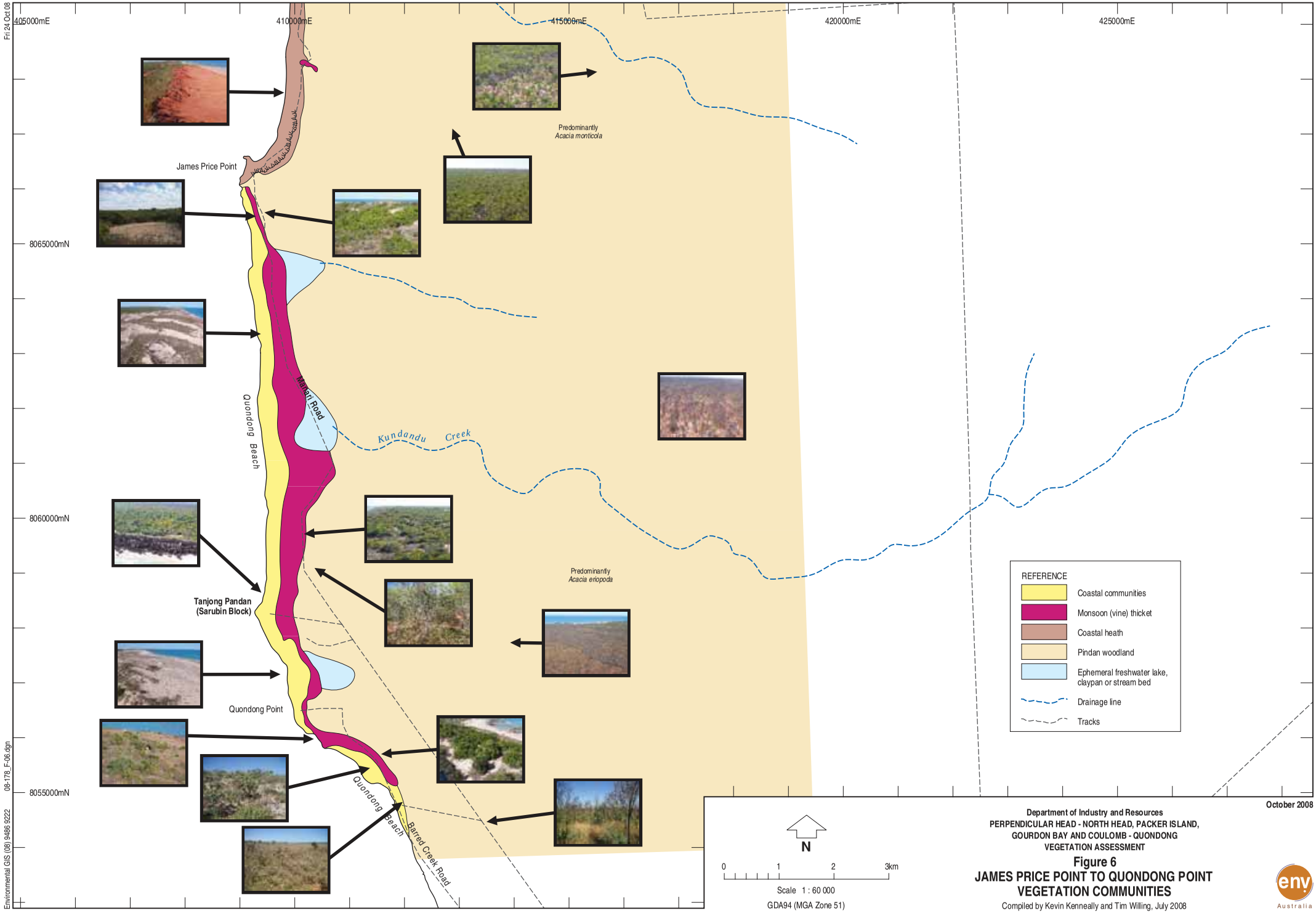
PACKER ISLAND
PERPENDICULAR HEAD - NORTH HEAD
Lacepede Islands
King
Sound
17°00'S
QUONDONG POINT - COULOMB POINT
(intended survey area)
Broome Airport
Broome
18°00'S
GOURDON BAY
Bidyadanga
REFERENCE
Weather station location
19°00'S
08-178_F-01.dgn
Environmental GIS (08) 9486 9222
October 2008
Department of Industry and Resources
PERPENDICULAR HEAD - NORTH HEAD, PACKER ISLAND,
GOURDON BAY AND COULOMB - QUONDONG
VEGETATION ASSESSMENT
N
0 10 20 30 40 50km
Scale 1 : 1 500 000
Figure 1
REGIONAL LOCATION
env
Australia


