Dinosaur Coast National Heritage Management Plan 2025

WARNING: This plan contains names and images of deceased Aboriginal and Torres Strait Islander people.

We acknowledge the Traditional Owners and Custodians of the lands on which we live, work, and conduct our research and we pay our respects to their Ancestors and Descendants. We support the continuation of their culture and protection of Country.

The Dinosaur Coast National Heritage Management Plan 2025 received funding from the Australian Heritage Grants Program. This management plan for the dinosaur tracks and associated ichnofossils, plant macrofossils and Cretaceous depositional environments of the Broome Sandstone exposed in the section of the Dampier Coast intertidal zone shown on Map 1.2 has been prepared for the purposes of Section 324X of the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*.

The plan was prepared for Dinosaur Coast Management Group Inc, PO Box 2478 Broome WA 6725.

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Significant contributions were received from the Goolarabooloo Millibinyarri Indigenous Corporation; UQ Dinosaur Lab (School of the Environment, formerly the School of Biological Sciences, The University of Queensland); Yawuru Registered Native Title Holders Body Corporate;

and Dianne Bennett. In addition, the Department of Biodiversity, Conservation and Attractions; the Department of Climate Change, Energy, the Environment and Water; the Kimberley Ports Authority; and the Shire of Broome collaborated throughout and provided valuable input.

Front cover image: Damian Kelly

All uncredited images are used courtesy of Stephanie Johnston & Associates.

The recommended citation for this publication is: Dinosaur Coast National Heritage Management Plan 2025 Dinosaur Coast Management Group, Broome.

Dedication

[IMG] Michael John Corpus (Micklo) 10 July 1959 – 8 May 2022 (Photo: Steve Salisbury)

This Dinosaur Coast National Heritage Management Plan is dedicated to the memory of Michael John Corpus (Micklo) 10 July 1959 – 8 May 2022.

A senior Yawuru Man and Native Title Holder (Rubibi Determination of 2006), Micklo has always said 'look after Country and it will look after you'.

As Chairperson of the Dinosaur Coast Management Group since 2016, Micklo was always focussed on the need to protect the ichnofossils of the Broome Sandstone, both for their relevance to the cultural heritage of the Dampier Peninsula and for their scientific significance globally.

The preparation of this plan has brought together a diverse group of people and agencies who now have a shared commitment to protect the National Heritage values of the dinosaur tracks and the rocks they are preserved in – First Nations peoples, not-for-profit organisations, community groups, researchers, business interest groups, local government, state government departments, federal government departments, and statutory authorities. Let us each deliver our implementation responsibilities as a mark of respect to a man who loved his Country.

Permission has been granted by the family to publish this dedication and image, and to acknowledge Michael John Corpus by name.

Contents

[IMG] Australia's Dinosaur Coast follows the coastline northwards from Roebuck Bay and Broome to Cape Leveque at the tip of the Dampier Peninsula in the Kimberley region of Western Australia.

Foreword

Carmen Lawrence AO

Patron of the Dinosaur Coast Management Group Inc.

[IMG] Photo: Steve Salisbury

Just over a decade ago, as Chair of the Australian Heritage Council, I was delighted to preside over the inscription of the West Kimberley in the National Heritage List. The enduring, deep cultural significance of the Kimberley area to the Aboriginal people and the unrivalled, largely unspoiled beauty and power of the landscape easily commanded attention in the listing process. Less obvious, and nearly overlooked in early assessments, but ultimately included for their heritage significance, were the ichnofossils (trace fossils including dinosaur tracks) preserved in the Broome Sandstone and exposed in the intertidal zone between Roebuck Bay and Cape Leveque.

Recognising the significance of the fossils and protecting and preserving these stunning records of the Cretaceous period quickly became the focus – indeed the obsession – of a dedicated group of local volunteers, including the former beloved Chairman of the Dinosaur Coast Management Group, Yawuru man, Michael Corpus (Micklo). The group have engaged in energetic public advocacy and long hours of research and discussion to highlight the cultural and scientific importance of these dinosaur tracks. Together with the responsible public officials, they have now produced this comprehensive and detailed management plan. Throughout, the importance of continued scientific research and documentation is highlighted. Critical too, for effective long-term protection of the fossils is the emphasis in the plan on the application of the precautionary principle in any decisions affecting the area.

Although too many of us take our cultural and heritage riches for granted, we can be deeply grateful that, with the implementation of this plan, these unique treasures will be preserved for future generations. With effective protection, World Heritage Listing would be a distinct possibility.

Summary

Australia's Dinosaur Coast follows the coastline northwards from Roebuck Bay and Broome to Cape Leveque at the tip of the Dampier Peninsula in the Kimberley region of Western Australia. The Broome Sandstone located in the intertidal zone (ITZ) along this coast is renowned for its fossilised dinosaur tracks and preserves a variety of other animal, plant and fossils of the Lower Cretaceous Period of the Mesozoic Era. These values are recognised under two criteria of the West Kimberley National Heritage listing. The primary aim of this Dinosaur Coast National Heritage Management Plan 2025 (DCNHMP) is to enable multiple stakeholders to work in partnership with the area's Indigenous peoples to appreciate, study, protect and manage these National Heritage values (NHVs) into the future.

The DCNHMP does not include the full extent of the known Broome Sandstone outcrops, dinosaur tracks and other Lower Cretaceous fossils within the West Kimberley National Heritage Place, but considers only the 50 kilometres of coastline between Willie Creek and Crab Creek. Neither does the DCNHMP attempt to describe and manage all the natural and cultural values associated with this dynamic landscape. Instead, it serves as a comprehensive ancillary document to a suite of existing and complementary joint management plans (JMPs) for the marine and terrestrial components of the Yawuru Conservation Estate around Broome, and the multiple local, state and federal statutory frameworks that affect or intersect the defined intertidal management area.

Chapter 1 introduces the management setting and outlines the objectives and limitations of the DCNHMP. Because the mapped National Heritage boundary for this section of the coast includes only a limited portion of the ITZ referred to in the written descriptions and statements of significance contained in the 2011 Commonwealth Gazette notice for the National Heritage listing, this section defines and maps a management area made up of nine distinct management zones that better reflect those written descriptions.

Chapter 2 examines the scientific context of the Dinosaur Coast NHVs, gives an overview of the landscape's geological and palaeontological features and summarises the history of recognition, research and management of that heritage to date. As the National Heritage listing occurred in 2011, this chapter brings readers up to date with the latest available scientific data and research.

Chapter 3 provides detailed descriptions and maps for each management zone, identifies the areas of significance and vulnerabilities within the landscape, and includes updated geological and palaeontological information and additional management resources. The DCNHMP primarily uses English-language place names to identify locations and zones related to the plan, recognising that Yawuru Registered Native Title Holders Body Corporate (Yawuru RNTBC, often referred to as the Yawuru PBC) and Goolarabooloo may use different place names that do not necessarily coincide with the defined management zones. Areas of relevance to the West Kimberley National Heritage listing are identified, categorised and mapped within each zone, based on their geological and palaeontological significance, as advised by The University of Queensland (UQ) Dinosaur Lab team.

Chapter 4 details the relevant geological and palaeontological values and summarises other documented heritage values contained within the DCNHMP management area, including a range of biological, historical and cultural values associated with the cultural landscape and its diverse custodians. Here further independent specialist anthropological research and documentation is recommended as the next step towards recognition of cultural values associated with the ichnofossils.

Chapter 5 sets the context for the development of management policy by identifying the key issues, opportunities and constraints associated with the cultural landscape. These range from the fragility and dynamism of the landscape in the face of natural and human impacts, to the pressures of population growth, a growing number of visitors and increasing visitor interest. The complexity of land tenure, resourcing and management of the public realm and the need for a more strategic management approach to supervision and monitoring of the NHVs and other relevant geological and palaeontological features located in the ITZ is at the heart of this discussion.

An overview of the self-assessment and referral obligations under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) recommends application of the precautionary principle when undertaking self-assessment due to the inaccuracies in the mapped Commonwealth Gazette boundary and the need to take into account upstream impacts on the NHVs. A summary of the complex management frameworks and associated land managers and land tenures, and a list and analysis of specific proposals that illustrate potential pressures on the Broome Sandstone NHVs are also included in this chapter.

Finally, Chapters 6 and 7 outline a joint management framework incorporating a ten-year implementation plan of actions for land managers and other members of the Broome community to protect, manage and promote awareness and understanding of the West Kimberley Dinosaur Coast using an adaptive management approach, and for that process to create value and benefit for current and future generations.

1 Introduction

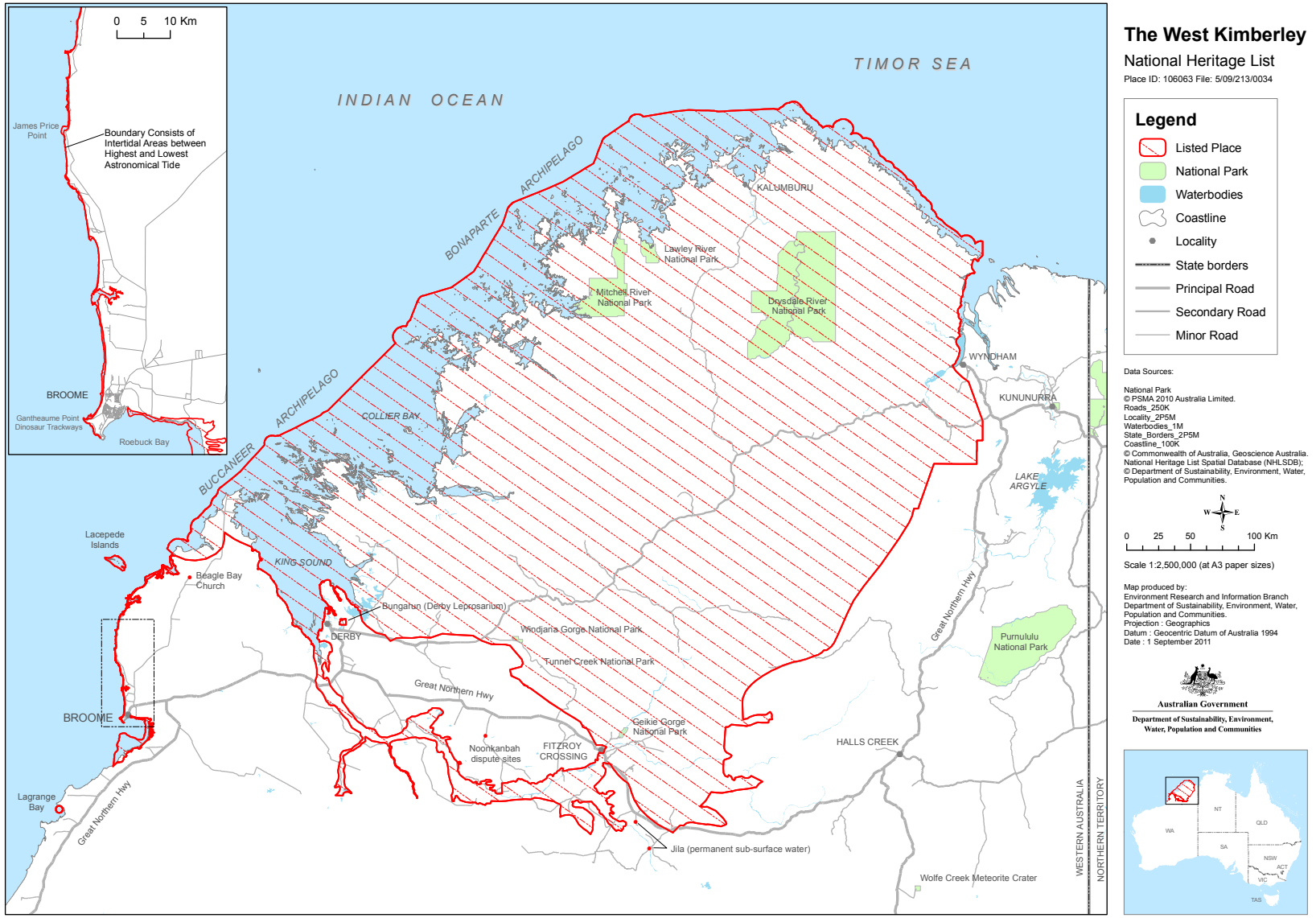
1.1 NHVs for the Dampier Coast dinosaur tracks and Cretaceous landscape

The West Kimberley (Map 1.1) was inscribed as a place on Australia's National Heritage List (NHL) established by the EPBC Act on 31 August 2011, encompassing an area of approximately 19.2 million hectares. The West Kimberley National Heritage Place is described as

> *… one of Australia's most special places. It is a vast area of dramatic and relatively undisturbed landscapes that has great biological richness and provides important geological and fossil evidence of Australia's evolutionary history.*
>
> *With sheer escarpments and pristine rivers that cut through sandstone plateaux and ancient coral reefs to create spectacular waterfalls and deep gorges, the region's remoteness has created a haven that supports plant and animal species found nowhere else on the Australian continent.*
>
> *Against the backdrop of this extraordinary landscape is woven a remarkable account of Aboriginal occupation over the course of more than 40,000 years and the story of European exploration and settlement, from William Dampier's landing at Karrakatta Bay to the development of rich and vibrant pastoral and pearling industries that continue today* (DCCEEW 2022).

The ichnofossils (trace fossils including dinosaur tracks) plant fossils and depositional environments of the Lower Cretaceous Broome Sandstone exposed in the ITZ of the Dampier Coast between Roebuck Bay and Cape Leveque have been recognised under criterion (b) and criterion (d) of the West Kimberley National Heritage listing:

> ***Criterion (b)*** *The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural and cultural history.*
>
> ***VALUES:*** *Ecology, biogeography and evolution – Dampier Coast*
>
> *The Dampier Coast dinosaur tracks have outstanding heritage value to the nation under criterion (b) as the best and most extensive evidence of dinosaurs from the western half of the continent, some of which are unknown from body fossils; for the diversity and exceptional sizes of the sauropod prints; and the unique census of the dinosaur community that they provide* (COMMONWEALTH OF AUSTRALIA 2011).
>
> ***Criterion (d)*** *The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: (i) a class of Australia's natural and cultural places; or (ii) a class of Australia's natural and cultural environments.*



The West Kimberley

National Heritage List

Place ID: 106063 File: 5/09/213/0034

Legend

- Listed Place
- National Park
- Waterbodies
- Coastline
- Locality
- State borders
- Principal Road
- Secondary Road
- Minor Road

Data Sources:

National Park
© PSMA 2010 Australia Limited.
Roads_250K
Locality_2P5M
Waterbodies_1M
State_Borders_2P5M
Coastline_100K
© Commonwealth of Australia, Geoscience Australia.
National Heritage List Spatial Database (NHLSDB);
© Department of Sustainability, Environment, Water, Population and Communities.

0 25 50 100 Km

Scale 1:2,500,000 (at A3 paper sizes)

Map produced by:
Environment Research and Information Branch
Department of Sustainability, Environment, Water, Population and Communities.
Projection : Geographics
Datum : Geocentric Datum of Australia 1994
Date : 1 September 2011

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Map 1.1 West Kimberley National Heritage listing location and boundary

VALUES: *Ecology, biogeography and evolution of the Dampier Coast Cretaceous landscape*

> *The dinosaur tracks and associated ichnofossils, plant macrofossils and Cretaceous depositional environments of the Broome Sandstone exposed in the intertidal zone of the Dampier Coast have outstanding heritage value to the nation under criterion (d) for preserving snapshots of the ecology of the Mesozoic* (COMMONWEALTH OF AUSTRALIA 2011).

These NHVs are described in detail in Chapter 4 and the complete Commonwealth Gazette notice for the West Kimberley is at Appendix A. This DCNHMP provides a management plan for the ichnofossils and Lower Cretaceous landscape of the Broome Sandstone exposures along the southern end of the Dampier Peninsula, within the project area described in Chapter 1.4. The DCNHMP does not include the full extent of known Broome Sandstone outcrops, dinosaur track and other Lower Cretaceous fossils within the West Kimberley NHL area, but focuses on the coastal area around Broome between Crab Creek and Willie Creek (Map 1.2). The northern boundary of the management plan area coincides with the boundary of the Yawuru Native Title Determination area. It is hoped that the DCNHMP will be extended or serve as a precursor for additional areas of the Dampier Peninsula coastline.

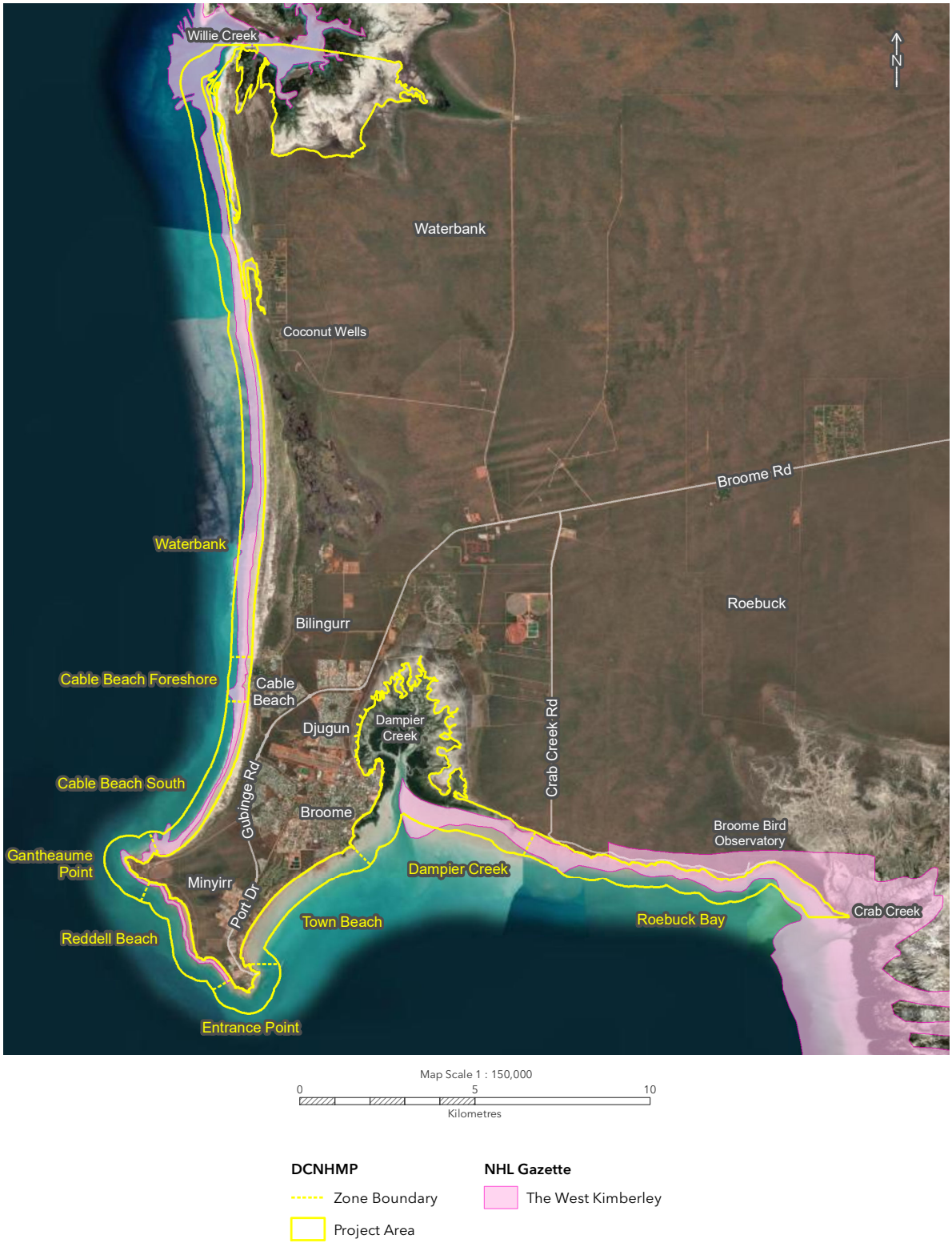
1.2 Development of the management plan

1.2.1 Guidelines for developing a national heritage management plan

The Commonwealth guidelines for the development of national heritage management plans describe what should be included.

> *A management plan is a tool intended to provide sufficient information for managers to protect and manage the heritage values (local, state and national) of heritage places.*
>
> *It is in an owner's interest to prepare a management plan to guide day-to-day management, assist in decision-making and to support local, state and Commonwealth approval processes. A management plan should comprehensively describe the place, state its official National Heritage values and identify any other heritage listings. It should specify the objectives, policies and principles that will govern the management of the place's heritage values and provide guidance on the preparation of project proposals to ensure that there are no adverse impacts on heritage values. It may also identify areas and items that do not embody heritage values or that are intrusive, and allow these to be removed or altered without affecting the values of the place* (DEWHA 2008: 3).

These 'Working Together' guidelines (DEWHA 2008) are based on the requirements of the EPBC Act, Regulations, Schedule 5A (Management plans for National Heritage Places) and Schedule 5B (National Heritage management principles) (see Appendix B). The 'Working Together' guidelines are consistent with the management plan development guidelines in the Australia ICOMOS (AICOMOS) Burra Charter (AICOMOS 2013a). The International Council on Monuments and Sites (ICOMOS) is the Heritage division of the United Nations Educational, Scientific and Cultural Organisation (UNESCO). In addition to these guidelines, the plan has been informed by other National and World Heritage management plans.



Map 1.2 DCNHMP management area and management zone boundaries

1.2.2 Dinosaur Coast Management Group, project team and project steering group

The Dinosaur Coast Management Group (DCMG) is a not-for-profit organisation, formed in 2015 to protect and promote the dinosaur tracks of the Dampier Peninsula and to educate the public about their cultural and scientific importance (dinosaurcoast.org.au). DCMG obtained grant funding from the Australian government to support the development of the DCNHMP and engaged an Adelaide-based consulting team to develop and produce the plan comprising Stephanie Johnston (Stephanie Johnston & Associates), Neale Draper (Neale Draper & Associates) and Andrew Maland (Andrew Maland GIS).

To guide the development of a shared management plan, DCMG recruited a project steering group made up of representatives of the following stakeholder groups who are responsible for implementation of the DCNHMP:

- Department of Biodiversity, Conservation and Attractions (DBCA), a state government department and joint management partner (JM Partner) for the Yawuru Conservation Estate (all conservation and marine parks);
- Department of Climate Change, Energy, the Environment and Water (DCCEEW) Commonwealth – observing;
- Dinosaur Coast Management Group (DCMG), a not-for-profit organisation focussed on the protection and promotion of local dinosaur tracks;
- Goolarabooloo Millibinyarri Indigenous Corporation (GMIC) Aboriginal Knowledge Holders, Song Cycle and Lurujarri Trail custodians;
- Kimberley Ports Authority (KPA) managers of Broome Port, ITZ and surrounding waters;
- Shire of Broome (SOB), local government body and planning authority, JM Partner for Yawuru Minyirr Buru and Guniyan Binba Conservation Parks;
- UQ Dinosaur Lab, School of the Environment (formerly the School of Biological Sciences), The University of Queensland (UQ); and
- Yawuru Registered Native Title Holders Body Corporate (Yawuru RNTBC, often referred to as the Yawuru PBC) representing Native Title Holders and Aboriginal Traditional Owners.