Fri 24 Oct 08
475000mE
480000mE
485000mE
490000mE
495000mE
8175000mN
8170000mN
Thomas Bay
Chile Head
Lombadina-Djarindjin
Lombadina Reserve
Chile Creek
Chile Creek
Lombadina Point
Byerugun Scrub
Black Rod Rock
Packer Island
Broome Cape Leveque Road
Predominantly Eucalyptus tectifica & E. miniata
Predominantly Eucalyptus tectifica & E. miniata
Shag Rocks 8165000mN
Tjilbata Creek
Spring
Spring
REFERENCE
Mangrove
Coastal communities
Supratidal mud flat
Monsoon (vine) thicket
Mixed shrubland thicket
Pindan woodland
Ephemeral freshwater lake, claypan or stream bed
Drainage line
Tracks
N
0
1
2
3km
Scale 1 : 60 000
GDA94 (MGA Zone 51)
October 2008
Department of Industry and Resources
PERPENDICULAR HEAD - NORTH HEAD, PACKER ISLAND,
GOURDON BAY AND COULOMB - QUONDONG
VEGETATION ASSESSMENT
Figure 3
PACKER ISLAND VEGETATION COMMUNITIES
Compiled by Kevin Kenneally and Tim Willing, July 2008
env Australia
Environmental GIS (08) 9486 9222
08-178_F-03.dgn


Fri 24 Oct 08
450000mE
455000mE
465000mE
470000mE
8145000mN
8140000mN
8135000mN
Chimney Rocks
Mercedes Cove
Perpendicular Head
Pender Bay
Emeriau Point
Middle Lagoon (Nature's Hideaway)
Wulgurding
Millargoon
Neem
Goojarr Goonyool
Bell Point
Weedong Lagoon
Goombaragun
Munget
Embalgun
Tappers Inlet
North Head
Cliff Point
Beagle Bay
Gnylmarung
Predominantly Corymbia flavescens, C. dampieri & Eucalyptus tectifica
Predominantly Eucalyptus tectifica
Predominantly Eucalyptus miniata
Predominantly Eucalyptus miniata
Predominantly Eucalyptus miniata
REFERENCE
Mangrove
Coastal communities
Supratidal mud flat
Monsoon (vine) thicket
Coastal heath
Mixed shrubland thicket
Pindan woodland
Ephemeral freshwater lake, claypan or stream bed
Drainage line
Tracks
N
0
1
2
3km
Scale 1 : 60 000
GDA94 (MGA Zone 51)
08-178_F-04.dgn
Environmental GIS (08) 9486 9222
September 2008
Department of Industry and Resources
PERPENDICULAR HEAD - NORTH HEAD, PACKER ISLAND, GOURDON BAY AND COULOMB - QUONDONG VEGETATION ASSESSMENT
Figure 4
PERPENDICULAR HEAD - NORTH HEAD VEGETATION COMMUNITIES
Compiled by Kevin Kenneally and Tim Willing, July 2008
env Australia