The steering group has been consulted at key stages throughout the development of the management plan, and their input has been incorporated where appropriate. Additional consultation has included the Department of Planning, Lands and Heritage (DPLH), Environs Kimberley (Kimberley region environmental NGO), Australia's North West Tourism (ANW), the Broome Chamber of Commerce and Industry (BCCI) and the Broome Historical Society and Museum (BHS&M).

1.2.3 Methodology

The development of the DCNHMP has followed the Commonwealth guidelines 'Working together: managing National Heritage Places' (DEWHA 2008). As recommended in that guide, this management plan has been developed and structured using the best-practice standards of the Burra Charter (AICOMOS 2013a).

The methodology used by the research team and DCMG committee has included extensive background research and direct consultation with the project steering group and individual stakeholders over a four-year period, including field trips and face-to-face consultation meetings in Broome, online meetings, and circulation of draft management plan components for feedback. The time frame for preparation of the management plan primarily was determined by the acquittal conditions of two Australian Heritage Grants to DCMG.

In relation to cultural heritage and consultation, the methodology is guided by:

(i) the AICOMOS Burra Charter for Places of Cultural Significance (AICOMOS 2013a);

(ii) the associated Practice Notes on Indigenous Cultural Heritage Management (AICOMOS 2013b);

(iii) Understanding and assessing cultural significance (AICOMOS 2013c);

(iv) Intangible cultural heritage and place (AICOMOS 2017);

(v) the Australian Heritage Commission's (2002) 'Ask First' guidelines;

(vi) the (former) Department of Agriculture, Water and the Environment's (DAWE) 'Engage early – guidance for proponents on best practice Indigenous engagement for environmental assessments under the *Environment Protection and Biodiversity Conservation Act 1999'* (DAWE 2016).

1.3 Vision, objectives and limitations

1.3.1 Vision and objectives

The vision for this DCNHMP is:

> *To understand, protect and promote the Dinosaur Coast and create opportunities for the Broome community.*

The primary purpose of the DCNHMP is to provide a shared national heritage management plan to enable all stakeholders to facilitate this vision through the following range of objectives:

1. To increase understanding and awareness of the Dinosaur Coast and its NHVs;

2. To conserve and protect the NHVs of the Dinosaur Coast with best practice adaptive management;

3. To monitor and manage the impacts of coastal erosion and other environmental processes;

4. To manage the impacts of the expansion of Broome and associated coastal development and infrastructure;

5. To manage increasing visitor interest in the tracks and the greater number of visitors;

6. To create opportunities for the Broome community; and

7. To improve the experience of visitors to the Dinosaur Coast.

1.3.2 Other NHVs in the management area

The DCNHMP is concerned with the NHVs of the Broome Sandstone outcrops, dinosaur tracks and associated fossils along the coast of the southern Dampier Peninsula and Roebuck Bay (Map 1.2). Other NHVs associated with the West Kimberley National Heritage Place may intersect the DCNHMP management area and these are discussed further in Chapter 4.

This management plan also refers to the cultural heritage significance of dinosaur tracks to some local Indigenous groups in Chapter 4.3.2. Detailed, site-specific documentation of these cultural heritage associations lies outside the scope of the management plan.

1.3.3 Spatial data limitations

The DCNHMP management area is shown in Map 1.2 and described in Chapter 1.4 below. Criterion (d) of the West Kimberley National Heritage listing refers to the dinosaur tracks and associated ichnofossils, plant macrofossils and Cretaceous depositional environments of the Broome Sandstone exposed in the ITZ of the Dampier Coast from Roebuck Bay to Cape Leveque, and this location information is annotated to the map inset for these NHVs in Map 1.1. However, the Commonwealth Gazette boundary does not always match the described area of where these values actually occur. At the time that the West Kimberley was inscribed on the NHL, there was no accurate spatial information for the extent of the Broome Sandstone exposures, the distribution of the ichnofossils and associated palaeoenvironmental features, nor indeed for the extent of the ITZ itself. A large portion of the ITZ is not captured in the originally gazetted mapping (see Chapter 3, Maps 3.1–3.21). There are also internal inconsistencies and ambiguities between the gazetted map, the written boundary coordinates and the written descriptions of where the values are located. The majority (56%) of the areas now mapped as containing geological and palaeontological features relevant to the National Heritage listing are located outside of the gazetted NHL boundary. The substantial spatial data that have been recorded since the listing will therefore need to be incorporated into any future update of the NHL mapping of the Dampier Coast ITZ.

Specifically, there are several inherent difficulties in mapping the ITZ as described in the National Heritage listing. The landward boundary used for this DCNHMP is the best representation of the highest tide mark (Highest Astronomical Tide, HAT), mapped primarily from cadastral boundaries and extent of tidal inundation around Dampier Creek.

There are few datasets available of the Lowest Astronomical Tide (LAT) line that have complete coverage of the management area on which to base the seaward boundary. Of those available, all ultimately are unsuitable as they are positioned to the landward side of recorded palaeoenvironmental features exposed within the ITZ. Commonly available versions of the LAT dataset appear to be coincident with that shown on the 1:50,000 scale Commonwealth-produced maps of the Broome region published in 1997 using data sourced in 1988 and 1989, suggesting that these datasets are quite possibly out of date and inaccurate. Data was sought directly from Geoscience Australia for their yet unreleased lowest tide mapping which is to form part of the next

Australian Maritime Boundary (AMB) dataset. This data was derived from a series of aerial imagery captured over a much greater period. The data has been released for use in the NHL management plan without the straight-line segments the AMB now includes to close bay areas such as Roebuck Bay so as to more generally follow the open coastline. Unfortunately, this dataset also appears to capture the average lowest tide only, with known heritage features and field observations again falling seaward of this line.

In general, the use of any recorded version of HAT and LAT or High Water Mark (HWM)/Low Water Mark (LWM) to map the ITZ as a boundary is problematic, as this area is highly variable in width around the coast, being dependent on many highly localised environmental conditions. Although the intertidal area can be easily described with words it is very difficult to map accurately.

With the benefit of data provided by UQ, the proposed Dinosaur Coast Management Reference Group (DCMRG) now has access to spatial data that accurately records the low waterline in key areas of the DCNHMP management area, and the spatially defined areas containing palaeoenvironmental features relevant to the National Heritage listing. Using these data as a guide, the use of a constant 600 metre width ITZ based on the coastline as defined by Western Australian state (Landgate) data has been used to define a simple and reliable seaward boundary that incorporates the entirety of the LWM mapping and mapped geological and palaeontological features.

1.3.4 EPBC Act referrals

DCCEEW (formerly DAWE) has advised that the EPBC Act will only apply to values contained within the current gazetted NHL boundary (though see Chapter 1.3.3 above regarding ambiguities in the gazetted boundary spatial mapping and written boundary descriptions). Actions 'upstream' also come under the EPBC Act, meaning that values contained within the gazetted boundary (e.g., Broome Sandstone, dinosaur tracks, human footprints, etc.) are protected from actions that may occur outside the boundary, but that cause collateral impacts on those internally located values. However, that does not mean that a 'value' – e.g., Broome Sandstone exposures, tracks or fossil human footprints – that occurs outside the NHL-gazetted boundary is protected under the EPBC Act. That said, any threats to areas outside the gazetted boundaries may be relevant to the extent that they diminish the values located within the boundary (e.g., an impact on the diversity of track types or the significance of certain track associations or trackmaker behaviours). When deciding whether or not a proposed action is likely to have a significant impact on the gazetted NHVs, the precautionary principle is relevant. Until the inaccuracies described in Chapter 1.3.3 for the mapped gazettal boundary are corrected, the referral process for assessment of development actions under the EPBC Act needs to follow the gazetted written description of the NHL boundary for this section of the Dampier Coast as being the ITZ bounded by the highest and lowest astronomical tides. Further guidance on EPBC Act obligations and referral processes is provided in Chapter 5.1 and Appendix C.

The DCNHMP includes consideration of Broome Sandstone, dinosaur tracks and other geological and palaeontological features located outside the current mapping of the gazetted NHL boundary, and also makes the recommendation that the NHL map boundary be updated and expanded to include current, accurate data for the ITZ and the ongoing research and documentation of Broome Sandstone, dinosaur tracks and human footprints. Consequently, both the current mapping interpretation of the gazetted NHL boundary and the updated management plan boundary are shown on all relevant maps in the management plan.

1.4 Project area location and description

1.4.1 Project location

Dinosaur tracks in the Broome Sandstone have been recorded at numerous places along the Dampier Peninsula coastline, but the DCNHMP covers only the area between Willie Creek and Crab Creek. The DCNHMP management area ("the project area") is generally the ITZ along approximately 50 kilometres of coastline centred on the town of Broome (Map 1.2). This occurs both within and outside the West Kimberley National Heritage Place (Maps 1.3 and 1.4). The regulatory implications of this are discussed in Chapter 1.3.4 (below). Spatial data limitations in the definition of the management plan boundary are summarised above in Chapter 1.3.3.

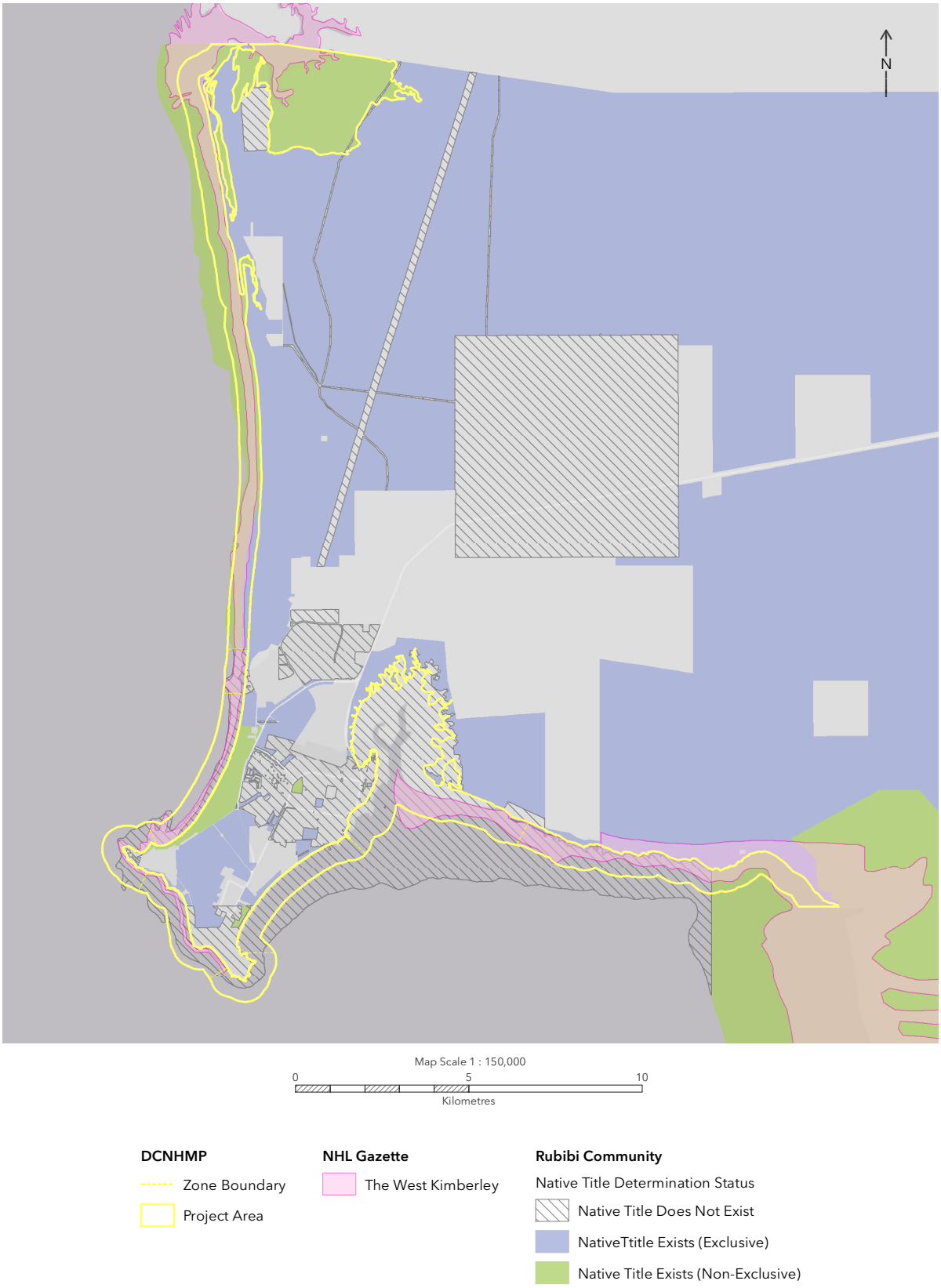
The project area commences in the southeast at the mouth of Crab Creek, which is situated in the northeast of Roebuck Bay, continues west along the northern shore of Roebuck Bay to Dampier Creek, turns southwest through Broome Town Beach and extends to Entrance Point, northwest past Reddell Point along Reddell Beach to Gantheaume Point, turns first northeast then north before continuing along Cable Beach past the Cable Beach Foreshore area to Cape Latreille (Coconut Wells), continues north to a point midway across Willie Creek, and finally turns east to include the southern shore of Willie Creek before terminating at a point approximately midway along the Willie Creek eastern shoreline.

The landward boundary for the management plan area is derived from the most appropriate cadastral boundaries adjacent to and above the tidal HWM. The seaward boundary is defined by a constant 600 metre seaward buffer of the coastline as defined by Western Australian state (Landgate) spatial data.

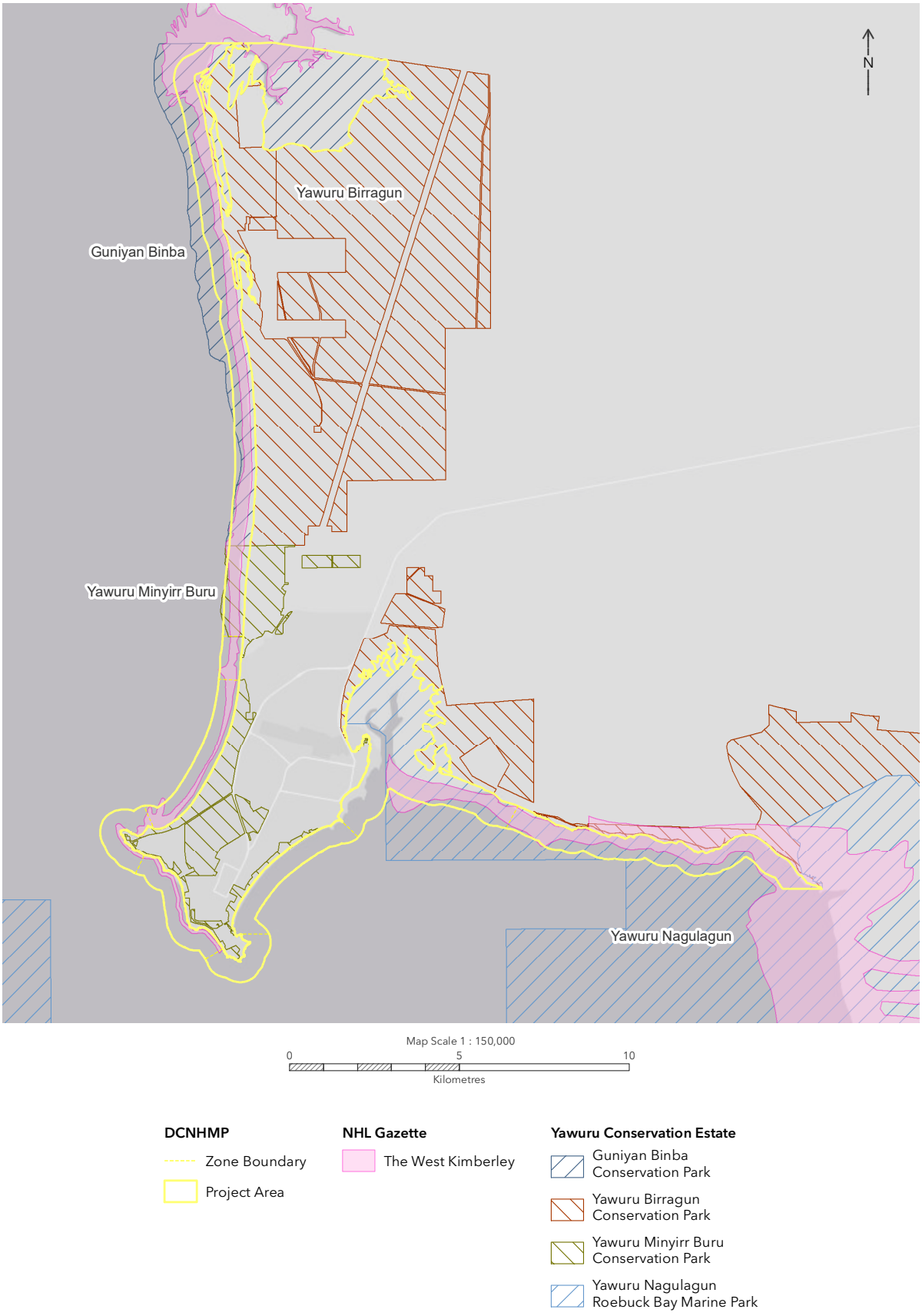
The landward boundary of the project area commences in the southeast at the mouth of Crab Creek (located in the northeast of Roebuck Bay). It then continues west along the northern shore of Roebuck Bay to Dampier Creek, turns southwest through Broome Town Beach and extends to Entrance Point. It then goes northwest past Reddell Point along Reddell Beach to Gantheaume Point, turns first northeast, then north along Cable Beach past the Cable Beach Foreshore area to Cape Latreille (Coconut Wells). From here the boundary continues north to the Willie Creek inlet before turning south then east and finally northeast, before terminating at a point approximately midway along the eastern inlet coastline and coincident with the intersection of the northwestern boundary of the Rubibi Community Native Title Determination.

The northern project area boundary line connecting the landward to the seaward boundary runs generally east to west, commencing landward midway along the eastern shoreline of the Willie Creek estuary, continues seaward west-northwest across the estuary, before turning west to continue out through the mouth of Willie Creek to meet the 600-metre offshore seaward boundary. The northern project boundary is consistent with northwestern boundary of the Rubibi Community Native Title Determination (Map 1.3).

The seaward boundary commences at the point in the mouth of Willie Creek where the Rubibi Community Native Title Determination northwestern boundary and the 600-metre offshore boundary intersect. It continues parallel and 600 metres offshore from the coastline, heading first south to Cable Beach, then southwest to Gantheaume Point, southeast past Reddell Beach to Entrance Point, turning northwest around Entrance Point then continuing northeast along Town Beach to the Dampier Creek inlet, then east-southeast and finally southeast along the northern shore of Roebuck Bay to Crab Creek.



Map 1.3 Rubibi Native Title Determination Status



Map 1.4 Yawuru Conservation Estate

The southeastern project area boundary line, connecting the 600-metre offshore boundary to the landward boundary, commences at a point due west and seaward of the most southeasterly point of the landward boundary near Crab Creek, and extends approximately 1,135 metres due east in a straight line to connect the 600-metre offshore boundary to the point of commencement.

From Willie Creek south almost to the Cable Beach Foreshore Reserve, most of the intertidal project area has non-exclusive Native Title and is part of the Yawuru Guniyan Binba Conservation Park (DBCA 2020). The southeastern end of the project area at Roebuck Bay from west of the Broome Bird Observatory (BBO) to Crab Creek also has non-exclusive Native Title and is within the Yawuru Nagulagun/Roebuck Bay Marine Park (DPW 2016b). Nearly all of the Roebuck Bay section of the DCNHMP area is within the Yawuru Nagulagun/Roebuck Bay Marine Park. Native Title has been extinguished within the remainder of the project area bordering Broome and Dampier Creek/Roebuck Bay. Currently neither the Yawuru Birragun Conservation Park (DPW 2016a) nor the Yawuru Minyirr Buru Conservation Park (DBCA 2018) extend into the ITZ, although the Yawuru Cultural Management Plan (Yawuru CMP) (Yawuru RNTBC 2016) includes a recommendation to expand the Yawuru Conservation Estate to include the Port of Broome section of the ITZ.

1.4.2 Management zones

To enable more fine-grained reporting and targeted management recommendations the greater project area is divided into nine distinct management zones (Map 1.2):

1. Roebuck Bay
2. Dampier Creek
3. Town Beach
4. Entrance Point
5. Reddell Beach
6. Gantheaume Point
7. Cable Beach South
8. Cable Beach Foreshore
9. Waterbank

These zones are primarily defined by coastal landforms and the related presence or absence (to date) of Broome Sandstone and other geological units that preserve features relevant to the West Kimberley National Heritage listing, with secondary consideration given to common levels of access, and tertiary consideration given to levels of immediate risk. Areas containing geological and palaeontological features relevant to the National Heritage listing are mapped within each zone and categorised either as ‘outstanding’ or simply ‘relevant’. The nine zones are described in detail in Chapter 3.

The occurrence of dinosaur tracks is restricted to the location of Broome Sandstone within the greater project area, while the Broome Sandstone itself is a recognised NHV. Known exposures of Broome Sandstone generally lie within but are not entirely bounded by the best possible mapping of the ITZ (see Chapter 1.3.3). Other features relevant to the National Heritage listing may occur in other rock units in the study area.

2 Scientific context

2.1 Geological and palaeontological overview

2.1.1 Broome Sandstone

The Broome Sandstone is a Lower Cretaceous stratigraphic unit within the Canning Basin of northwestern Western Australia, currently dated by plant macrofossils, dinocysts and palynology to the Lower Cretaceous (Valanginian to Barremian), making it between 140 and approximately 127 million years old (McLoughlin 1996; Nicoll et al 2009; Smith et al 2013; Salisbury et al 2017: 17).

> *During the Mesozoic, through much of Jurassic and into Early Cretaceous, the Canning Basin was covered by shallow marine shelves and marginal continental platforms that formed the eastern margin of the expanding rift system between Australia and India-Madagascar (Veevers & Wells 1961; Veevers 1967; Playford et al 1975; Leslie et al 1976; Plumb 1979; Forman & Wales 1981)* (McCrea et al 2011: 12).
>
> ***Broome Sandstone***
>
> *The Broome Sandstone forms a portion of the eighth depositional cycle within the Canning Basin, emplaced during three cycles of transgression and regression (Interval 8 of Forman & Wales 1981). The base of the Broome Sandstone disconformably overlies the Upper Jurassic–Lower Cretaceous (Tithonian–Berriasian) sediments of the Baleine Formation and the Jarlemai Siltstone (Brunnschweiler 1957; Yeates et al 1984; Nicoll et al 2009; Smith et al 2013). Overlying the Broome Sandstone are the clastic sediments of the Lower Cretaceous (Aptian) Parda Formation and the Melligo, Frezier, and Leveque sandstones (Brunnschweiler 1957; Veevers & Wells 1961; Forman & Wales 1981), and the Upper Cretaceous–Neogene Emeriau Sandstone (Veevers & Wells 1961; Forman & Wales 1981).*
>
> *Pervasive northwest–southeast-trending fault systems divide the Canning Basin into several subunits, greatly reducing the surficial exposure of many units. As a result, exposure of the Broome Sandstone is limited to the Broome Platform, the Jurgurra Terrace, and the Fitzroy Trough (Haines & Wingate 2007). Onshore exposures of the Broome Sandstone are limited to discontinuous shore platforms and low rocky cliffs spread over approximately 200 km of the western coastline of the Dampier Peninsula, from Roebuck Bay north to Cape Leveque … (Brunnschweiler 1957). Exposures of Broome Sandstone along the coast rarely exceed a thickness of 11–15 m (during low tide). Boreholes, however, show that the preserved portion of the Broome Sandstone is at least 274 m thick (McWhae et al 1958; Veevers & Wells 1961; Playford et al 1975; Forman & Wales 1981; Gibson 1983; Yeates et al 1984; Haines 2011). Paleogene–Quaternary coastal deposits also often unconformably overlay the more landward portions of the Broome Sandstone* (Salisbury et al 2017: 14–15).

These main characteristics of the Broome Sandstone are summarised in relation to dinosaur track and other fossils in Salisbury et al (2017) and McCrea et al (2011).

2.1.2 Dinosaur tracks

The Broome Sandstone preserves a variety of Lower Cretaceous animal and plant fossils, but is renowned for its fossilised non-avian dinosaur tracks.

> *The Broome Sandstone on the Dampier Peninsula, Western Australia, preserves the most diverse dinosaurian track fauna in the world. Twenty one different types of tracks have been identified, preserved in over 70 tracksites scattered over approximately 80 km of coastline from Roebuck Bay north to Minarriny (Coloumb Point) (Glauert 1952; Colbert & Merrilees 1967; Long 1990, 1992a, 1993; Thulborn et al 1994; Long 1998, 2002; Thulborn 2002; Rich & Vickers-Rich 2003a; Willis & Thomas 2005; Thulborn 2009* [Thulborn 2009b]*, 2012; Commonwealth of Australia 2011; Salisbury et al 2017; Romilio et al 2017). With the exception of a few fragments of bone from other fossil localities in Western Australia (Long 1992b; Long & Cruickshank 1996; Long & Molnar 1998; Agnolín et al 2010; Salisbury & Long 2018), this ichnofauna constitutes the primary record of dinosaurs for the western half of Australia, with many of the tracks having no obvious counterpart among described body fossils from other parts of the continent. The dinosaurian ichnofauna of the Broome Sandstone comprises five different types of tracks made by predatory theropod dinosaurs, at least six types of tracks assigned to long-necked herbivorous sauropods, four types of tracks assigned to two-legged herbivorous ornithopods, and six types of tracks assigned to armoured dinosaurs. Among the tracks is the only confirmed evidence for stegosaurs in Australia. There are also some of the largest dinosaurian tracks ever recorded, with some of the sauropod tracks being 1.7 m long.*
>
> *In recognition of their outstanding heritage value, dinosaurian tracks in the Broome Sandstone were included in the West Kimberley National Heritage Area in 2011 (Place ID 106063; Commonwealth of Australia 2011)* (SALISBURY & ROMILIO 2019: 1).

2.1.3 Other Broome Sandstone fossils

The Broome Sandstone dinosaur tracks occur within a rich diversity of other fossil evidence, including plant macrofossils and invertebrate trace fossils.

> *In addition to dinosaurian tracks, the ichnofauna of the Broome Sandstone also comprises invertebrate trails and burrows with meniscate fillings (Brunnschweiler 1957; Thulborn et al 1994). Body fossils include arenaceous foraminiferans, microplankton, meiospores (Towner & Gibson 1983), and rare bivalves (Yeates et al 1984). Marine bivalves have been reported from outcrops exposed at or near Cape Leveque (Brunnschweiler 1957; McCrea et al 2011). Bennettitaleans, pteridosperms, and araucarian and podocarpacean conifers dominate the rich and diverse plant macrofossil assemblage. Other plant macrofossils include lycophytes, ferns, and pentoxylaleans (White 1961; McLoughlin 1996). Overall, the flora is thought to be indicative of fern-dominated coastal marshes and stream border communities, and Ptilophyllum swamp forests (Forman & Wales 1981). McLoughlin (1996) suggested that the abundance of bennettitaleans was indicative of a relatively warm, but seasonal climate* (SALISBURY ET AL 2017: 15).

2.2 Scientific documentation of dinosaur tracks and the Broome Sandstone Lower Cretaceous heritage

2.2.1 History of scientific recognition and documentation

This section provides a short summary of the history of scientific documentation of the dinosaur tracks and Lower Cretaceous palaeontological heritage preserved in the Broome Sandstone. A more detailed account is found in Salisbury et al 2017: 5–9.

Glauert (1952) reported the discovery by Walter Jones of Broome in 1945 of large impressions 'shaped like giant emu tracks', approximately 13 inches (330 millimetres) long, in the Broome Sandstone at extreme low spring tide near the Point Gantheaume Lighthouse. In fact, some of these tracks had been encountered by a group of Girl Guides in 1935 and reported in a Perth newspaper article in 1946 (Salisbury et al 2017: 5–6). Glauert noted:

> *Although so recently brought to our knowledge the tracks have long been familiar to the aborigines, who have given them the name of* warragunna*, and who have a legend to account for their origin. The story is that a native walking along the beach noticed the tracks and at once began to follow them. Suddenly a very large bird was seen trying to get across the bay in a southerly direction. When the bird turned and came towards him the native fled, not stopping until he reached "Willy's Creek," where his footprint can be seen* (GLAUERT 1952: 82–83)*.*

This information came from Jones. Glauert published a sketch of the tracks, provided by Mr Jones, and he based his description on reports, measurements, and a cement cast of one of the prints (Colbert & Merrilees 1967: 21).

McWhae et al (1958) referred to these tracks and the fossil flora at Gantheaume Point in their description of the Broome Sandstone:

> *The unit contains plants with Lower Cretaceous affinities, and is believed to be, in the main, a continental deposit. At Gantheaume Point, well-preserved footprints of a three-toed iguanadont* [sic: iguanodont] *reptile can be seen in the Broome Sandstone when the tide is low* (MCWHAE ET AL 1958: 107)*.*

Veevers and Wells (1961) reached essentially the same conclusions.

The Gantheaume Point tracks were examined in the field by Colbert and Merrilees (1967), who described three fossil locations, including two at Gantheaume Point and one at the adjacent Reddell Beach. Colbert and Merrilees (1967: 23) concluded that all of the prints described could be assigned to a new ichnotaxon, which they named *Megalosauropus broomensis*.

The Geological survey of Western Australia (GSWA) Memoir 2, 'The Geology of Western Australia', contains a brief description of the Broome Sandstone fossils at Gantheaume Point (Playford et al 1975). The fossil plant species recorded by White (1959) were noted and theropod dinosaur prints were mentioned (citing Colbert & Merrilees 1967) and illustrated.

In 1987 local Broome resident and naturalist Paul Foulkes began to record dinosaur tracks along the Dampier Peninsula coast known to Goolarabooloo Law Boss Paddy Roe OAM (deceased), whose family group has maintained strong cultural associations with the dinosaur tracks as part of the

Northern Tradition of the Song Cycle (see Chapter 4.3.2) (Salisbury et al 2017: 7). Foulkes recruited other local enthusiasts as well as John Long at the Western Australian Museum.

> *Long visited Broome in mid-1990, and, in addition to more theropod tracks similar to* M. broomensis*, he was able to confirm the presence of numerous other tracks and trackways referable to sauropods, large and small ornithopods, and quadrupedal ornithischians, at tracksites he was taken to by Foulkes, Middleton, and another Broome local, John Martin (Long 1990; Rich & Vickers-Rich 2003a)* (SALISBURY ET AL 2017: 7).

In a general-audience book on the Dinosaurs of Australia and New Zealand, Long (1998: 53) recorded that dinosaur footprints were first recognised in extensive outcrops of Cretaceous rocks in northern Western Australia in the 1940s, as had been outlined earlier by others (e.g., Glauert 1952; Colbert & Merrilees 1967; see Salisbury et al 2017 for further detail). He noted that he studied finds that were shown to him by Paul Foulkes and friends from Broome, revealing at least six different kinds of dinosaur tracks, and that ongoing research by Thulborn, Hamley and Foulkes (see the summary published in 1994) was revealing additional types of footprint, 'including some of the world's largest sauropod tracks'.

> *Since 1987 one of the present authors (P.F.) has discovered many more dinosaur footprints in the Broome Sandstone, some of them very different in appearance from* Megalosauropus broomensis*. It is now apparent that the Broome Sandstone contains a rich dinosaurian ichnofauna, including the tracks of sauropods, theropods, ornithopods and quadrupedal ornithischians. Our preliminary studies have revealed at least 10 distinct morphological types of dinosaur tracks in the Broome Sandstone, some referable to existing ichnogenera and others almost certainly indicative of new ichnotaxa. By world standards this is a remarkably diverse ichnofauna …* (THULBORN ET AL 1994: 87).

Thulborn et al (1994) also studied the palaeoenvironmental evidence preserved with the dinosaur tracks in the Broome Sandstone.

> *Thulborn et al (1994) provided the first detailed account of the dinosaurian tracksites on the coast north of Broome. Although intended as a preliminary assessment of the sauropod tracks, their study focused primarily on the depositional settings directly associated with the dinosaurian ichnites. Thulborn et al (1994) found that dinosaurian tracks in the Broome Sandstone occurred in what they regarded as two distinct paleoenvironmental settings: a 'lagoonal/tidal paleoenvironment' and a 'swamp/forest paleoenvironment'. They distinguished each of these paleoenvironmental settings based upon observed differences in sedimentary features, track preservation, and faunal and floral compositions. Confirming the earlier reports of Long (1990, 1992a), Thulborn et al (1994) identified at least ten different types of dinosaurian tracks, referable to theropod, sauropod, ornithopod, and thyreophoran trackmakers. Only the sauropod tracks were described in any detail, with further information provided in Thulborn (2002). A more exhaustive account of the sauropod tracks and the sedimentary structures associated with them has been provided recently by Thulborn (2012), who indicated that the total number of dinosaurian ichnotaxa present in the Broome Sandstone could be as high as 16* (SALISBURY ET AL 2017: 8).

The Commonwealth and Western Australian environmental assessment process for the proposed Browse Liquefied Natural Gas (LNG) project at James Price Point in 2010–2011 (approximately 60

kilometres north of Broome) included submissions from Thulborn and others regarding the significance of the Broome Sandstone exposures and dinosaur tracks. A short report on the James Price Point footprint sites by Mikael Siversson (2010) from the Western Australian Museum ascribed low significance to those intertidal exposures inspected during three days of fieldwork.

A further field assessment was commissioned by the Department of State Development at the request of the WA Environmental Protection Authority (EPA) and was conducted by palaeontologists Richard McCrea, Curator of the Peace Region Palaeontology Research Centre, British Columbia, Canada and Dr Martin Lockley, Professor of Geology at the University of Colorado at Denver, USA. These scientists inspected sites in the vicinity of James Price Point with Assoc. Prof. Steven Salisbury, UQ (McCrea et al 2011: 43), while part of their field team made preliminary GPS and photographic records of dinosaur tracks at intertidal locations around Broome Gantheaume Point, Reddell Beach and Roebuck Bay (Red Cliffs) (McCrea et al 2011: 7).

McCrea et al (2011: iii) acknowledged the participation and advice of Traditional Owners including Jabbir Jabbir, Goolaraboolo and Yawuru, as well as the Kimberley Land Council, in accomplishing their fieldwork.

In addressing a major study objective to 'place the palaeontological features that may be impacted by the development into a local, regional, national and international context' (McCrea et al 2011: 3), the report concluded:

> *As the science of vertebrate ichnology has matured, efforts to nominate sites and regions for World Heritage status represent just one example of efforts to preserve fossil footprint resources as local, regional or national heritage sites. All such endeavours require evaluation of the resource, along the lines of the effort undertaken in this survey. This is because local communities and local, regional and national governments need to understand the resources in their areas of jurisdiction in order to make appropriate management decisions. In the case of the Broome region, already part of the larger Kimberley Heritage region, there is no doubt that a significant paleontological resource exists, that has yet to be adequately documented* (McCrea et al 2011: 49).

By the time the McCrea et al (2011) report was completed, the West Kimberley NHL area already had been gazetted (Commonwealth Gazette 2011).

Palaeontological and related research coordinated by UQ Dinosaur Lab has continued ever since (Romilio et al 2017; Salisbury et al 2017), and they also have produced a palaeontological assessment of the Broome Safe Boat Harbour Project location at Reddell Point–Entrance Point (Salisbury & Romilio 2019). Their summary of the current, cumulative state of scientific knowledge of the Broome Sandstone dinosaur tracks is quoted above in Chapter 2.1.2.

[IMG] Figure 2.1 Aerial view of Minyirr – Gantheaume Point (Photo: Neale Draper)

2.2.2 History of conservation and management

To date there have not been any specific, government-based management or protection measures for Broome Sandstone fossils, including dinosaur tracks. Collecting and selling fossils is regulated in Western Australia. However, destruction of fossils and sites through natural erosion processes or through development construction work is not mentioned. There is a State Register of geoheritage sites maintained by the Geological Survey of Western Australia, but these sites do not have any legal protection. More information is on the website of the Western Australian Department of Energy,

Mines, Industry Regulation and Safety (DEMIRS) at dmp.wa.gov.au/Geological-Survey/Geoheritage-1412.aspx.

DEMIRS highlights the significance of the Broome Sandstone dinosaur track sites and refers to a presumed cycle of disappearance and replenishment of the visible population of tracks, as the Broome Sandstone exposed in the ITZ naturally erodes through tidal action.

[IMG] Figure 2.2 Minyirr – Gantheaume Point current interpretation shelter and signage (Photo: Neale Draper)

> *The tracks provide valuable information on the diversity of dinosaurs in Australia at the time, their community structure and even aspects of their individual style of movement. The sites are considered to be of world significance due to the diversity of footprints seen. The trackways, as part of the West Kimberley, were registered on the Australian National Heritage List in 2011. As the trackways are very close to the coast, some of them can only be visited when the tide is low; at high tide, the tracks are covered by the ocean. The footprints will eventually be completely eroded by waves, but other buried footprints will likely become exposed in time* (DMIRS 2022).

At the first published track site location of Gantheaume Point (Minyirr) (Figure 2.1) there is at the time of publishing a dilapidated shelter with site interpretation information provided by the SOB and the former Rubibi Aboriginal Land, Heritage and Development Council (Figure 2.2), and a sign on the path to the point advising that the area is culturally sensitive (Figure 2.3). The interpretation signs at the shelter describe some local Aboriginal creation stories associated with this locality, historical information, local plants and geology, and a description of the dinosaur tracks, with the added advisory note:

> *These footprints are difficult to find and can only be seen at very low tide. Conditions can be treacherous and visitors are not encouraged to seek out the prints.*

As an alternative viewing experience, there is a misleading concrete facsimile of three theropod tracks (all left feet) on the cliff top (Figure 2.4). There is no interpretive information on this display. All of these interpretative features are in poor condition.

Contemporary scientific publications generally avoid giving the location of tracks (e.g., McCrea et al 2011, Salisbury et al 2017), except where they already are publicly well known, such as at Gantheaume Point (e.g., Glauert 1952, Romilio et al 2017). Anonymity has long been a primary means of protection for palaeontological, archaeological and cultural sites of significance. The premise is that if only a few people are able to recognise sites without assistance, and in the absence of public information on locations, those places are partly protected, at least from deliberate damage.

McCrea et al (2011: 49) recommended detailed scientific recording of track sites and salvage of type specimens to a museum or other institution, to mitigate the impacts of natural erosion or human activities. Other scientists made strong recommendations in the particular case of the proposed Browse LNG development to avoid harm by preserving the James Price Point area tracks in situ and industrial development not occurring at that location (see Salisbury et al 2017 for a summary).

More recently, Salisbury and Romilio (2019) conducted a palaeontological survey of the proposed location for construction of the Broome Safe Harbour Project. Their survey contains significant, detailed results for this location.

> *Over 140 National Heritage listed dinosaurian track-bearing surfaces in the Broome Sandstone were recorded in the survey area. Many of these surfaces preserve multiple tracks and trackways, so the total number of individual tracks is much higher. Some areas, such as Reddell Point are heavily trampled and probably include hundreds of individual tracks and trackways. We conservatively estimate that there are more than 500 individual tracks in the survey area, potentially spanning many tens, if not hundreds of thousands of years of dinosaurian activity between 140–127 million years ago* (SALISBURY & ROMILIO 2019: VI).
>
> *The Reddell Point–Entrance Point area preserves the most southerly dinosaurian track-bearing surfaces in the Broome Sandstone within the West Kimberley. These tracksites may therefore sit within a unique part of the great delta system that formed the Broome Sandstone 140–127 million years ago. The dinosaurs that inhabited this area may have lived in the most coastal of all the palaeoenvironmental settings that formed part of the Broome Sandstone delta system, and could therefore represent a unique part of the palaeontological story that we are beginning to reconstruct for this area. In the context of this broader story, all the tracks in the survey area are important, and only in their entirety can they help us to reconstruct this prehistoric 'lost world' of the Kimberley* (SALISBURY & ROMILIO 2019: VII).

Referring to the NHL values of the Broome Sandstone and dinosaur track sites, Salisbury and Romilio (2019) conclude that the construction of the boat harbour at that location would not only cause extensive direct destruction to Broome Sandstone and dinosaur tracks, but also cause significant, wider collateral damage to an adjacent site at Reddell Beach and Entrance Point by changing sedimentation and erosion patterns. The report recommends that the project should be moved to another location that would not cause significant harm to the dinosaur tracks, or at least radically redesigned to reduce its impacts on them (Salisbury & Romilio 2019: vii–viii).

In practice, the focus of ongoing management of dinosaur track sites comes from volunteers in the DCMG, established in 2015. This non-government organisation has continuously worked to manage and protect dinosaur track sites through public education initiatives and providing information on local development planning proposals that may impact these sites.

[IMG] Figure 2.3 Signage at Minyirr – Gantheaume Point advising that the area is culturally sensitive

The DCMG also responds to development proposals that may harm dinosaur track sites in the absence of any existing process for considering these sites and their NHL values. The DCNHMP is intended to provide a better alternative for management of the Broome Sandstone and Lower Cretaceous fossil sites. DCMG volunteers continue to record and monitor track sites, providing additional field data for UQ researchers.

As a result of a DCMG nomination, the dinosaur tracks are recognised as Place 73 in the SOB Municipal Inventory of Heritage Places with a classification 'A' 'Exceptional Significance'. DCMG also nominated the tracks for inclusion in the State Register in August 2019; however, that nomination is yet to be assessed.

In general, management initiatives to date have focussed on a combination of keeping many of the dinosaur track site locations confidential, while at the same time improving educational and promotional public information on the importance of the sites, with visitor guidance and interpretation for locations at Broome that already are widely known. Some local tourist maps indicate that dinosaur tracks can be seen at low tides from Gantheaume Point eastwards around Reddell Beach to Entrance Point.

[IMG] Figure 2.4 Minyirr – Gantheaume Point concrete casts of theropod tracks (all impressions of the left foot)

The Yawuru Native Title Holders also have two Indigenous Land Use Agreements (ILUAs) with the state of Western Australia and the SOB that have resulted in the establishment of four conservation parks that intersect or adjoin the DCNHMP area. The JMPs for these parks (DBCA 2018, 2020; DPW 2016a, 2016b), as well as the overarching Yawuru CMP (Yawuru RNTBC 2016) behind them, include the recognition and protection of dinosaur track sites and the extension of the Conservation Estate to include the ITZ in the Port of Broome Area (KPA) (Chapter 5.2, 5.3; Map 1.3).

There is also the unrecorded, ongoing management by Aboriginal Traditional Owners and Cultural Custodians of significant cultural places that may include Broome Sandstone exposures and Lower Cretaceous fossils, including dinosaur tracks. Cultural heritage significance and management of such sites are discussed in more detail in Chapter 4.4.

2.3 Unresolved research

There is systematic scientific research continuing on the Broome Sandstone Lower Cretaceous fossil assemblages. This is based at UQ Dinosaur Lab (e.g., Salisbury et al 2017, Romilio et al 2017, the most recent publications from this research) and is a methodical, slow process, as is the publication of results.

These scientists also provide periodic assessment and verification of track discoveries reported through local volunteer data collection (Bennett 2022, 2024), though no database of verified discoveries and locations is publicly available. Apart from the detailed assessment of tracks in the Entrance Point/Reddell Beach area by Salisbury and Romilio (2019), dinosaur track-location data have not been published or provided to management stakeholders such as the SOB, KPA, DBCA or Yawuru. This has been addressed in this DCNHMP through the refined mapping of Broome Sandstone and dinosaur track exposure areas (Chapter 3 zone maps: geological and palaeontological features) by UQ. There is an inevitable gap between palaeontological field research and reporting timelines and the updating of spatial management information for local land and resource management agencies.

This gap is exacerbated by the inaccurate mapping of the extent of the Broome Sandstone and fossil exposures accompanying the NHL Gazette (Commonwealth of Australia 2011), which excludes the majority of the features that it is intended to protect and promote. The added complication is that the sites concerned occur in an ITZ with a depth range of approximately 10 metres with varying access, and ongoing erosion of recorded features and exposure of new ones.

UQ Dinosaur Lab continues to conduct research along the length of the Dinosaur Coast of the Dampier Peninsula, including the project area for this management plan, to increase knowledge of the extent, diversity and significance of the Dinosaur Coast fossil record.