405000mE
410000mE
415000mE
420000mE
425000mE
COULOMB POINT NATURE RESERVE
Coulomb Point
Manari Road
8080000mN
Flow Dam
Flat Rock
Predominantly
Eucalyptus miniata
8075000mN
Predominantly
Corymbia dampieri
Mangri Road
Predominantly
Eucalyptus miniata
8070000mN
Predominantly
Acacia monticola
James Price Point
REFERENCE
Coastal communities
Monsoon (vine) thicket
Coastal heath
Pindan woodland
Ephemeral freshwater lake, claypan or stream bed
Drainage line
Tracks
N
0
1
2
3km
Scale 1 : 60 000
GDA94 (MGA Zone 51)
October 2008
Department of Industry and Resources
PERPENDICULAR HEAD - NORTH HEAD, PACKER ISLAND,
GOURDON BAY AND COULOMB - QUONDONG
VEGETATION ASSESSMENT
Figure 5
COULOMB POINT TO JAMES PRICE POINT
VEGETATION COMMUNITIES
Compiled by Kevin Kenneally and Tim Willing, July 2008
env
Australia
Fri 24 Oct 08
08-178_F-05.dgn
Environmental GIS (08) 9486 9222


405000mE
410000mE
415000mE
420000mE
425000mE
8065000mN
8060000mN
8055000mN
James Price Point
Predominantly
Acacia monticola
Quondong Beach
Mahori Road
Kundandu Creek
Predominantly
Acacia eriopoda
Tanjong Pandan
(Sarubin Block)
Quondong Point
Quondong Beach
Barred Creek Road
REFERENCE
Coastal communities
Monsoon (vine) thicket
Coastal heath
Pindan woodland
Ephemeral freshwater lake, claypan or stream bed
Drainage line
Tracks
N
0
1
2
3km
Scale 1 : 60 000
GDA94 (MGA Zone 51)
October 2008
Department of Industry and Resources
PERPENDICULAR HEAD - NORTH HEAD, PACKER ISLAND,
GOURDON BAY AND COULOMB - QUONDONG
VEGETATION ASSESSMENT
Figure 6
JAMES PRICE POINT TO QUONDONG POINT
VEGETATION COMMUNITIES
Compiled by Kevin Kenneally and Tim Willing, July 2008
env
Australia
Fri 24 Oct 08
08-178_F-06.dgn
Environmental GIS (08) 9486 9222


Fri 24 Oct 08
370000mE
375000mE
380000mE
385000mE
390000mE
7960000mN
7955000mN
7950000mN
Cape Latouche Treville
Gourdon Bay
Cape Du Boulay
Yardoogara
Nygah Nygah
Port Smith
Predominantly
Corymbia flavescens & C. dampieri
Predominantly
Corymbia zygophylla & C. dampieri
Port Smith Road
Port Smith
Bird Park
Port Smith
Caravan Park
REFERENCE
Mangrove
Coastal communities
Supratidal mud flat
Coastal heath
Coastal swale thicket
Pindan shrubland
Ephemeral freshwater lake, claypan or stream bed
Drainage line
Tracks
N
0
1
2
3km
Scale 1 : 60 000
GDA94 (MGA Zone 51)
October 2008
Department of Industry and Resources
PERPENDICULAR HEAD - NORTH HEAD, PACKER ISLAND,
GOURDON BAY AND COULOMB - QUONDONG
VEGETATION ASSESSMENT
Figure 7
GOURDON BAY VEGETATION COMMUNITIES
Compiled by Kevin Kenneally and Tim Willing, July 2008
env Australia
08-178_F-07.dgn
Environmental GIS (08) 9486 9222

APPENDIX A

PACKER ISLAND VEGETATION PHOTOGRAPHS

PERPENDICULAR HEAD–NORTH HEAD, PACKER ISLAND, GOURDON BAY AND COULOMB-QUONDONG - VEGETATION ASSESSMENT

APPENDIX A - Packer Island Vegetation Photographs

Mangroves

Chile Head showing coastal communities on karst limestone with mangroves in sheltered embayments

Coastal Communities

Packer Island fringed with mangroves showing karst limestone supporting low shrubs of *Pemphis acidula*

South of Tjilbata Creek, broad sandy beaches support sparse vegetation

Supra Tidal Mudflats

Supra tidal mudflat near Packer Island showing samphires (*Tecticornia* spp.).