3 Description of the landscape

3.1 Overview

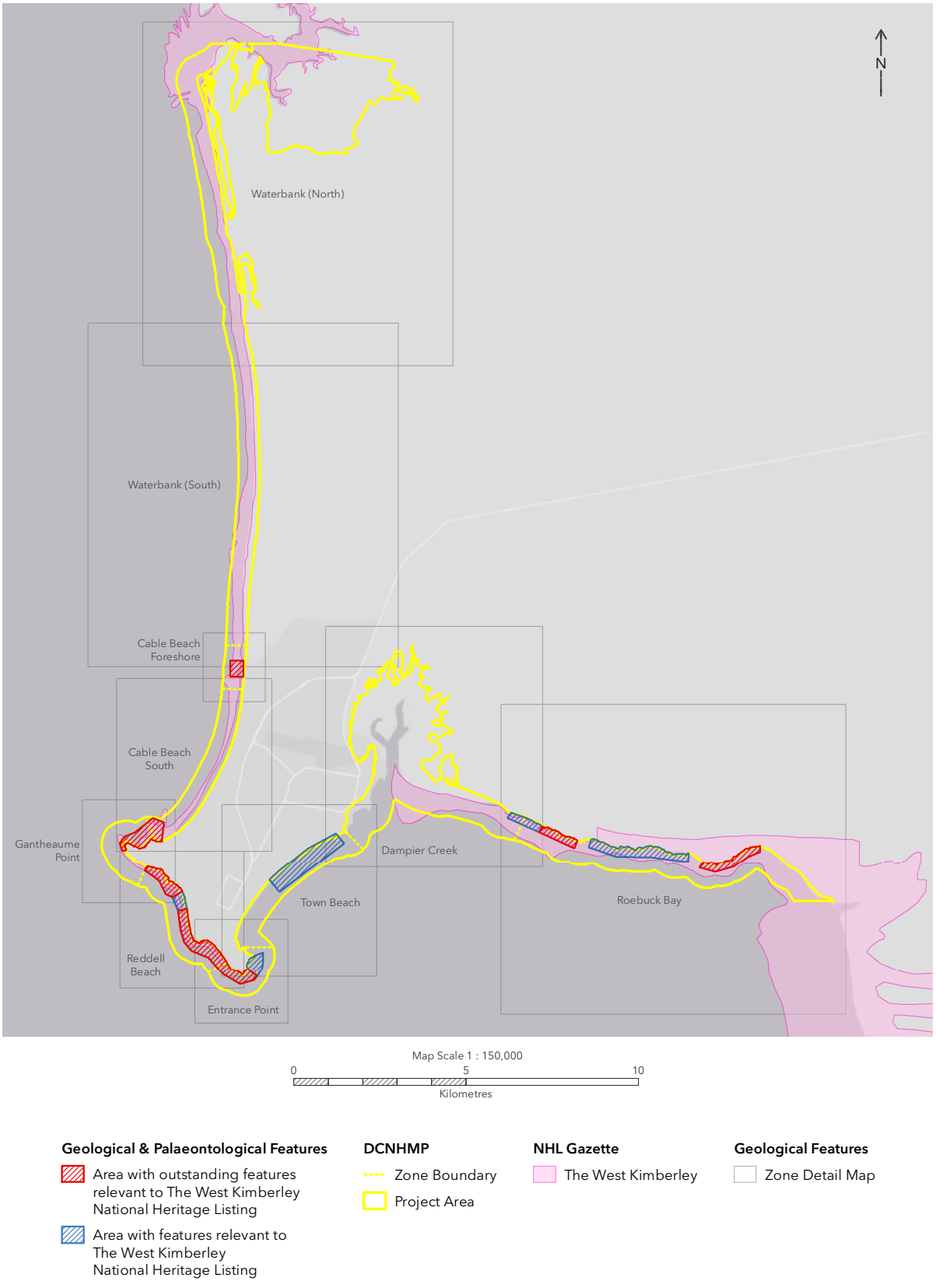
The Dampier Peninsula ITZ comprises a very small portion of the total West Kimberley National Heritage Place, which covers about 19,200,000 hectares. The coastal landscape containing the Broome Sandstone extends from Cape Leveque in the north to Eighty Mile Beach in the south; however, outcrops are restricted to thin local coastal exposures, mainly around the Dampier Peninsula, and a few inland hill or creek-bed exposures (Gorter et al 1979 in McCrea et al 2011).

The landscape is subject to one of the highest tidal ranges anywhere in the world, and many of the dinosaur track sites can only be seen for short periods during very low tides. Seasonal cyclone and storm activity can also greatly affect the distribution of sand along this portion of coast, periodically exposing some rock platforms while burying others (Salisbury et al 2017). The coastal landscape of the defined management area between Crab Creek and Willie Creek features long sandy beaches, frequent intermittent exposures of Broome Sandstone, river estuaries, wetlands and tidal inlets, dense mangrove communities, and intertidal sand and mudflats that provide important habitat for diverse marine fauna, which in turn support large numbers of migratory shore birds. Low, red Pleistocene pindan cliffs of Mowanjum Sand and stretches of Holocene sand dune border the upper limit of the ITZ. In parts, the beach sands and other coastal sediments have lithified to form a diverse suite of Holocene rocks that include limestones, coquinas, calcilutites, aeolianites, and calcreted shelly calcarenites. Additionally, there are unnamed units of Cenozoic and Quaternary age that include ferruginised sandstones, ironstone gravels and conglomerates, and mottled muddy sands, muds and gravels (Semeniuk 2008; Salisbury & Romilio 2019).

Table 3.1 Summary of geological unit descriptions

Geological unit	Map label	Description
Broome Sandstone	Kb	Cross-bedded, bedded to laminated, fine to very coarse sandstone, mudstone and minor conglomerate of Lower Cretaceous (Valanginian–Barremian) age. Contains dinosaur and invertebrate traces, and plant macrofossils.
Built environment	BE	
Cable Beach Sand	Qcd	Laminated, bedded, to low-angle cross-bedded, medium to fine to coarse sand and shelly sand; locally, patches of mid- to high-tidal cemented in situ beachrock, and slabs and breccia (the latter two embedded in laminated sand), bubble sand, and cross-laminated shelly sand and sand; when prograded it forms a sheet deposit under tidal beach face, otherwise it is ribbon shaped in geometry. Holocene/contemporary.
Cape Boileau Calcarenite Lombadina Conglomerate	Qbr	CBC: Cemented beachrock comprising laminated, bedded, to low-angle cross-bedded, medium to fine to coarse calcarenite and shelly calcarenite, with local layers of bubble sand, and locally incorporated slabs and breccia of (earlier cemented beachrock)

Geological unit	Map label	Description
		intraclasts; ribbon deposit formed on and buried under the tidal beach face. Contains fossilised human tracks. Holocene. LC: Within the Cable Beach Sand, deposits of reworked beachrock forming rounded slabs and breccia, pebble to boulder sized; these fragments of beachrock are embedded in laminated sand, bubble sand, and cross-laminated shelly sand and sand, or form a sand-free deposit resting on beachrock pavement; ribbon deposit formed along upper tidal beach face. Holocene.
Djugun Member	Qdm	Within the Sandfire Calcilutite, muddy red quartz sand, muddy brown quartz sand (mud in the muddy sand is kaolinitic and/or calcilutaceous); sheet-like deposit occurring between red sand and calcilutite. Holocene/contemporary.
Holocene aeolian dune sand (Church Hill Sand + Shoonta Hill Sand) overlying Pleistocene Mowanjum Sand	Qsz	CHS: Mainly structureless, but locally laminated to cross-laminated red quartz sand; shoe-string to lensoid deposit formed as supratidal dunes. Holocene/contemporary. SHS: White fine-grained sand; shoe-string to lensoid deposit formed as supratidal dunes. Holocene/contemporary. MS: 'Pindan'; structureless red sand (red sand and red muddy sand, root structured and mottled). Pleistocene.
Horsewater Soak Calcarenite	Qhsc	Cross-laminated aeolian calcarenite; shoe-string deposit formed as earlier Holocene supratidal dunes; lithified. Contains invertebrate trace fossils.
Sandfire Calcilutite	Qsc	White/cream/grey largely structureless, to bioturbated, to laminated, to locally indurated calcilutite; grades into underlying sand via calcilutaceous muddy sand, and into laterally adjoining sand via kaolinitic and calcilutaceous muddy sand; underlies sand flats, samphire flats, mangrove flats, and mid–low tidal flats; prism to wedge-shaped deposit formed under muddy tidal flats (note that this formational description encompasses the lithological characteristics of its component three members); lithified. Holocene.
Unnamed Pliocene–Quaternary Conglomerate	PQc	Ironstone gravel and breccia; a gravel to cobble to boulder deposit of ironstone clasts and ferruginised sandstone eroded from overlying Cretaceous and Cenozoic sandstones; often unconformably overlies exposures of Broome Sandstone.



Map 3.1 Overview of management zones and areas that contain geological and palaeontological features that are relevant to the National Heritage listing

3.2 Zone descriptions

The descriptions of the geological and palaeontological features in each management zone have been reviewed and updated by UQ Dinosaur Lab. The maps and spatial data which accompany these zone descriptions identify the areas within each management zone that contain geological and palaeontological features that are relevant to the West Kimberley National Heritage listing, and the following classifications have been supplied by Assoc. Prof. Steven Salisbury following consultation with staff in the Heritage Division of DCCEEW, Canberra during 2022 and 2023:

Areas with geological and palaeontological features relevant to the West Kimberley National Heritage listing

These are locations that contain palaeontological and geological features that are relevant to the West Kimberley National Heritage listing. For this stretch of coast this means either dinosaur tracks and associated trace fossils in the Broome Sandstone and/or exposures of Broome Sandstone that offer insight into depositional settings during the time that the dinosaur tracks were made. Fossilised human tracks in Holocene sediments are also considered relevant to the National Heritage listing.

Most of the exposures of Broome Sandstone in the management area would fall under these criteria. Some exposures, however, either (at least presently) contain no dinosaur and/or other trace fossils, or are so encrusted with marine life and sediment as to be of little value for interpretation.

Areas with outstanding geological and palaeontological features relevant to the West Kimberley National Heritage listing

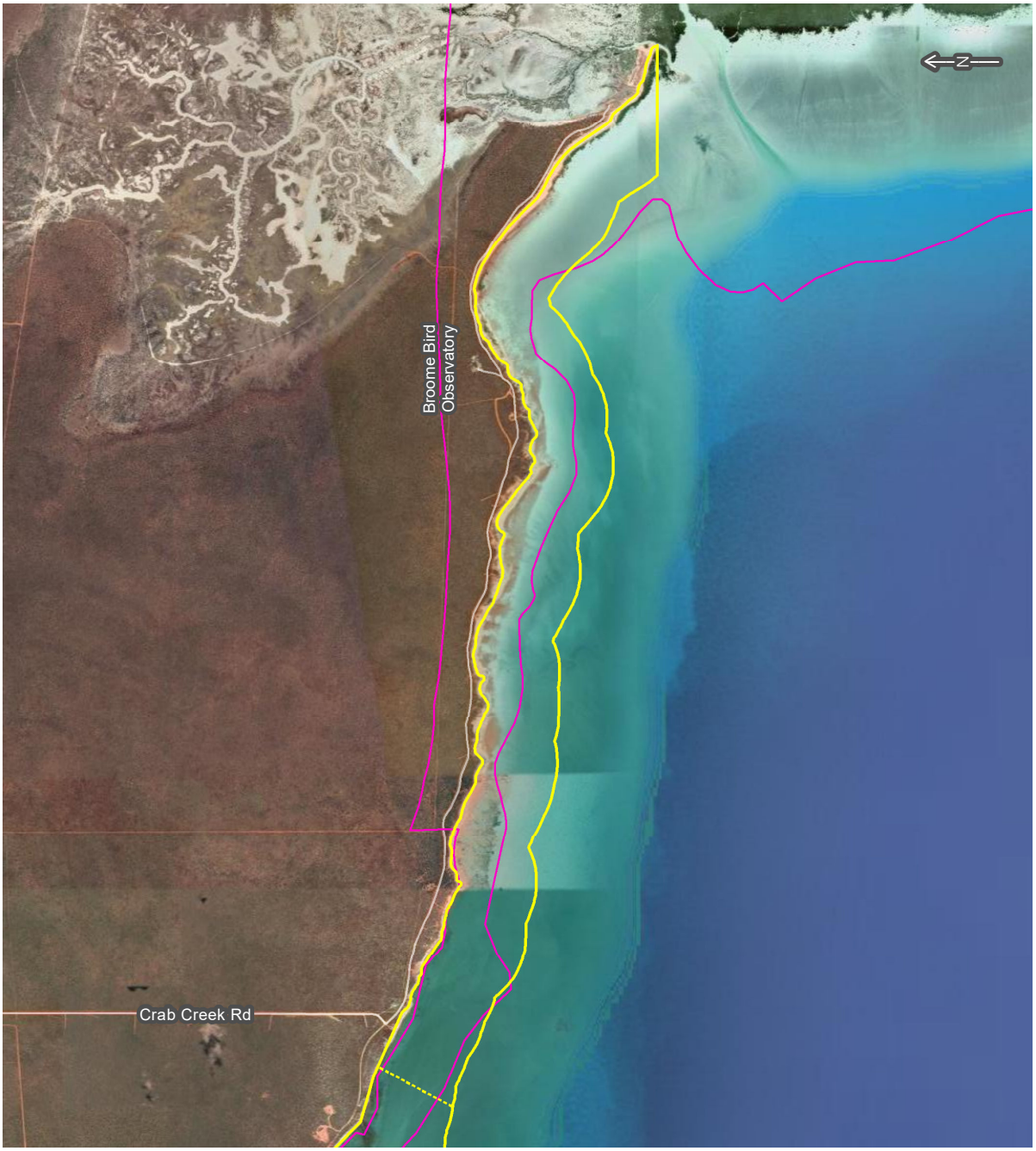
These are places that meet all the criteria listed above, but also include either unique, rare, historically or culturally significant tracks, a high concentration of tracks, tracks that offer unique insights into the diversity of the Broome Sandstone dinosaur ichnofauna, the behaviour of the trackmakers, or the temporal or spatial distribution of the trackmakers; i.e., significant geological features that provide important insights into depositional settings during the time that the dinosaur tracks were made.

3.2.1 Roebuck Bay

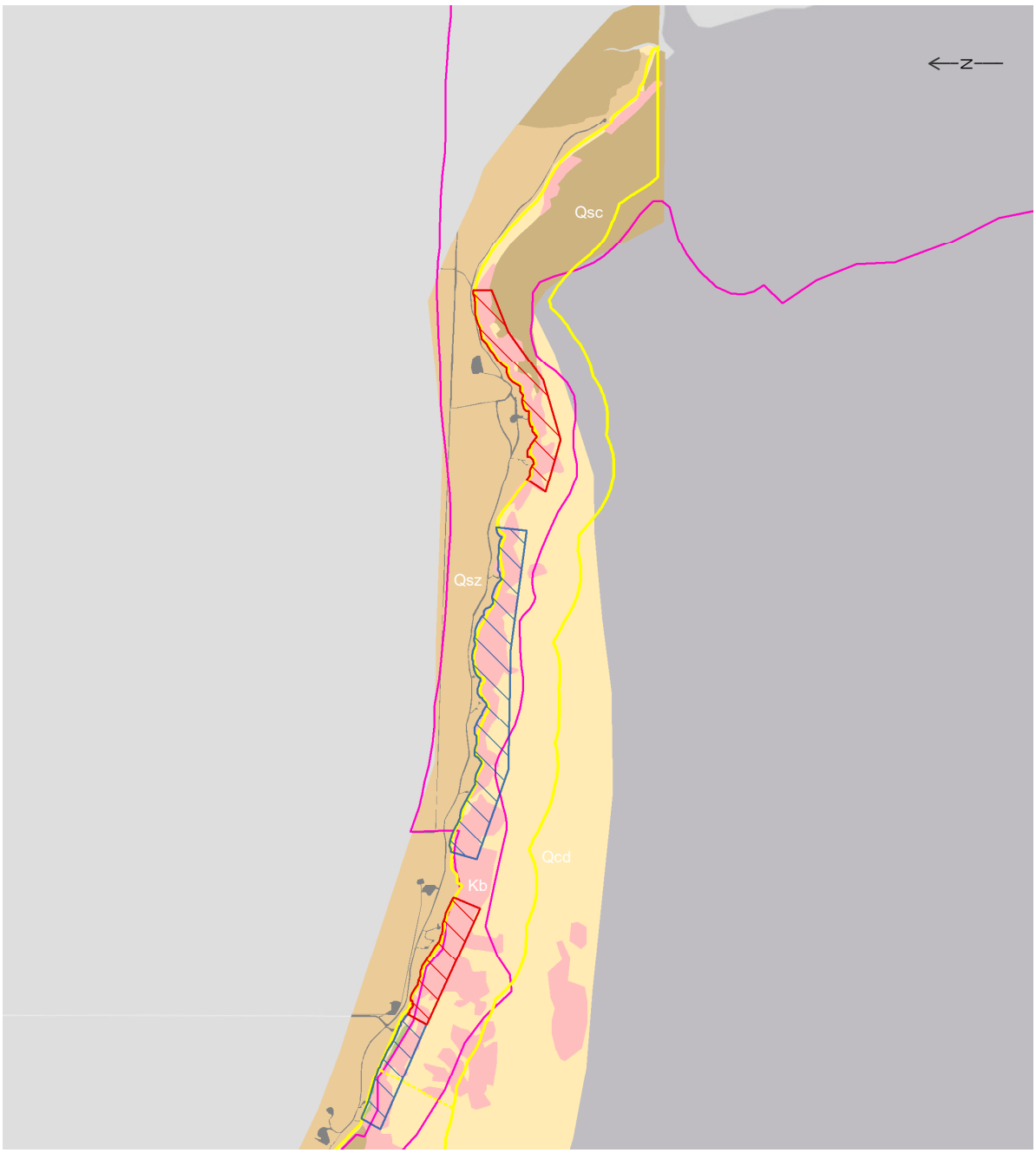
The Roebuck Bay Zone extends along the coast for 8.2 kilometres, commencing at the eastern end of the beach near the BBO adjacent to Crab Creek. It then follows westwards along the northern shore of Roebuck Bay to the establishment of continuous mangrove coverage of the Dampier Creek estuary approximately 500 metres west of the Crab Creek Road T-junction.

Topography and ecology

The coastal landscape features sandy beaches, small rocky points, intertidal sand and mudflats and frequent intermittent Broome Sandstone exposures with occasional sparse areas of mangroves. Low red pindan cliffs of Quaternary Mowanjum Sands border the upper limit of the ITZ. Sand and mudflats in the ITZ are habitat for a high diversity of invertebrates, including crabs, other crustaceans, bivalves, gastropods and marine worms, which in turn support a globally significant migratory bird hub. At its eastern end the Roebuck Bay Zone intersects with a wetland of international importance that is recognised and managed under the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention). The intertidal and mudflat ecological communities are believed to be in generally undisturbed condition, although changes to community composition have been observed in localised areas, and populations of blood cockles may be declining (DPW 2016b).



Map 3.2 Roebuck Bay Zone: Location



Map 3.3 Roebuck Bay Zone: Geological and palaeontological features

[IMG] Figure 3.1 Aerial view of Roebuck Bay area

Geological and palaeontological features

The long stretch of south-facing beach has a large Broome Sandstone outcrop, mainly in the form of low-relief in situ bedding planes in the intertidal area. At the eastern end of the zone the low cliffs of red Mowanjum Sand recede to high tidal-flat muds of the Sandfire Calcilutite in the Crab Creek inlet (Semeniuk 2008). The in situ dinosaur tracks in the Broome Sandstone are preserved as natural moulds (i.e., impressions with negative relief). The majority of tracks recorded are attributable to sauropods and many of the tracks are in lengthy trackway sequences (McCrea et al 2011). Over 500 tracks have been recorded here, most of them sauropod tracks. In addition are several important examples of theropod tracks (assigned to *Megalosauropus broomensis*) and a possible example of Broome Sauropod morphotype A (Salisbury et al 2017; Bennett 2022, 2024). Numerous invertebrate fossil burrows with meniscate fillings as well as wave ripple marks can also be found in the Broome Sandstone outcrops here. As a consequence of all these features, the ITZ through this management zone is classified as having outstanding geological and palaeontological features relevant to the West Kimberley National Heritage listing.

[IMG] Figure 3.2 Sauropod trackways in the Roebuck Bay area showing tidal mud flats and Broome Sandstone exposures

Access and landscape modifications

There is continuous access to the ITZ via Crab Creek Road and the unnamed coastal road, sometimes referred to as the 'Mangalagun Track' with key access points also located at an informal car park and footpath at the T-junction, and four kilometres further northeast at the Gurlbinwila boat ramp, although this access is cut off each year during the wet season. There is also access via boat and hovercraft to known dinosaur track locations, in particular at the location known as Black Ledge which is around 200 metres east of the T-junction. There are numerous Aboriginal middens (Figure 4.9), campsites and other culturally significant sites along this stretch of coastline (Durack 1946; Salisbury et al 2017).

[IMG] Figure 3.3 Fossil burrows in Broome Sandstone in the Roebuck Bay area, likely made by small invertebrates such as molluscs or worms (Photo: Steve Salisbury)

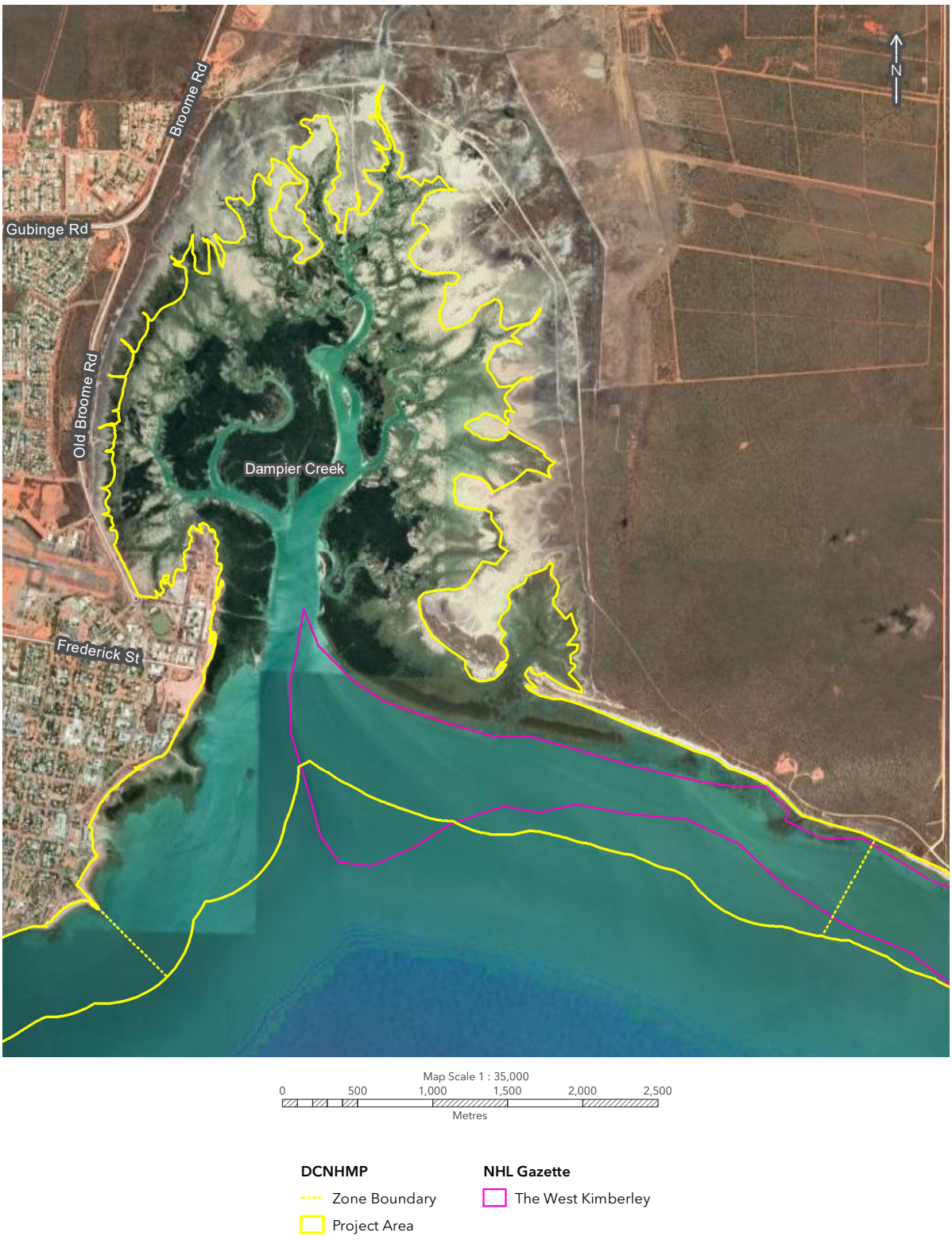
Activities and vulnerabilities

The zone is vulnerable to boats and hovercraft, pedestrians, quad bikes and motorcycles, vehicles with boat trailers and increasing beach traffic due to improvements to the Gurlbinwila boat ramp near the BBO, public toilet facilities, formal and informal car parking and other facilities to support recreation and tourism.