Monsoon (Vine) Thicket

The largest single vine thicket community on Dampier Peninsula is located north of Cape Borda and shows the impact of fire on the adjoining pindan woodland

Mixed Shrubland Thicket

Mixed shrubland thicket south of Tjilbata Creek showing *Acacia tumida* flowering on dunes abutting seepage area dominated by *Timonius timon* and *Melaleuca dealbata*

Mixed shrubland thicket known locally as the 'Byerugun Scrub' can be seen in the middle distance. Dominated by dense *Acacia tumida* on white sand dunes it grades into pindan woodland in the foreground

Pindan Woodland

South of Chile Creek the pindan woodland is dominated by Darwin woollybutt (*Eucalyptus miniata*) and *Acacia tumida*

Pindan woodland dominated by *Eucalyptus tectifica* and *E. miniata* near Chile Creek

Ephemeral Wetlands

North of Chile Creek seepage areas behind coastal dunes are dominated by the dragon tree (*Sesbania formosa*)

APPENDIX B

PERPENDICULAR HEAD-NORTH HEAD VEGETATION PHOTOGRAPHS

PERPENDICULAR HEAD–NORTH HEAD, PARKER ISLAND GOURDON BAY AND COULOMB-QUONDONG - VEGETATION ASSESSMENT

APPENDIX B - Perpendicular Head-North Head Vegetation Photographs

Coastal Communities

North shore of Beagle Bay showing coastal karst limestone supporting Beach Spinifex (*Spinifex longifolius*) and clumps of *Pandanus spiralis*

South of Chimney Rocks coastal beach sand and mobile dunes are fringed by patches vine thicket

Monsoon (Vine) Thicket

Coastal vine thicket dominated by *Diospyros maritima* with *Pandanus spiralis* on exposed dunes south of Emeriau Point

Coastal Heath

Coastal heath dominated by prostrate *Acacia tumida* on ferruginised sandstone at Perpendicular Head

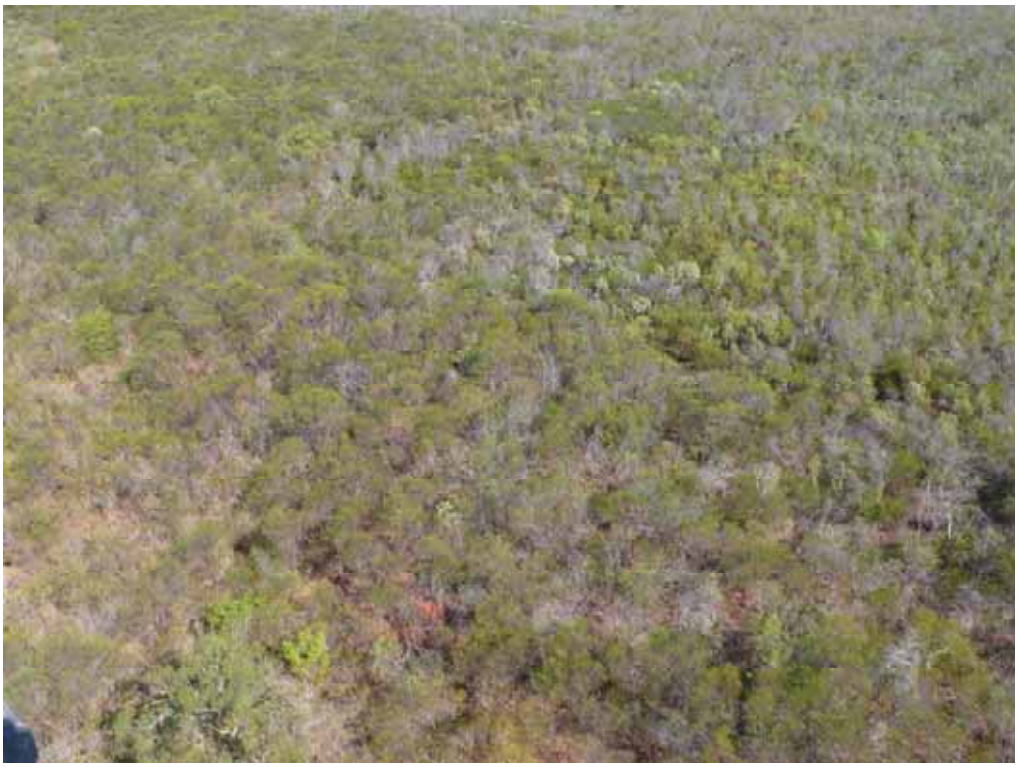
Mixed Shrubland Thickets

Close-up of the mixed shrubland thicket dominated by *Acacia tumida* inland from Perpendicular Head

Pindan Woodland

South of Weedong Lake the pindan woodland extensive patches of defoliated Darwin woollybutt (*Eucalyptus miniata*) occur. The cause of the defoliation is not known. The surrounding *Corymbia flavescens* and *Eucalyptus tectifica* do not appear to be affected.

East of Tappers Inlet the pindan woodland is dominated by *Corymbia flavescens* and *Acacia tumida*



South of Tappers Inlet large patches of unburnt *Acacia monticola* are common in the pindan woodland

Eroding pindan cliffs at Pender Bay fringed with pindan woodland

Ephemeral Wetlands

Weedong Lagoon (viewed from the west) showing the ponded water and fringing aquatic vegetation behind the coastal sand dune barrier

Weedong Lagoon showing dense fringing stand of bulrush (*Typha domingensis*) as well as a narrow band of *Melaleuca dealbata* on the landward side of the mobile dune

APPENDIX C

COULOMB POINT TO QUONDONG POINT VEGETATION PHOTOGRAPHS

PERPENDICULAR HEAD–NORTH HEAD, PARKER POINT, GOURDAN BAY AND COULOMB-QUONDONG AND GOURDON BAY - VEGETATION ASSESSMENT

APPENDIX C - Coulomb Point to Quondong Point Vegetation Photographs

Monsoon (Vine) Thicket

Open vine thicket near James Price Point dominated by *Mimusops elengi*

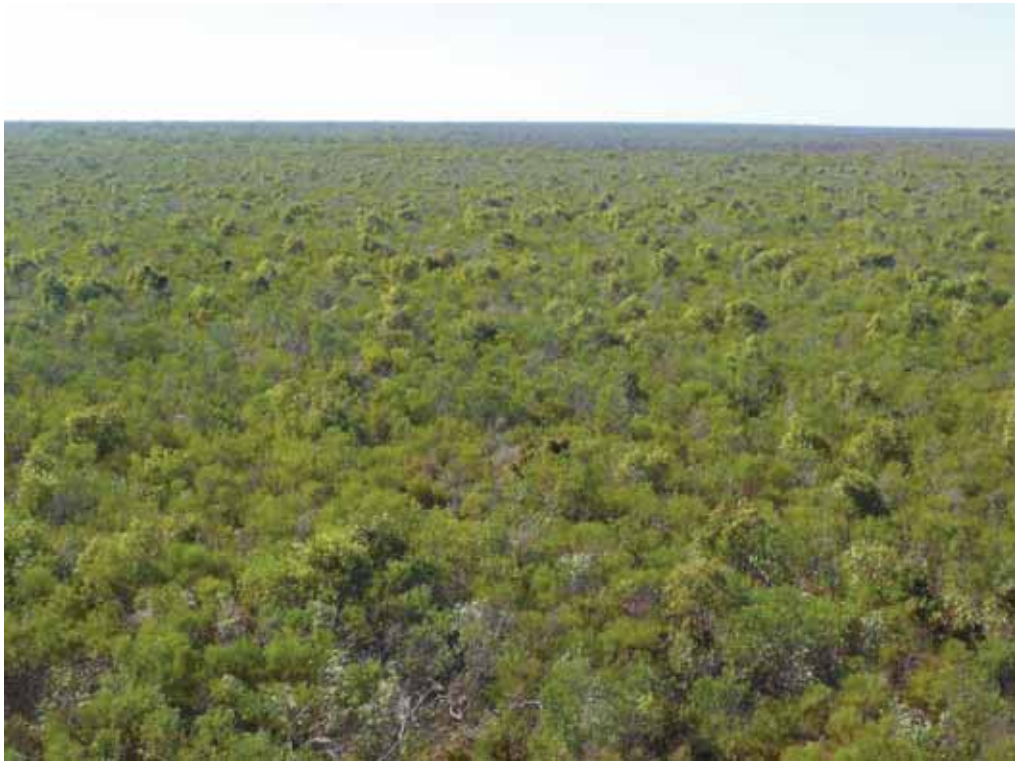
Mixed vine thicket with ghost gums (*Corymbia flavescens*) near Coulomb Point