Supporting information

The Roebuck Bay Zone is contained entirely within the Roebuck Bay Marine Park which is described and managed under the Yawuru Nagulagun/Roebuck Bay Marine Park JMP 2016 (DPW 2016b). The plan references fossil dinosaur footprints but acknowledges that the significance, condition and locations of these features are not currently well known. An *Ecological character description for Roebuck Bay* details the relevant components of the Ramsar Site and provides a framework for monitoring its key ecological values (Bennelongia 2009). The cultural context of the Yawuru Conservation Estate is detailed in the Yawuru CMP (Yawuru RNTBC 2016) which also references the geological and palaeontological features. A palaeontological survey by McCrea et al (2011) for the Western Australian Department of State Development covers the Roebuck Bay Zone. References to the history of track discoveries in the zone include Long 2002: 182, Long 1998, 2002 and Latham v. The Queen 2000. See also Yawuru Birragun Conservation Park JMP (DPW 2016a).

[IMG] Figure 3.4 Recreational fishing on the Broome Sandstone reef in the Roebuck Bay area (Photo: Damian Kelly)



Map 3.4 Dampier Creek Zone: Location

[IMG] Figure 3.5 Ichnofossil tourism in the Roebuck Bay area

3.2.2 Dampier Creek

The Dampier Creek Zone extends for 12.3 kilometres, commencing at the establishment of dense mangrove coverage approximately 500 metres west of the Crab Creek Road T-junction, and extending initially westward then southwest to the end of the mangrove coverage at Town Beach Jetty.

Topography and ecology

There are continuous coastal mangrove communities throughout the Dampier Creek Zone with few discernible beach areas, and no definitive coastline. Several mangrove species have been identified here and they are critical habitat for both terrestrial and marine wildlife species, while mangrove detritus is an important food source for animals in the Roebuck Bay Marine Park. Fish, invertebrate and crustacean species also use the mangroves as a nursery area (DPW 2016b: 40).

[IMG] Figure 3.6 Aerial view of Dampier Creek showing mangroves and tidal mudflats

[IMG] Figure 3.7 Coastal fortification and provision for pedestrian access to the Dampier Creek ITZ between Catalina Place and Town Beach Jetty

Geological and palaeontological features

The Dampier Creek inlet is dominated by thick, tidal muds of the Sandfire Calcilutite and, in the supratidal area, the Djugun Member. To the east and south the muds fade to low, sloping cliffs of red Mowanjum Sand. An exposure of ferruginised sandstone eroded from overlying Cretaceous and Cenozoic sandstones forms a small island known as Buccaneer Rock, south of estuary mouth. Exposures of Broome Sandstone on the east and west margins of the creek mouth are very limited, although isolated sauropod tracks (one believed to be ex situ) have been recorded in Broome Sandstone exposures immediately north of Town Beach Jetty and 500 metres further north near Catalina Place (Bennett 2022, 2024).

Access and landscape modifications

There is limited informal pedestrian and boat access to the ITZ within the Dampier Creek estuary system although there is some access to the zone through the coastal reserve along Old Broome Road, and more regular pedestrian access along the two kilometre stretch of road between Gray Street and Town Beach Jetty. Built development borders the ITZ between Gray Street and Napier Terrace, and further south, to the east of Carnarvon Street, there is a boat ramp and footpath allowing access to a Broome Sandstone exposure immediately south of the Catalina Place stormwater runoff area where an ex situ sauropod track has been recorded. There is also extensive modification and fortification of the coast between Catalina Place and Town Beach Jetty (Figure 3.7).

Activities and vulnerabilities

Recreational fishing occurs throughout the estuary; however, access to the ITZ is limited and recordings of trackways and sandstone exposures are currently limited to the area within 500 metres north of Town Beach Jetty. The mud flats around Town Beach Jetty where sauropod tracks are recorded is a popular mud crabbing spot at low tide. Generally exposures of Broome Sandstone adjacent to the town are vulnerable to an increasing residential population, with built development and stormwater runoff creating changes in hydrological and sedimentary processes that are visible at Catalina Place.

[IMG] Figure 3.8 A tour group examines exposures of Broome Sandstone in the mangroves of Dampier Creek (Photo: Bart Pigram)

Geological & Palaeontological Features

- Area with outstanding features relevant to The West Kimberley National Heritage Listing
- Area with features relevant to The West Kimberley National Heritage Listing

DCNHMP

- Zone Boundary
- Project Area

NHL Gazette

- The West Kimberley

Geological Units

- Kb : Broome Sandstone
- BE : Built Environment
- Qcd : Cable Beach Sand
- Qbr : Cape Boileau Calcarenite + Lombadina Conglomerate
- Qdm : Djugun Member
- Qsz : Holocene Aeolean Dune Sand (Church Hill Sand + Shoonta Hill Sand) overlying Pleistocene Mowanjum Sand
- Qsc : Sandfire Calcilutite
- PQc : Unnamed Pliocene-Quaternary Conglomerate

Map 3.5 Dampier Creek Zone: Geological and palaeontological features

Supporting information

The mangrove communities or *Gundurung* of the Dampier Creek estuary are described and managed under the Yawuru Nagulagun/Roebuck Bay Marine Park JMP (DPW 2016b) while the Yawuru Birragun Conservation Park JMP (DPW 2016a) and Yawuru Minyirr Buru Conservation Park JMP (DBCA 2018) describe and manage the reserve areas adjacent to the eastern and western shores of the Dampier Creek mouth respectively.

3.2.3 Town Beach

The Town Beach Zone extends for 4.7 kilometres, commencing at Town Beach Jetty and extending generally southwest along Demco Beach and Simpson's Beach to the slipway at the northern end of the Port of Broome facility at Entrance Point.

Topography and ecology

The beach is mostly continuous and sandy with a small Broome Sandstone exposure and mangrove headland southwest of Town Beach Jetty (Figures 3.9 and 3.10). There are other occasional small exposures of Broome Sandstone along the beach and immediately north of the slipway, with sparse clumps of mangroves at the southern end of the zone.

[IMG] Figure 3.9 Sauropod trackway in exposures of Broome Sandstone along the Town Beach foreshore (Photo: Steve Salisbury)

Geological and palaeontological features

The Town Beach Zone has an extensively exposed intertidal area with small outcrops of Broome Sandstone that are intermittently covered with tidal mud and sand, broken coral and macrofauna. Low cliffs of Holocene aeolian dune sand (Church Hill Sand + Shoonta Hill Sand) overly Pleistocene red 'pindan' (Mowanjum Sand).

The Mowanjum Sand sits unconformably on an unnamed ironstone conglomerate that has eroded from the underlying Cretaceous and Cenozoic sandstones. Within the ITZ, cobbles and boulders of ferruginised sandstone from this conglomerate unconformably overly exposures of Broome Sandstone and extensive pavements of cemented Holocene beachrock (Cape Boileau Calcarenite). Recorded dinosaur tracks within exposures of Broome Sandstone are mostly eroded natural moulds. The majority of the more than 50 tracks recorded here can be attributed to sauropods (single prints, a single pair of hand and foot tracks and at least one partial trackway), with one *Megalosauropus broomensis* theropod track located near Demco Reserve. The mud and macrofauna covering the in situ, track-bearing sediments could also feasibly be covering smaller track features (McCrea et al 2011; Bennett 2022, 2024).

[IMG] Figure 3.10 Aerial view of the Broome Sandstone and mangrove headland adjacent Town Beach reserve and caravan park, with water treatment facility in the distance

Access and landscape modifications

There is high pedestrian traffic within the northern 1,000 metre section of the zone abutting the beachfront reserves and caravan park, and limited boat ramp vehicle access immediately southwest of Town Beach Jetty (Figure 3.10). Hovercraft and boat launching facilities are located at the south end of the zone just north of the slipway near a sandstone outcrop where no tracks have been recorded to date (Figure 3.11).

Map 3.6 Town Beach Zone: Location

[IMG] Figure 3.11 Hovercraft and boat launching site at the southern end of Town Beach Zone with Broome Sandstone in the background

Map 3.7 Town Beach Zone: Geological and palaeontological features

Activities and vulnerabilities

The Town Beach ITZ is contained entirely within KPA waters. It is not included in the West Kimberley National Heritage listing boundary and is not managed within the Yawuru Conservation Estate. It is therefore vulnerable to high levels of pedestrian access from beach reserves at its northeast end, and the pressures of caravan park redevelopments and boat access at the port facility slipway. Overflow and deposition from the water treatment facility near Demco Reserve is already covering an outcrop of Broome Sandstone there (Figure 3.10).

Supporting information

The Yawuru Minyirr Buru Conservation Park JMP (DBCA 2018) describes and manages the reserve area above the ITZ along Town Beach, while the KPA is responsible for management of the ITZ itself. See KPA Environmental Management Plan 2023. The palaeontological survey by McCrea et al (2011) also includes the Town Beach Zone.

3.2.4 Entrance Point

The Entrance Point Zone covers two kilometres of coastline. It commences at the KPA slipway, then extends southeast to southwest around the Broome Port Jetty and Kimberley Marine Support Base (KMSB) floating jetty (under construction), southwest along two small sandy coves separated by a rocky headland, then southwest to northwest around three rocky points, finishing at the sandy beach at the southwestern end of Reddell Beach.

Topography and ecology

The zone consists of mostly rocky headlands of Broome Sandstone separating a series of isolated sandy beach coves, with additional exposures of Holocene Cape Boileau Calcarenite and Lombadina Conglomerate (part of the Cable Beach Sand) adjacent to the two existing boat ramps.

[IMG] Figure 3.12 Aerial view of Entrance Point showing the proximity of geological and palaeontological features to the existing car park and boat ramps

Geological and palaeontological features

There are extensive exposures of Broome Sandstone in the Entrance Point ITZ. Broome Sandstone forms a nearly continuous reef that runs parallel to the shore, 200–300 metres wide for most of its length. These reefs preserve the most southerly dinosaurian track-bearing surfaces in the Broome Sandstone within the West Kimberley (Salisbury & Romilio 2019). The majority of track-bearing horizons seem to be concentrated in two main bands: the first starting close to the astronomical high-tide mark and extending 30–40 metres seawards; the second is between the 2.5 and 1 metre low-tide marks, close to the seaward edge of main reef system (Salisbury & Romilio 2019).

[IMG] Figure 3.13 View of Entrance Point from the reef showing the proximity of Broome Sandstone exposures to the location of the proposed new boat launching facility

A moderate abundance of tracks is found within these horizons, with over 350 tracks recorded to date (Bennett 2022, 2024). These are mostly attributable to sauropods but also include over 30 theropod tracks (*Megalosauropus broomensis*) and a single ornithopod track (*Wintonopous middletonae*), the second ichnospecies of *Wintonopus* to be recognised in Australia (Salisbury et al 2017; Salisbury & Romilio 2019). This particular track is one of only four *Wintonopous middletonae* documented on the entire Dampier Peninsula.

Map 3.8 Entrance Point Zone: Location

[IMG] Figure 3.14 Theropod trackway on one of the outer reefs of Broome Sandstone at Entrance Point (Photo: Nigel Clark)

[IMG] Figure 3.15 Ornithopod track *(Wintonopous middletonae*) in the Broome Sandstone at Entrance Point (Photo: Steve Salisbury)

[IMG] Figure 3.16 Large invertebrate burrows (trace fossils assigned to *Thalassinoides*) in the Broome Sandstone at Entrance Point

One horizon within the Entrance Point Zone, only visible at the lowest tide mark (1.2–0.3 metres), preserves one of the highest single concentrations of theropod tracks currently known within the Broome Sandstone environment. Preliminary research of this track site indicates evidence of gregarious behaviour among the theropod trackmakers. A number of the sauropod tracks and trackways that occur within the Entrance Point Zone also show morphological details suggestive of a new track type that is yet to be formally described or named (Salisbury & Romilio 2019). The abundance and diversity of tracks, their southerly location and the potential insights they might offer to the behaviour and palaeoecology of their trackmakers, make parts of the Entrance Point Zone of outstanding heritage value. The additional presence of ichnological values within the Cape Boileau Calcarenite adjacent to the two boat ramps (S. Salisbury, pers. obs. May 2022) also adds to the 'outstanding' category assigned to this area (Figures 3.13, 3.14, 3.15 and 3.16).

Access and landscape modifications

The zone experiences extremely high pedestrian traffic due to the ease of access and car parking. A high volume of boat launching traffic is generated by the beach launching facility adjacent the car park to the southeast, and a concrete boat ramp extension of the car park to the southwest (Figure 3.17). There is also private road access onto Broome Port Jetty, which intersects with the ITZ at the end of Port Drive.

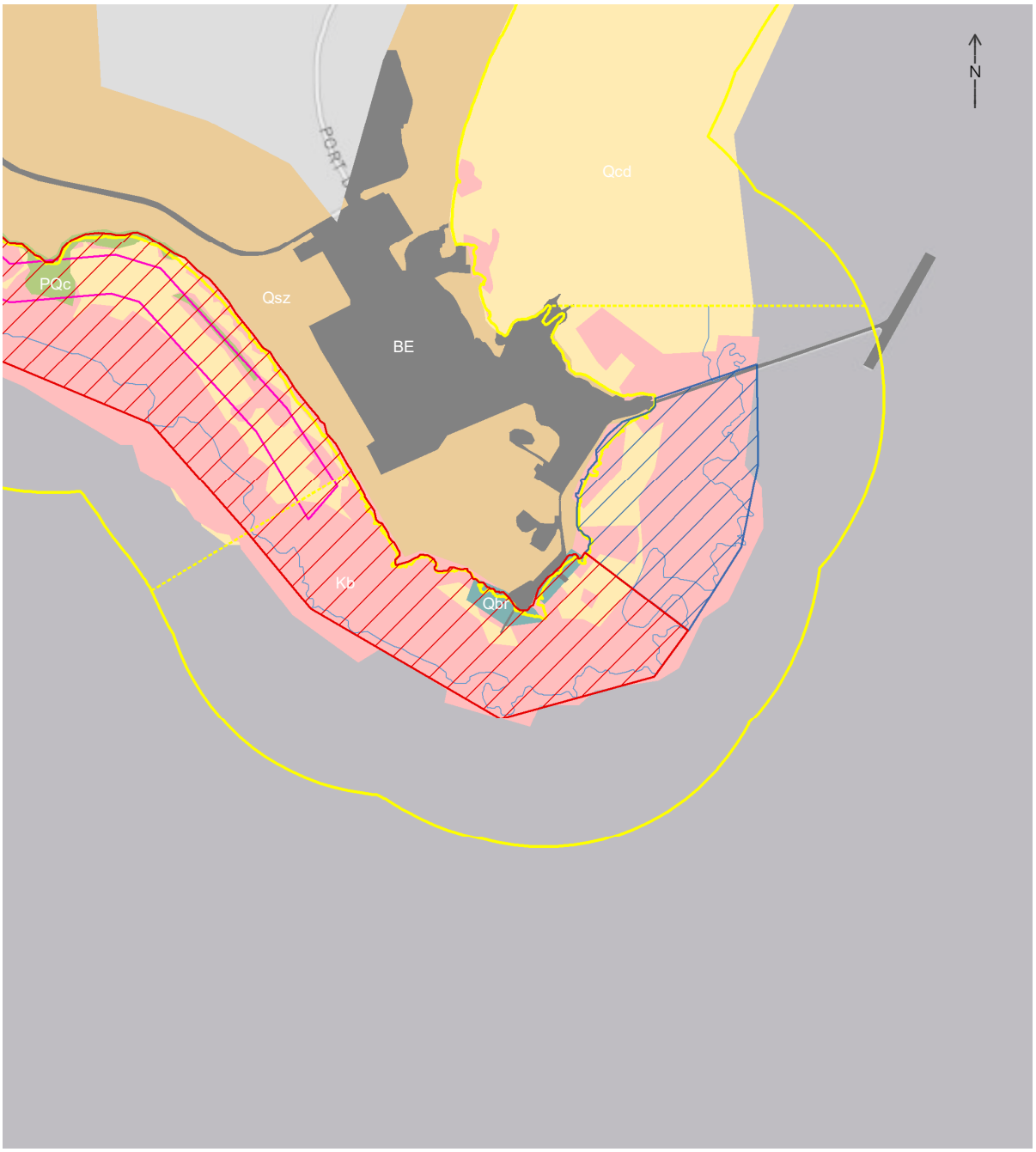
Activities and vulnerabilities

In addition to intensive recreational boating, Entrance Point Zone currently incorporates sites that DCMG uses for school field excursions and a highly utilised local swimming beach. There are some well-publicised dinosaur track locations here. A large new boat launching facility is currently proposed, incorporating 12-metre-high groynes with a 40-metre-wide base, land reclamation for a further 250 trailer and car parking bays, an offshore breakwater and a four-lane boat ramp with floating jetties to support all weather and tide access for recreational fishing and charter boat tourism. Adjacent to the current KPA wharf, work has commenced on the KMSB which includes a fixed causeway linked to a floating jetty.

Supporting information

Entrance Point Zone was included in a detailed UQ palaeontological and geological survey which documented the richness of the Broome Sandstone exposures in this area and its extreme vulnerability to the development pressures of a proposed new safe boat harbour and breakwater (Salisbury & Romilio 2019). As a result of the study the location of the proposed harbour was changed. The original proposal also would have affected the reef system next to the jetty and large traditional campsite and shell midden near the Fishing Club, both of which have cultural heritage significance, as well as a substantial area of Broome Sandstone. The revised proposal avoids these impacts. However, the new proposed site has moved closer to other dinosaur tracks and significant Aboriginal cultural places and has since been determined to be a controlled action requiring assessment and approval under the EPBC Act before it can proceed (DAWE 2022). There are concerns about possible impacts on hydrological and sedimentary processes that could affect the Broome Sandstone and other matters of national environmental significance. Further information can be found at the Broome Boating Facility project website (broomeboatingfacility.com.au) and current EPBC Act referrals at the public portal (DAWE 2022). Refer also to the KPA Marine Notices for the latest information (kimberleyports.wa.gov.au/port-operations/local-marine-notices) (KPA 2025). See also Yawuru Minyirr Buru Conservation Park JMP (DBCA 2018) and KPA Environmental Management Plan 2023 (KPA 2023).

[IMG] Figure 3.17 Car parks, boat ramps and a private road onto the jetty at Entrance Point provide direct pedestrian and vehicle access to the ITZ



Geological & Palaeontological Features

- Area with outstanding features relevant to The West Kimberley National Heritage Listing
- Area with features relevant to The West Kimberley National Heritage Listing

DCNHMP

- Zone Boundary
- Project Area

NHL Gazette

- The West Kimberley
- Low Tide (approx 0.6m)

Geological Units

- Kb : Broome Sandstone
- BE : Built Environment
- Qcd : Cable Beach Sand
- Qbr : Cape Boileau Calcarenite + Lombadina Conglomerate
- Qsz : Holocene Aeolean Dune Sand (Church Hill Sand + Shoonta Hill Sand) overlying Pleistocene Mowanjum Sand
- PQc : Unnamed Pliocene-Quaternary Conglomerate

Map 3.9 Entrance Point Zone: Geological and palaeontological features

3.2.5 Reddell Beach

The Reddell Beach Zone covers four kilometres of coastline. It commences at the beginning of the continuous sandy beach at the southeastern end of Reddell Point Beach, heads northwest to Reddell Point, then continues northwest along a sandy beach to a small unnamed rocky headland, then reverts again to sandy beach before terminating at the limit of beach access where the water meets the base of the rocky headland at the boundary with the Gantheaume Point Zone.

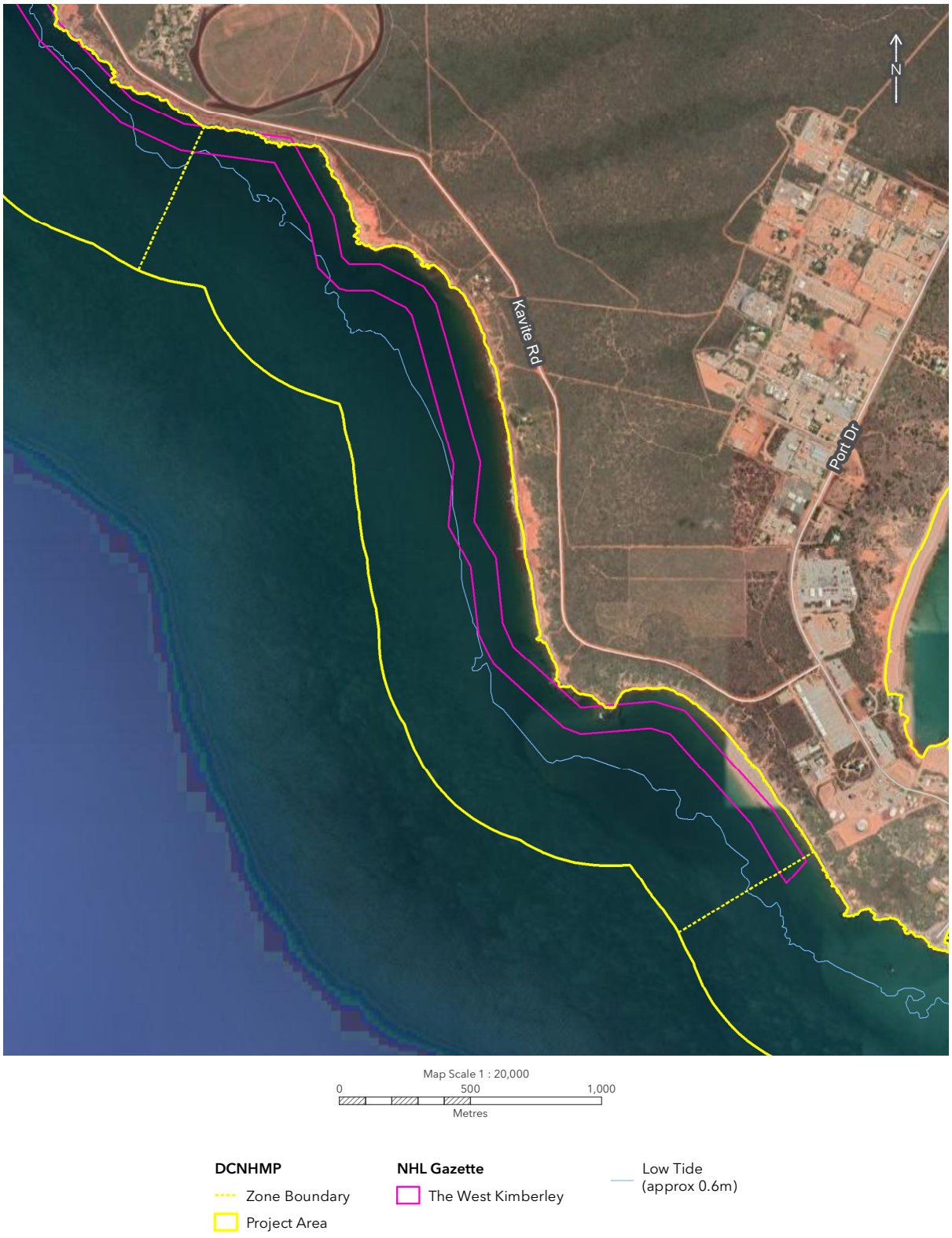
Topography and ecology

The zone is predominantly long, white sandy beaches of unconsolidated, calcareous quartz beach sand (Cable Beach Sand) with Broome Sandstone forming small rocky headlands and exposures containing a high abundance and diversity of dinosaur tracks and track-bearing surfaces. Red desert pindan cliffs of Mowanjum Sand and white and red coastal dune sands (Church Hill Sand + Shoonta Hill Sand) sit above the ITZ, overlying an unnamed Pliocene–Quaternary conglomerate and the much older and thicker Broome Sandstone. Above the ITZ between the main foredune complex and Kavite Road and the industrial precinct at Entrance Point, small patches of endangered monsoon vine thicket persist in the more protected swales formed by the Holocene dunes. (In other parts of the Kimberley, similar patches of dry rainforest are gazetted as West Kimberley NHVs because of the evolutionary refugial role they play in supporting high invertebrate richness and endemism.) Further north around Reddell Point, a sequence of yellow to brown creamy-coloured, mottled muddy sands, muds and gravels interbedded with boulder deposits of dark-grey ironstone and iron-impregnated sandstone form the low cliffs above the ITZ, and distinctive eroded pillars on the beaches (Salisbury & Romilio 2019). The low cliffs and eroded pillars around Reddell Point are formed by a distinctive set of Quaternary consolidated muds, sandy muds and ironstone conglomerates atop the eroded remnants of the upper parts of the Broome Sandstone. Where the cliffs meet the beach, the sands within the conglomerate have eroded and the cliffs have collapsed, leaving boulders of resilient black ironstone and ferruginised sandstone clasts strewn over upper parts of the beach, particularly at the southern end (Salisbury & Romilio 2019).

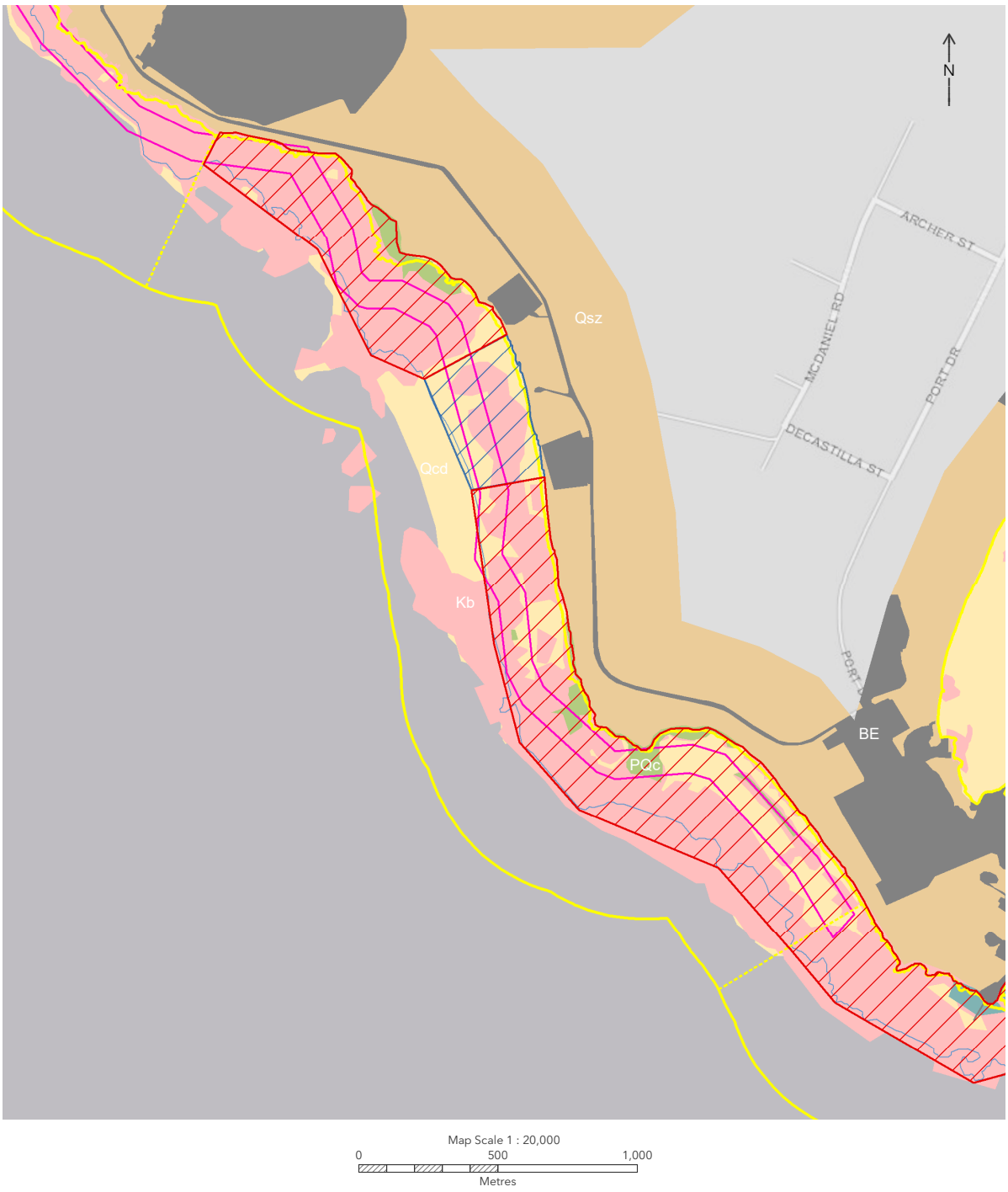
[IMG] Figure 3.18: Aerial view of Reddell Beach showing Kavite Road and a car park access point to an area of Broome Sandstone in the foreground

Geological and palaeontological features

There are extensive exposures of in situ Broome Sandstone within the Reddell Beach Zone, as well as many large dislocated blocks of Broome Sandstone scattered over the beach. Over 2,500 dinosaur tracks have been recorded here, the majority of tracks and trackways attributable to sauropods, although close to 150 tracks and trackways attributed to theropods and assigned to *Megalosauropus broomensis* have also been recorded. Most of the tracks are natural moulds (impressions with negative relief), but some isolated natural casts (where infilling material has created a positive impression) are found here as well (Colbert & Merrilees 1967; McCrea et al 2011; Salisbury et al 2017; Salisbury & Romilio 2019; Bennett 2022, 2024. See also the glossary at the end of this document). Some of the track-bearing surfaces are heavily trampled over a large area (200–300 square metres), and the concentration of tracks is so high that individual trackways are often difficult to discern (Salisbury & Romilio 2019). Of historical significance, this area includes the first sauropod tracks discovered in Australia by the late Paul Foulkes back in the late 1980s (Salisbury & Romilio 2019). Some of the *Megalosauropus broomensis* trackways on Reddell Beach are the best examples in the Broome Sandstone and are currently being researched as part of a UQ study focussed on this particular track type (Salisbury & Romilio 2019). This zone has been categorised as outstanding due to its historical significance combined with the high concentration and diversity of tracks.



Map 3.10 Reddell Beach Zone: Location



Map 3.11 Reddell Beach Zone: Geological and palaeontological features

Access and landscape modifications

Universal access to all areas of Reddell Beach from regularly spaced car parks along Kavite Road leaves a short walk to the beach, thus generating relatively high pedestrian traffic due to the ease of access. Recently completed improvements to the Kavite Road car parking facilities to accommodate additional vehicle types, and the beach's use as a wedding location continue to make this fragile Cretaceous landscape increasingly vulnerable to pedestrian traffic (Figure 3.22) The Lurujarri Heritage Trail follows the beach and there are small settlements on the clifftop near 281 Kavite Road (locally known as the Bishop's House) and the Sisters of St John of God residences at Lots 203 and 219 Kavite Road.

[IMG] Figure 3.19 Citizen scientist Dianne Bennett indicates the approximate height of a sauropod's hip deduced from the size of this track in the southern Reddell Beach area

[IMG] Figure 3.20 Assoc. Prof. Steven Salisbury with multiple sauropod trackways at Reddell Beach (Photo: Steve Salisbury)

Activities and vulnerabilities

The picturesque nature of the place makes it popular for fishing, walking and dog walking; it attracts beachgoers, photographers and is a popular location for weddings and other events including rave parties. The car parks here are favourite locations for illegal camping. Many tourists look for dinosaur tracks but don't have much idea of what to look for or how they should behave to protect and preserve the landscape. (For example, using hard objects to scrape sand and crustaceans out of tracks has already damaged a significant trackway.) The posting of GPS locations for rare and scientifically important theropod tracks on shared media sites and tourism information apps like WikiCamps and Tripadvisor is resulting in those tracks experiencing increasing tourism and apparent damage. Other tracks at Reddell Beach have had small pieces broken off them. Increasing illegal camping and recreational activities (such as slacklining between culturally significant stone pillars) is also a problem.

[IMG] Figure 3.21 A theropod (*Megalosauropus broomensis*) natural cast in the southern Reddell Beach area (Photo: Dianne Bennett)

[IMG] Figure 3.22 Parts of Reddell Beach that preserve numerous palaeontological and geological features have become a popular location for weddings (Photo: Julia Rau)

Supporting information

Palaentological surveys by McCrea et al (2011) and Salisbury and Romilio (2019) cover sections of the Reddell Beach Zone. Colbert and Merrilees (1967), Lambert and Elix (2004) and Salisbury et al (2017) give additional historical context. See also Yawuru Minyirr Buru Conservation Park JMP (DBCA 2018), KPA Environmental Management Plan 2023 (KPA 2023) and *Control of Vehicles (Off-road Areas) Act 1978* (CV Act) administered by the SOB (Appendix D).

3.2.6 Gantheaume Point

The Gantheaume Point Zone covers 2.1 kilometres of coastline. It commences in the southeast at the limit of sandy Reddell Beach where the rocky headland meets the sea, continues northwest, turning north to southeast to the beginning of a shallow rocky bay (informally known as Gantheaume Bay), then northeast across Gantheaume Bay to the small rocky outcrop (known as Red Point) and terminating at the commencement of continuous sandy beach at the southern end of Cable Beach (also known as Gantheaume Point Beach).

[IMG] Figure 3.23 Gantheaume Point showing the northern Reddell Beach area in the foreground

Map 3.12 Gantheaume Point Zone: Location

Topography and ecology

The zone is made up of predominantly rocky headland and an extensive reef system of Broome Sandstone and the rocky inlet of Gantheaume Bay.

Geological and palaeontological features

The Gantheaume Point Zone has extensive exposures of Broome Sandstone that form high cliffs at the point itself, as well as large in situ surface exposures seaward. The cliff line extends for around three metres above the astronomical high tide mark, creating a total stratigraphic thickness of around 11 metres. There are massive blocks of dislocated Broome Sandstone in the area around the base of the cliffs. The more landward parts of Red Point include a thin veneer of Pliocene–Quaternary aged conglomerate and eroded black ironstone clasts, similar to those that occur in the Reddell Beach Zone.

The Gantheaume Point Zone contains the type sequence for the Broome Sandstone (Reeves 1951; Brunnschweiler 1957; Forman & Wales 1981), and is also the topotype locality for *Megalosauropus broomensis* (Colbert & Merrilees 1967). The platform that included the topotype tracks was destroyed during storm action during the early 1990s, with new tracks being exposed as a result (Salisbury et al 2017). Over 500 tracks have been recorded here, 65% sauropods, and 35% *Megalosauropus broomensis* theropods (Bennett 2022, 2024). All these tracks occur in the lower five metres of the exposed section of Broome Sandstone (Romilio et al 2017). As a result, many of the theropod tracks are covered with encrusting macrofauna common in intertidal areas. Several sauropod tracks and a few sauropod trackways have been recorded to the north of the point toward Cable Beach. Most prints are natural moulds, but many are eroded and visible only as transmitted tracks. Gantheaume Point is one of many sites where plant macrofossils are found in the Broome Sandstone. The plant fossils are relatively abundant with 30 different species documented. (McLoughlin 1996). Due to the scientific and historical importance of tracks in the northern half of this zone, it is classified as containing outstanding geological and palaeontological features.

[IMG] Figure 3.24 The northern half of Gantheaume Point Zone is classified as having outstanding geological and palaeontological features relevant to the West Kimberley National Heritage listing due to the scientific and historical importance of the tracks there (Photo: Alamy Australia Pty Ltd)

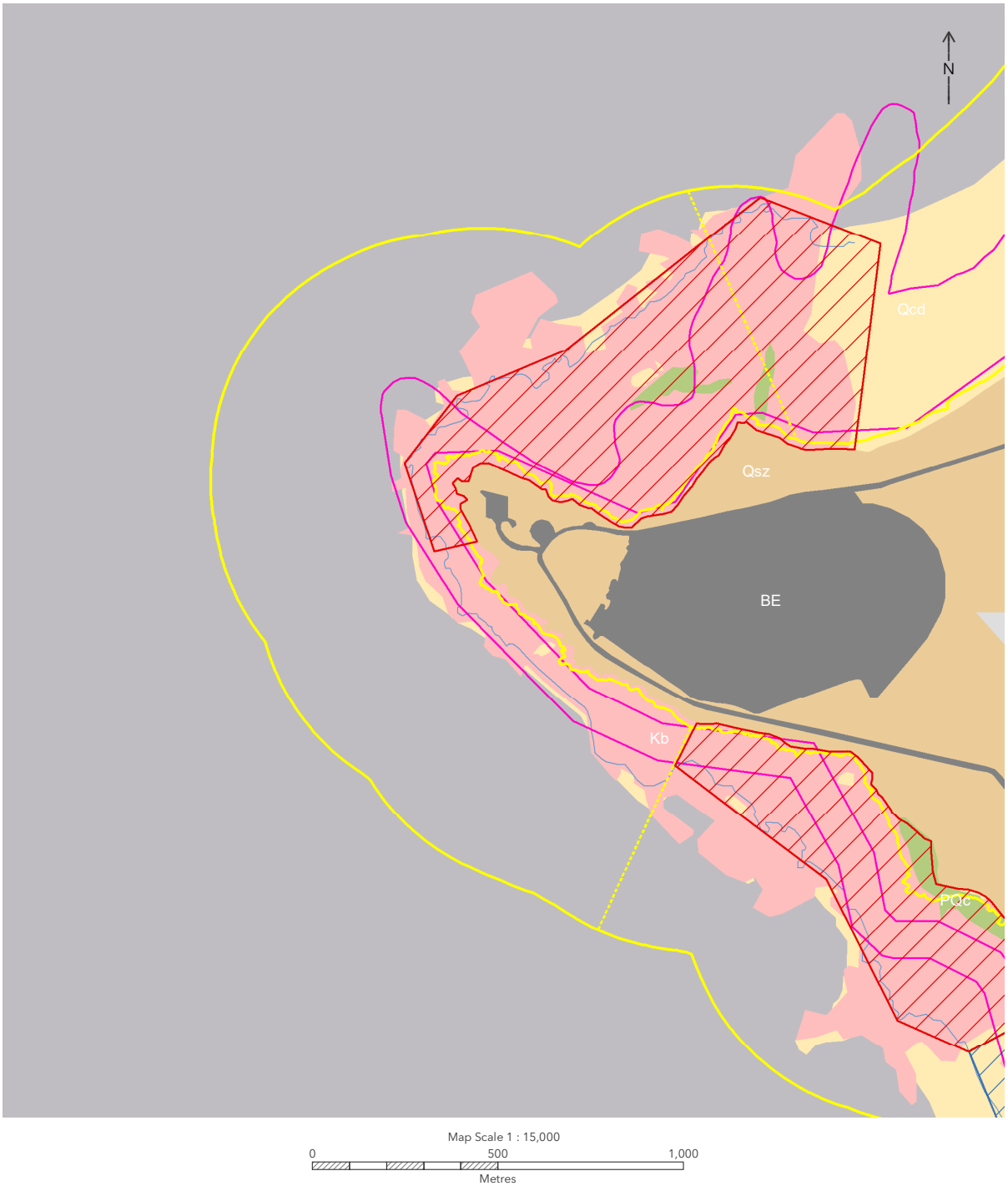
[IMG] Figure 3.25 Gantheaume Point is one of many sites where plant macrofossils are found in the Broome Sandstone (Photo: Dianne Bennett)

Access and landscape modifications

Access to the rocky headland around Gantheaume Point is moderately difficult with the Gantheaume Point car park about 150 to 250 metres away, and a necessary climb down the rocks. Access to Gantheaume Bay and the Red Point area is relatively easy with a shorter walk from the car park of some 100 metres and gently sloping access to the southwestern end of the bay. There is also pedestrian access to the Red Point and Gantheaume Bay area from the Cable Beach/Gantheaume Point Beach access track opposite the Broome Turf Club car park.

Activities and vulnerabilities

The zone is vulnerable to pedestrian traffic from the Gantheaume Point car park and illegal vehicular traffic from the short Cable Beach/Gantheaume Point Beach access track off Gantheaume Point Road. There is potential for vehicle and pedestrian traffic, as well as illegal camping to increase as a result of upgrades to Kavite Road and Gantheaume Point Road, upgrades to the Gantheaume Point car parking facilities and visitor information area, and car park upgrades along Kavite Road.



Map 3.13 Gantheaume Point Zone: Geological and palaeontological features

Supporting information

Romilio et al (2017) describes surveying techniques that use a combination of high-resolution aerial photography, airborne and handheld high-resolution lidar imaging and handheld photography to enable the rapid collection of large amounts of digital data across a range of spatial scales. The use of such remote sensing technologies is an important means of digitally conserving dinosaur tracks and of documenting intermittently exposed sites with the potential to monitor changing states over time.

[IMG] Figure 3.26 Aerial view of Cable Beach South showing beach parking area adjacent to an area with outstanding geological and palaeontological features relevant to the West Kimberley National Heritage listing

The same techniques were used by Salisbury et al (2017) and Salisbury and Romilio (2019) to digitally document other sections of coastline and their associated geological and palaeontological features. UQ Dinosaur Lab used the same methods to document and map geological and palaeontological features for this management plan. McCrea et al (2011) also cover the Gantheaume Point zone and further historical documentation includes White's (1959) study of the palaeoflora and documentation of *Megalosauropus broomensis* 'emu-like' tracks in Glauert (1952); McWhae et al (1958); and Colbert and Merrilees (1967). For a detailed account of community and research activities related to the dinosaur tracks at Gantheaume Point, see Salisbury et al (2017).

See also KPA Environmental Management Plan 2023 and CV Act administered by the SOB (Appendix D).

3.2.7 Cable Beach South

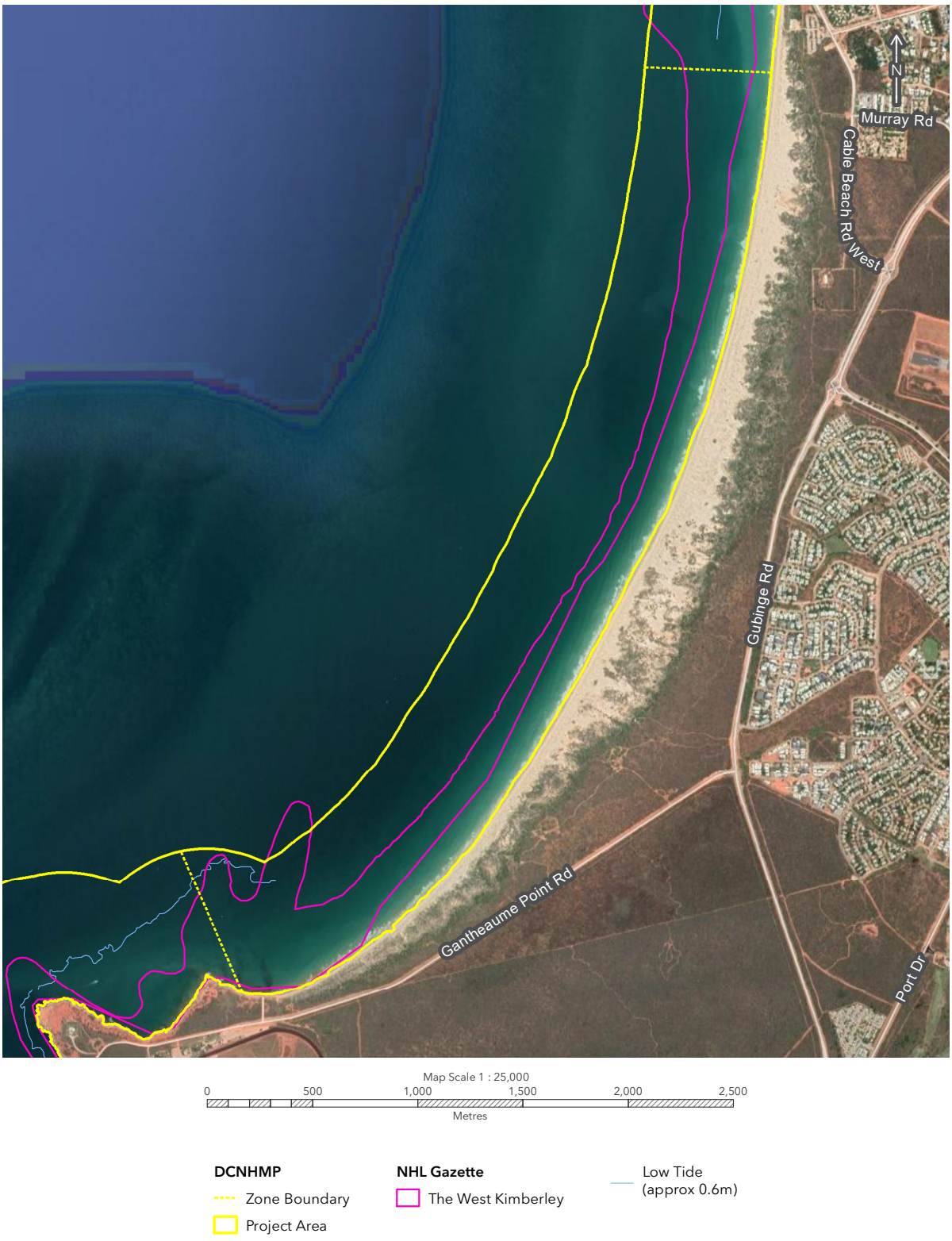
The Cable Beach South Zone extends along 5.2 kilometres of coastline, commencing in the south at the limit of the rocky Red Point headland at the beginning of a continuous stretch of sandy beach. It then heads generally north-northeast, terminating at the south boundary of the Cable Beach Foreshore Zone where the Minyirr Buru Conservation Park boundary transects the ITZ.