Coastal Heath

Coastal heath on eroded pindan cliffs north of James Price Point dominated by prostrate *Acacia tumida*

Pindan Woodland

Pindan woodland dominated by *Corymbia dampieri* at Quondong Point



Coastal unburnt pindan woodland showing wind-pruned canopies east of James Price Point

Ephemeral Wetlands

The only claypan recorded from any of the study sites holding water is located south east of Coulomb Point. Known locally as ‘Flow Dam’ it has been modified to accommodate watering of stock.

At the northern boundary of the Coulomb Point-Quondong study area is a sandy creek line dominated in parts by salt water paperbark (*Melaleuca alsophila*), with red river gums (*Eucalyptus camaldulensis*) and clumps of *Pandanus spiralis*

South of Coulomb Point, *w*here drainage lines are truncated by coastal dunes, dense patches of *Lophostemon grandiflorus* occur often mixed with the paperbark (*Melaleuca dealbata* and *M. alsophila*)

APPENDIX D

GOURDON BAY VEGETATION PHOTOGRAPHS

PERPENDICULAR HEAD–NORTH HEAD, PARKER ISLAND, GOURDON BAY AND COULOMB-QUONDONG - VEGETATION ASSESSMENT

APPENDIX D - Gourdon Bay Vegetation Photographs

Mangroves

Mixed mangrove at Gourdon Bay dominated by *Avicennia marina* (light green) and *Rhizophora stylosa* (dark green)

Mangrove showing *Ceriops tagal* (dark green) on landward edge and stunted *Avicennia marina* on seaward edge

Coastal Communities

Coastal dunes at Gourdon Bay dominated by *Acacia bivenosa*

Outcropping limestone dominated by *Acacia bivenosa* only occurs south at Gourdon Bay

Supra Tidal Mudflats

Supra tidal mudflat north of Port Smith with stunted *Avicennia marina,* samphires (*Tecticornia* spp.) and salt water couch (*Sporobolus virginicus*)

Coastal Heath

Coastal heath dominated by *Acacia stellaticeps* on eroded lateritised pindan at Cape Du Boulay

Coastal Swale Thickets

Coastal swale thickets behind dunes at Cape Latouche Treville

Pindan Shrubland

Unburnt pindan shrubland north of Port Smith with scattered ghost gums (*Corymbia flavescens*) and *Acacia eriopoda*

Regenerating pindan shrubland south of Gourdon Bay with scattered ghost gums (*Corymbia flavescens*) and bloodwood (*C. dampieri*)

South of Gourdon Bay scattered Broome bloodwoods (*Corymbia zygophylla*) dominate the burnt pindan shrubland

Ephemeral Wetlands

Ephemeral claypan surrounded by Pleistocene dunes at Cape Latouche Treville. The dominant species are the grasses *Sporobolus virginicus* and the introduced buffel (*Cenchrus ciliaris*)

Melaleuca alsophila on seepage areas behind coastal dunes south of Gourdon Bay