Topography and ecology

Cable Beach South consists of a continuous stretch of sandy beach exposed to the Indian Ocean. There are Flatback Turtle nesting sites along the beach.

Geological and palaeontological features

The southern end of the Cable Beach Zone includes the northern end of the reef system of Broome Sandstone that extends around Gantheaume Point. This area contains sauropod and theropod tracks and trackways and is classified as outstanding. Although most of this part of the Red Rock headland includes patches of Broome Sandstone, overlying it are loose blocks of black ironstone clasts. North of the point, the beach extends for approximately five kilometres to the start of the Cable Beach Foreshore Zone. There are only small, scattered outcrops of Broome Sandstone in this part of the zone and the potential for further exposures is likely to be small unless a cyclone event or similar exposes new bedding planes (McCrea et al 2011). As with other sandy beaches around Broome, the beach sand along Cable Beach is likely to be only 1–2 metres thick, with a basement of Broome Sandstone (Semeniuk 2008; Salisbury & Romilio 2019). Commencing at the southern end of Cable Beach and extending north into the Cable Beach Foreshore Zone there are extensive exposures of Holocene Horsewater Soak Calcarenite. These occur as a sheet to discontinuous ribbon close to the current astronomical high tide mark, extending landward into the base of the Holocene dune system of the Shoonta Hill Sand which overlies them.



Map 3.14 Cable Beach South Zone: Location

Access and landscape modifications

There is vehicle access to the beach from the access track off Gantheaume Point Road opposite the Broome Turf Club. Vehicle traffic is currently restricted to the northeast of the ramp and within 500 metres of the ramp only; however, this is frequently ignored by cars parking south of the access track towards Red Point (Figures 3.27 and 3.28). Pedestrian access via Minyirr Park walk trails through the sand dunes to the beach is mainly located in line with the central Cable Beach residential area, but also in the north of the zone just south of the boundary to the Cable Beach Foreshore Zone. Direct vehicle access to the Cable Beach South Zone is also possible, though currently prohibited, from the Cable Beach Foreshore Reserve Beach Access Ramp. Pedestrian access to the Cable Beach South Zone is also possible by walking south along the beach from the Cable Beach Foreshore Zone.

[IMG] Figure 3.27 Current restrictions state there is no parking south of the access track from Gantheaume Point Road, however cars frequently park towards Red Point, an area preserving outstanding geological and palaeontological features relevant to the West Kimberley National Heritage listing

[IMG] Figure 3.28 The existing signage at Cable Beach South Zone access ramp does not clearly indicate the location of the SOB Off Road Prohibited Vehicle Area

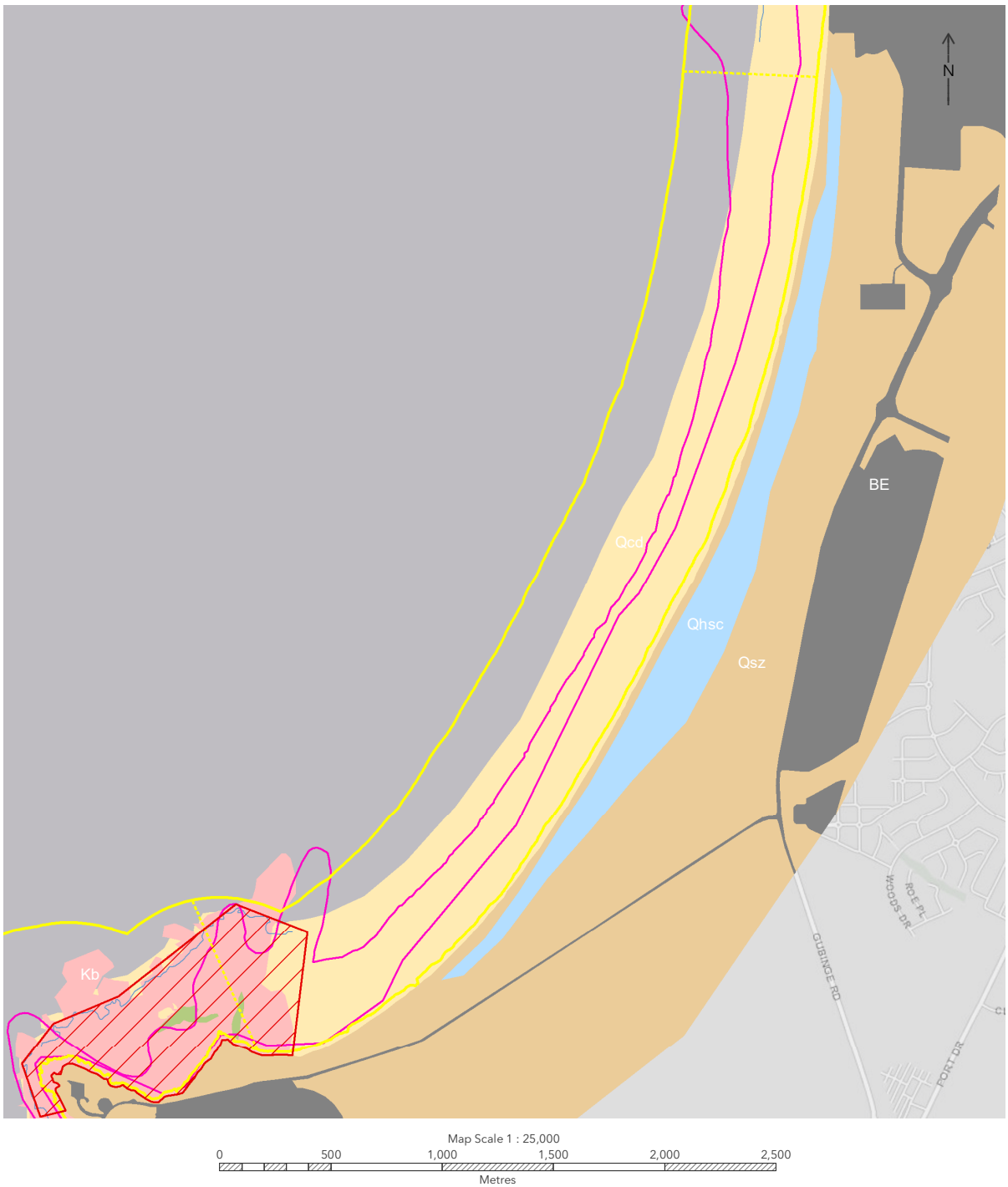
Activities and vulnerabilities

The zone is vulnerable to concentrations of vehicle and pedestrian traffic in the north and south, with only limited pedestrian access to the central area of the beach via the Minyirr Park walk trails through the sand dunes. From either end of the beach pedestrians and vehicles can also access the more vulnerable Cretaceous heritage of the adjoining Gantheaume Point and Cable Beach Foreshore Zones by walking along the beach. Racehorse training is allowed between April and August in an Approved Horse Exercise Area which extends for two kilometres northeast of the vehicle beach access point. Yacht and boat hire companies also operate from this southwestern end of Cable Beach.

Supporting information

The Yawuru Minyirr Buru Conservation Park JMP (DBCA 2018) describes and manages the reserve area adjacent to Cable Beach South Zone. See also KPA Environmental Management Plan and CV Act.

[IMG] Figure 3.29 Aerial view of the Cable Beach Foreshore area



Map Scale 1 : 25,000

0 500 1,000 1,500 2,000 2,500

Metres

Geological & Palaeontological Features

Area with outstanding features relevant to The West Kimberley National Heritage Listing

DCNHMP

Zone Boundary

Project Area

NHL Gazette

The West Kimberley

Low Tide (approx 0.6m)

Geological Units

Kb : Broome Sandstone

BE : Built Environment

Qcd : Cable Beach Sand

Qsz : Holocene Aeolean Dune Sand (Church Hill Sand + Shoonta Hill Sand) overlying Pleistocene Mowanjum Sand

Qhsc : Horsewater Soak Calcarenite

PQc : Unnamed Pliocene-Quaternary Conglomerate

Map 3.15 Cable Beach South Zone: Geological and palaeontological features

3.2.8 Cable Beach Foreshore

The Cable Beach Foreshore Zone extends 1.3 kilometres, commencing in the south at the northern ITZ boundary of Yawuru Minyirr Buru Conservation Park (YMBCP) (Reserve 51106) and extends northwards ending at the point where YMBCP (Reserve 50994) transects the intertidal area. This zone coincides with the Cable Beach tourism precinct.

Topography and ecology

This zone is a predominantly sandy beach with a centrally located Broome Sandstone exposure and small rocky headland of Pliocene–Quaternary conglomerate topped by Mowanjum Sand and Holocene aeolian dune sand (Church Hill Sand + Shoonta Hill Sand) adjacent to the beach vehicle ramp. There are Flatback Turtle nesting sites along the beach.

Geological and palaeontological features

The Cable Beach Foreshore Zone has extensive outcrops of Broome Sandstone which are periodically exposed during low tides. Sand loads in this area are variable, and the amount of Broome Sandstone that is exposed changes from month to month, year to year depending on wave and storm activity. In addition to the platforms in the low tide zone, there are also small, irregular outcrops of Broome Sandstone higher up on the beach. Around 750 tracks have been recorded in this zone, half of which are attributable to sauropods and half to *Megalosauropus broomensis* (Bennett 2022, 2024), including several well-preserved trackways. All tracks are preserved as natural moulds, and fossil burrows are also evident at the northern end of the zone which is classified as containing outstanding geological and palaeontological features relevant to the West Kimberley National Heritage listing.

[IMG] Figure 3.30 Ripples preserved in Broome Sandstone in the Cable Beach Foreshore area

Access and landscape modifications

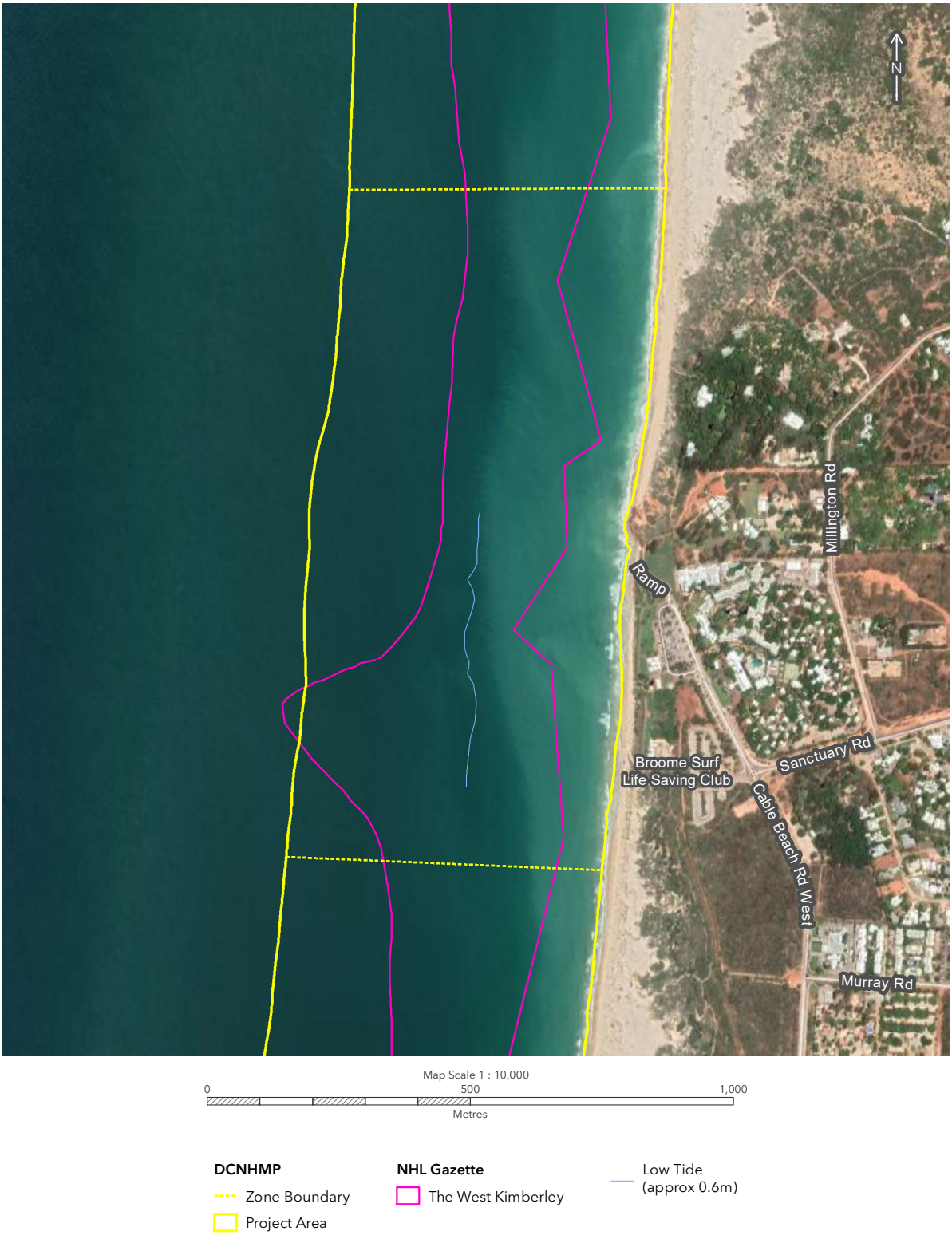
There is a high level of pedestrian and vehicle traffic via the beach access ramp and pedestrian access via multiple other access points. Coastal erosion management projects and redevelopments of the tourism precinct also intersect with the ITZ here.

Activities and vulnerabilities

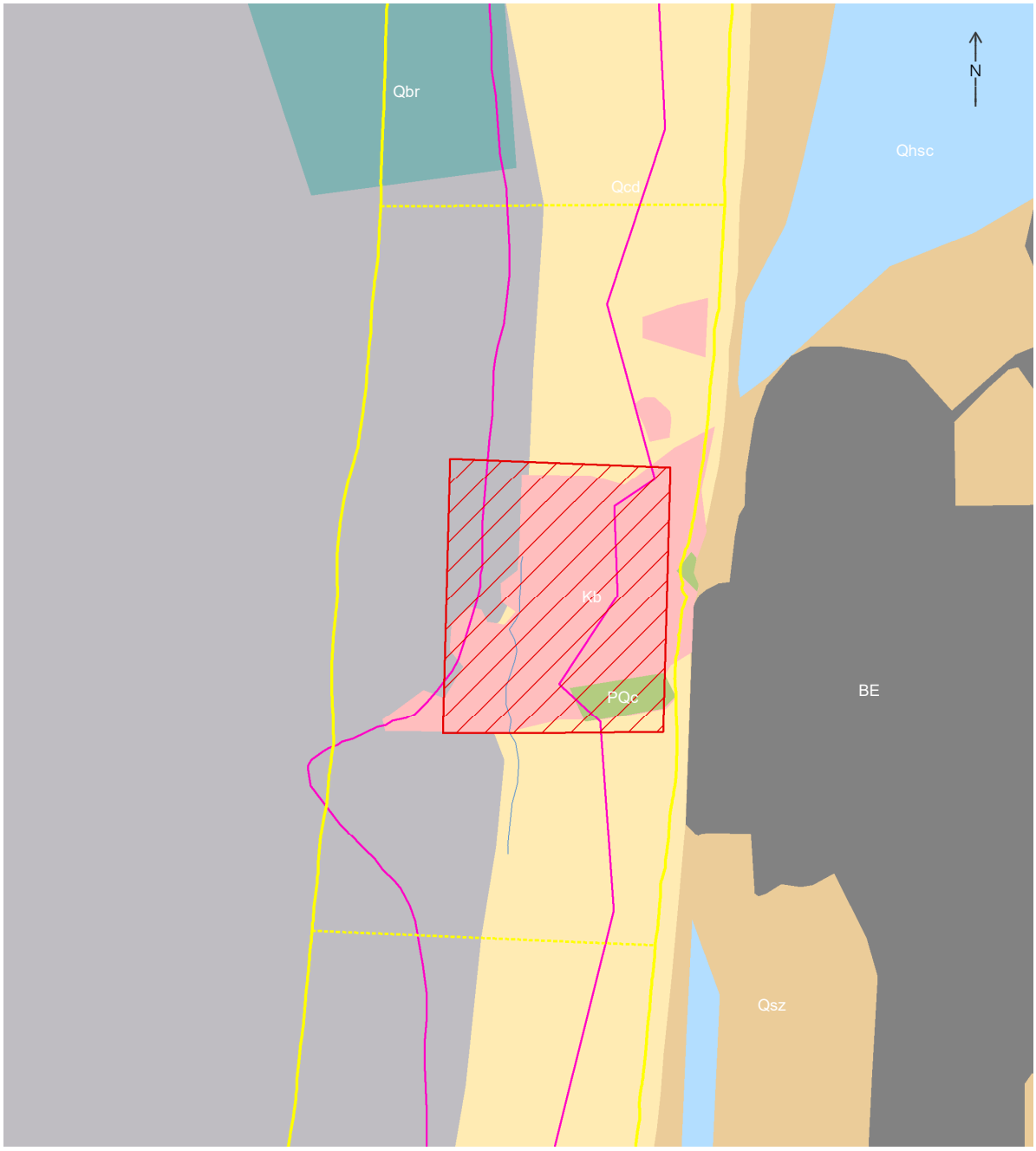
Both the irregular sandstone exposures at low tide and permanently exposed higher sandstone outcrops are extremely vulnerable to increasing developmental pressure associated with upgrades currently underway to the Cable Beach tourism precinct, increasing pedestrian traffic and tourism activity on the beach, coastal erosion management proposals and other upgrades to local facilities. Recreational activities in the zone include car access to the beach, camel rides, jet ski tours, Broome Surf Life Saving Club activities, beach polo, volleyball, and large events including the Shinju Long Table, and beach weddings (Figures 3.31 and 3.32).

[IMG] Figure 3.31 Camel chain entering the Cable Beach Foreshore area

[IMG] Figure 3.32 Vehicles access the Cable Beach Foreshore Broome Sandstone exposures daily



Map 3.16 Cable Beach Foreshore Zone: Location



Geological & Palaeontological Features

- Area with outstanding features relevant to The West Kimberley National Heritage Listing

DCNHMP

- Zone Boundary
- Project Area

NHL Gazette

- The West Kimberley
- Low Tide (approx 0.6m)

Geological Units

- Kb : Broome Sandstone
- BE : Built Environment
- Qcd : Cable Beach Sand
- Qbr : Cape Boileau Calcarenite + Lombadina Conglomerate
- Qsz : Holocene Aeolean Dune Sand (Church Hill Sand + Shoonta Hill Sand) overlying Pleistocene Mowanjum Sand
- Qhsc : Horsewater Soak Calcarenite
- PQc : Unnamed Pliocene-Quaternary Conglomerate

Map 3.17 Cable Beach Foreshore Zone: Geological and palaeontological features

Supporting information

The Yawuru Minyirr Buru Conservation Park JMP (DBCA 2018) provides the framework for joint management of the entire intertidal section of the Cable Beach Foreshore Zone; however, the SOB controls access to the beach via the access ramp. Other relevant information documents include the Cable Beach Foreshore Master Plan (SOB 2017) and Cable Beach Foreshore Redevelopment (SOB 2022) with subsequent updates found at cablebeachredevelopment.com.au. See also the Cable Beach Coastal Protection Options and Geotechnical Investigations Report (SOB 2019a); Cable Beach Broome – Review of Additional Coastal Adaption Concepts Report (SOB 2021); Broome Townsite Coastal Hazard Risk Management and Adaptation Plan (Baird 2017); and KPA Environmental Management Plan 2023 (KPA 2023); and CV Act.

3.2.9 Waterbank

The Waterbank Zone commences at the northern extent of the Cable Beach Foreshore Zone and coincides with the boundary between the Yawuru Minyirr Buru and Guniyan Binba Conservation Parks. The zone extends generally north for 29.1 kilometres, terminating at a northern extent coincident with the Rubibi (Yawuru) Community Native Title claim northern boundary that transects the Willie Creek estuary.

Topography and ecology

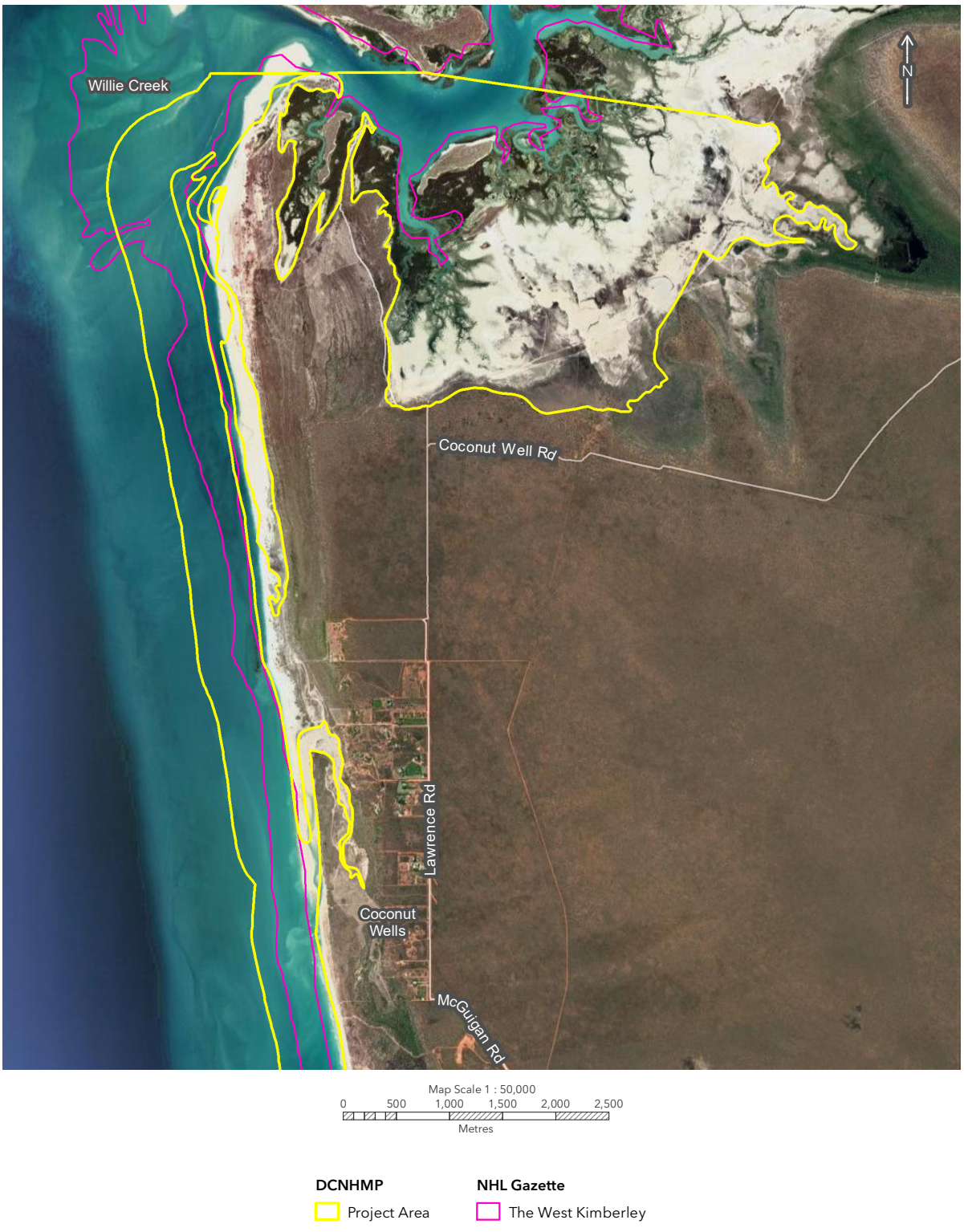
This is a mainly sandy beach bordered by dunes from the Cable Beach Foreshore Zone in the south to Cape Latreille, where the estuary inlet associated with this landform at Coconut Wells forms a break in the bordering dune system. The zone continues north from Cape Latreille to the southern banks of the Willie Creek estuary along a highly changeable shoreline, where the beach is subject to continuous sand erosion and backed by vegetated sand ridges rather than dunes. This zone includes an area of the Willie Creek estuary east of the Willie Creek mouth and to the north of Waterbank Station located near the southern shoreline of the creek. The barred embayments of Willie Creek and Coconut Wells are dominant features of the zone's geomorphology. At Coconut Wells the barriers of sand and limestone have forced a linear lagoon parallel to the shore (Semeniuk 2008; DBCA 2020: 23; Figure 3.36). Fauna associated with the shelly white sand beaches of this zone include various crabs, bivalves and other invertebrates that live on the intertidal flats, and marine turtles (including the threatened Flatback Turtle and Green Turtle) which traverse the ITZ to nest in the dunes (Figure 3.35). The beaches and lagoon are habitat for migratory bird species, while the Willie Creek wetland system of intertidal sand and mudflats, mangroves and salt flats is important habitat for diverse marine and terrestrial fauna (including saltwater crocodiles), and is a source of nutrients to the surrounding waters (GBCP JMP 2020: 24–29) (Figure 3.34).

[IMG] Figure 3.33 Aerial view of Waterbank Zone showing the Lombadina Conglomerate/Cape Boileau Calcarenite reef system

Geological and palaeontological features

North of the boundary with the Cable Beach Foreshore Zone, exposures of Broome Sandstone begin to thin, replaced by a complex sequence of Quaternary coastal sediments associated with the estuaries of Coconut Wells and Willie Creek. A large offshore reef system formed from a pavement of Cape Boileau Calcarenite, the Lombadina Conglomerate stretches almost unbroken along this stretch of coast. It is exposed during low tides. Combined with the beach sand, this stretch of beach forms the type area for the Cable Beach Sand (Semeniuk 2008). Scattered exposures of Broome Sandstone occur within and adjacent to the Waterbank Zone at Coconut Wells and within the Willie Creek estuary (GBCP JMP 2020: 10).

Map 3.18 Waterbank Zone (South): Location



Map 3.19 Waterbank Zone (North): Location

The southern extent of the ITZ north of the Cable Beach Foreshore Zone is dominated by beach sand. Towards the astronomical high-tide mark boulders and lithified Horsewater Soak Calcarenite occur, large sections of which contain invertebrate trace fossils. The low dunes and foredune complex are predominantly formed by the Holocene Shoonta Hill Sand. Each of the embayments around Coconut Wells and Willie Creek is barred by extensive dunes of Shoonta Hill Sands, along with ridges of the Horsewater Soak Calcarenite. At Willie Creek, the tidal flats west of the estuary mouth are formed by the Port Smith Sand. Along the shores of the inner estuary, between the red Mowanjum Sand and the tidal flat of Sandfire Calcilutite is a ribbon of muddy sand. Landward exposures are dominated by calcarenites of the Horsewater Soak Calcarenite (Semeniuk 2008).

[IMG] Figure 3.34 The Willie Creek wetland system of intertidal sand and mudflats, mangroves and salt flats is important habitat for diverse marine and terrestrial fauna

At Coconut Wells there are small but important outcrops of Broome Sandstone along the eastern edge of the lagoon within the supratidal zone. This is in the splash zone on the landward margin of the ITZ, which is affected by the highest tidal surges. The exposed Broome Sandstone outcrops at these locations, although outside the DCNHMP management area, may contain ichnofossils and have significant Aboriginal cultural heritage values, as well as additional scientific (palaeontological) values (refer also Chapter 4.3.2). The broader location also contains exposures of the overlying Sandfire Calcilutite and Horsewater Soak Calcarenite, the former containing many invertebrate body fossils and the latter containing invertebrate trace and body fossils. Although not listed in the NHVs, these fossils are considered to be scientifically significant.

Access and landscape modifications

There is limited formal pedestrian and vehicle access along this zone, but a rural living subdivision bordering the tidal inlet at Coconut Wells enables direct access to the ITZ.

Activities and vulnerabilities

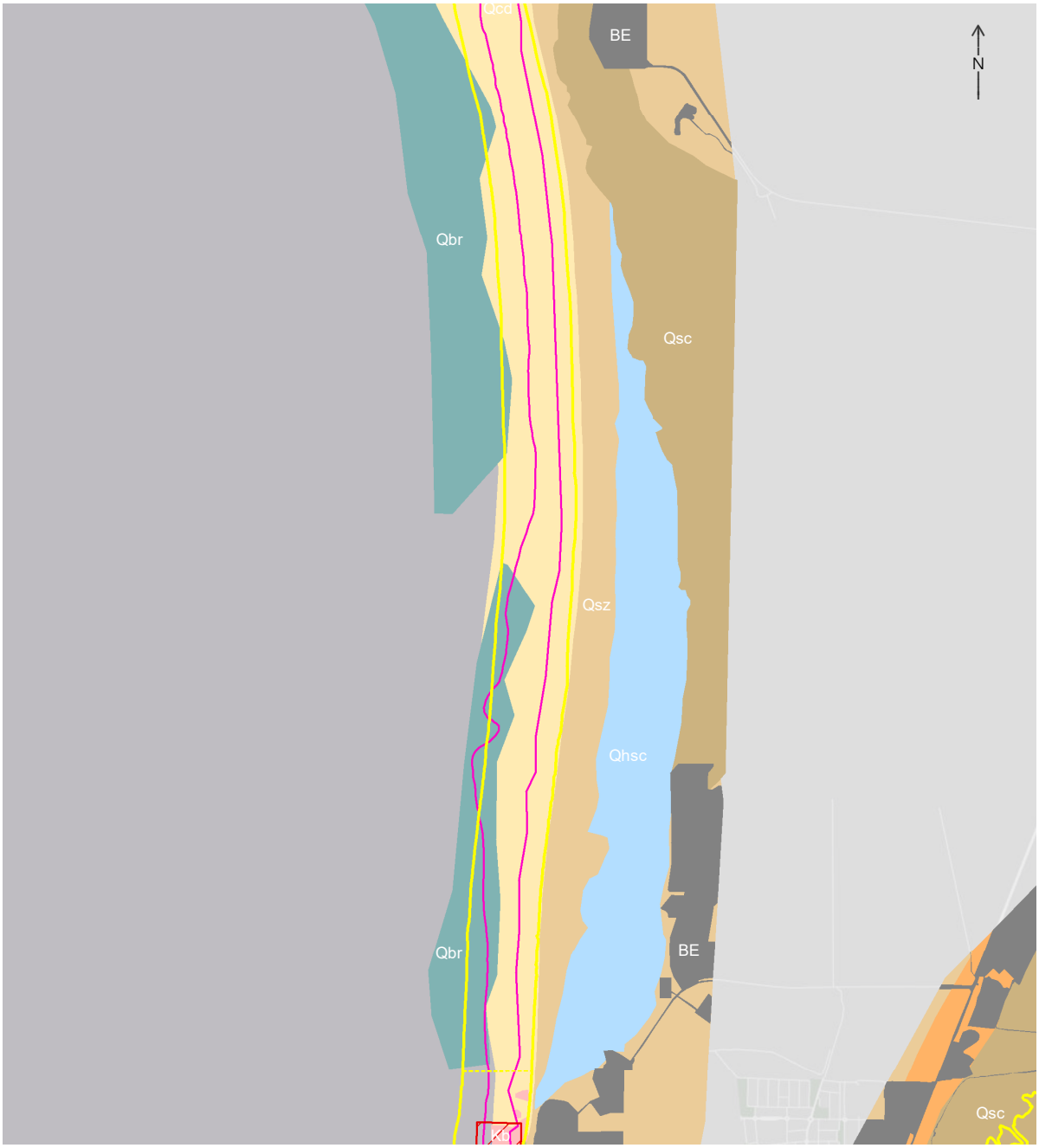
Vulnerable to vehicle traffic in the forms of 4WD, quad bikes or trikes, and motorcycles, Waterbank Zone is subject to ‘tidal tourism’, illegal camping and party behaviour consistent with it being situated remotely, the enforcement of regulations is infrequent.

Supporting information

Guniyan Binba Conservation Park JMP (DBCA 2020) and associated references and CV Act.

[IMG] Figure 3.35 Flatback Turtle nesting site near Coconut Wells

[IMG] Figure 3.36 Tidal lagoon at Coconut Wells



Geological & Palaeontological Features

- Area with outstanding features relevant to The West Kimberley National Heritage Listing

DCNHMP

- Zone Boundary
- Project Area

NHL Gazette

- The West Kimberley
- Low Tide (approx 0.6m)

Geological Units

- Kb : Broome Sandstone
- BE : Built Environment
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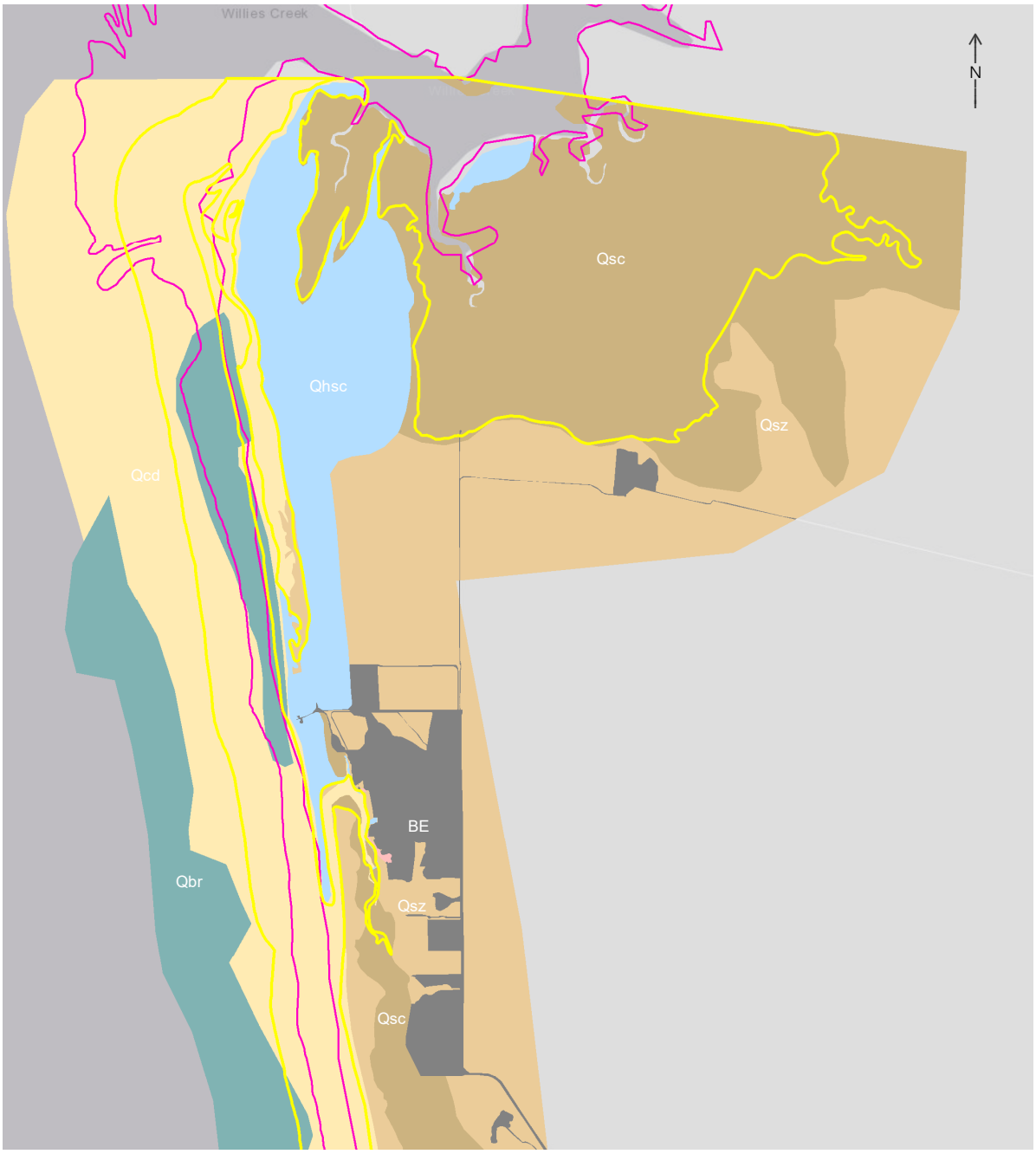
- Qbr : Cape Boileau Calcarenite + Lombadina Conglomerate
- Qdm : Djugun Member
- Qsz : Holocene Aeolean Dune Sand (Church Hill Sand + Shoonta Hill Sand) overlying Pleistocene Mowanjum Sand
- Qhsc : Horsewater Soak Calcarenite
- Qsc : Sandfire Calcilutite
- PQc : Unnamed Pliocene-Quaternary Conglomerate

Map 3.20 Waterbank (South) Zone: Geological and palaeontological features



Map 3.21 Waterbank (North) Zone: Geological and palaeontological features

3.3 Summary comparative analysis

The dinosaur tracks and associated ichnofossils, plant macrofossils and depositional environments of the Broome Sandstone exposures along 200 kilometres of the Dampier Coast (between Crab Creek in the south and Cape Leveque in the north) are significant because of the diversity of dinosaurian track types, the exceptional size of the sauropod prints, the unique census of Australian dinosaur populations that they provide, and for the integrated story they tell of the ecology of this area during the Lower Cretaceous Period of the Mesozoic Era, between 140 and 127 million years ago (Salisbury et al 2017; Romilio 2020).

The diversity of non-avian dinosaurian track types seen on this stretch of coastline, along with many of the area's individual track and trackways sites have been demonstrated to be unparalleled in Australia, and even globally; however, the full extent and nature of that diversity is the subject of ongoing research. While Salisbury et al (2017) focusses on the ichnofauna of the James Price Point/Walmadany area, much of the discussion relates to the Broome Sandstone exposures in general, providing the most up-to-date basis for a summary analysis of comparative sites in Australia and elsewhere in the world. The results of the study indicate that intertidal exposures of Broome Sandstone in the James Price Point/Walmadany area contain at least 11 and possibly as many as 21 different types of dinosaurian tracks, six of which do not occur anywhere else in the world (Salisbury et al 2017; Romilio 2020).

Within Australia, the next most diverse assemblage of dinosaurian tracks (also referred to as ichnofossils) is found in the Lower Jurassic Razorback Beds at Mount Morgan in the Fitzroy region of Queensland, and in the Middle Jurassic Walloon Coal Measures at Balgowan, Darling Downs, Queensland. Both of these units are currently thought to contain seven to eight dinosaurian ichnotaxa/track morphotypes, some of which are shared with the Broome Sandstone. The Mount Morgan track sites (which occur in man-made caverns, excavated to extract material for making bricks) were a tourist attraction for a number of years, but have been closed for over a decade due to rock-fall risk (Salisbury et al 2017). Early Jurassic dinosaur track sites are exclusive to Queensland and include Carnarvon Gorge and Biloela, where purportedly hundreds of tracks have been uncovered by open-cut coal mining and then dumped. There has been little scientific access to these sites and no specimens have been recorded or preserved (Romilio 2020).

Other Australian track sites have a much lower diversity of track types: the Upper Triassic Ipswich Coal Measures have one theropod and one non-sauropod sauropodmorph that represent Australia's only dinosaur fossils from the Triassic, while the Lower Cretaceous Eumeralla Formation of the Otway Group in southern Victoria has produced one possible ornithopod track and two types of theropod track. Lark Quarry, central-western Queensland, in the Upper Cretaceous portion of the Winton Formation, has two types of ornithopod track (Romilio & Salisbury 2011, 2014; Romilio et al 2013; Salisbury et al 2017; Romilio et al 2021).

[IMG] Figure 3.37 Goolarabooloo Law Boss Richard Hunter (left) with Assoc. Prof. Steven Salisbury (centre) and members of UQ Dinosaur Lab team (Photo: Damian Kelly)

A global comparison of the ichnodiversity of track sites in Salisbury et al, (2017) thus concludes that the Broome Sandstone of the Dampier Peninsula contains the highest diversity of dinosaurian ichnotaxa anywhere in the world. After the Broome Sandstone, the next most diverse non-avian dinosaur ichnofaunas likely come from the Middle Jurassic Saltwick and Scalby formations of the Cleveland Basin, UK, and the Late Cretaceous (Campanian) Blackhawk Formation, Utah, USA. The Saltwick and Scalby formations have a combined total of 17–18 types of dinosaurian track, only some of which have been named. These represent a minimum of three types of theropod track, two types of sauropod track, at least three types of ornithopod track, and one type of thyreophoran track

(Romano & Whyte 2003; Whyte et al 2007) spread across approximately 10 million years of deposition. The Blackhawk Formation is estimated to contain 14 different non-avian dinosaur track types, pertaining to theropods, ornithopods and a thyreophoran (Parker & Rowley 1989 in Salisbury et al 2017).

Most other well-known formations and/or track-bearing areas contain no more than ten or so non-avian dinosaur track types. These include the Lower Cretaceous (Aptian) Gething Formation of the Western Canadian Sedimentary Basin, Canada (eight types of non-avian dinosaurian tracks); the Lower Cretaceous (Aptian–Albian), Jindong Formation of the Gyeongsang Basin, Korea (six types of non-avian dinosaurian tracks); the Upper Jurassic (Kimmeridgian) Morrison Formation of the San Juan Basin, USA (nine types of non-avian dinosaurian tracks); the Upper Jurassic (Kimmeridgian) Vega, Terenes, and Lastres formations of the Gijón-Villaviciosa Basin, Spain (nine types of non-avian dinosaurian tracks); the Upper Jurassic (Tithonian–Kimmeridgian) Lourinhã Formation of the Lusitanian Basin, Portugal (up to seven different types of non-avian dinosaurian tracks); the Lower Cretaceous (pre-Aptian) Sousa Formation of the Rio do Peixe (Sousa) Basin, Brazil (six to eight types of non-avian dinosaurian tracks); and the Lower or Middle Jurassic Botucatu Formation of the Sao Bento Group, Brazil (eight or nine types of non-avian dinosaurian tracks).

Salisbury et al (2017) conclude that the high abundance of sauropod, large ornithopod (*Walmadan-yichnus*), and thyreophoran (in particular *Garbina*) tracks at certain track sites is also unique globally for the Lower Cretaceous and provides enormous potential for future paleoecological and behavioural studies (Figure 3.37).

4 Heritage significance

4.1 NHVs and statements of national significance for the West Kimberley National Heritage Place

Located in the far northwest of Australia's tropical north, the West Kimberley National Heritage Place covers some 19,200,000 hectares. The National Heritage listing of this vast cultural landscape recognises natural, historic and Indigenous values that are of outstanding heritage value to the nation, including values related to continuing Aboriginal occupation and custodianship over the course of more than 40,000 years. The listing also recognises the history of non-Indigenous exploration and settlement, including pastoralism and pearling. Along with these cultural values, the region's natural and aesthetic values are also recognised as landscapes of relatively undisturbed beauty and biological richness containing important geological and fossil evidence of Australia's evolutionary history.

The complete gazettal notice for the National Heritage listing of the West Kimberley Item 106063 can be found on the Australian Heritage Database (AHD) record: environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;search=place_name%3Dwest%2520kimberley;%3Bplace_id%3D106063;place_id=106063 and at Appendix A.

4.2 NHVs and statements of national significance relating to the Dampier Coast

The Dampier Coast occupies a relatively small portion of the West Kimberley National Heritage area; the scope of the DCNHMP is limited to the ITZ between Crab Creek and Willie Creek. Extracted summaries from the AHD record of the National Heritage criteria, themes, values and statements of significance that relate to the Dampier Coast are given below, along with additional commentary relating to the intersection of those themes and values with the defined DCNHMP management area and NHL gazetted area.

4.2.1 National Heritage criterion (a): events and processes

The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern of Australia's natural and cultural history.

Theme: *Ecology, biogeography and evolution*

Value: *Vine thickets*

Many of the small immobile invertebrate species endemic to the Kimberley have only been recorded in its rainforest patches (vine thickets), including 90 per cent of the earthworms and 48 per cent of the land snails (Kenneally & McKenzie 1991). Survey and taxonomic work by Solem (1979, 1981, 1984, 1985 in AHC 2011a) and more recent research (Graham 2001; Köhler 2010) have helped highlight the national importance of the Kimberley Plateau and surrounding islands for land snail richness and endemism.

Statement of national significance: *Vine thickets of the northern Kimberley coast and islands and the Kimberley Plateau, and the Devonian reefs of the west Kimberley, are of outstanding heritage value to the nation under criterion (a) for their evolutionary refugial role that has resulted in high invertebrate richness and endemism* (COMMONWEALTH OF AUSTRALIA 2011).

Commentary: Small patches of monsoon vine thicket (dry rainforest) also occur along the Dampier Peninsula coast amongst Holocene sand dune systems (Kenneally & McKenzie 1991). These coastal thickets, while simpler in structure and possessing fewer plant species than the thickets of the northern Kimberley Coast and Plateau, offer important dry season refuge and food resources for birds such as the Rose-Crowned Fruit-Dove (*Ptilinopus regina*) and Great Bowerbird (*Ptilonorhynchus nuchalis*) (Black et al 2010 in AHC 2011a).

[IMG] Figure 4.1 Monsoon vine thickets are an NHV of the northern Kimberley coast (Photo: Environs Kimberley)

[IMG] Figure 4.2 Healthy monsoon vine thicket and leaf litter (Photo: Louise Beames Environs Kimberley)

Dampier Peninsula vine thicket patches contain many fewer species of plants than vine thickets further north, and also fewer bird species (Johnstone & Burbidge 1991). However, the Rose-Crowned Fruit-Dove, which is confined to vine thickets, is more common here than in other parts of the Kimberley. Restricted or locally endemic Camaenid snails are found frequently in Kimberley vine thicket surveys, including the more geographically isolated Dampier Peninsula dune thickets, as far south as Broome (AHC 2011a).

The patches of endangered monsoon vine thicket that persist in Holocene dune locations within and adjacent to the ITZ of the DCNHMP management area (see Chapter 3.2.5) are not for the most part contained within the NHL boundary, nor are they considered to be an attribute of NHV as described in the NHL gazettal notice, which refers only to locations further north. However, 'Monsoon vine thickets on coastal sand dunes of the Dampier Peninsula' within and adjacent to the management area are separately protected under the EPBC Act as threatened ecological communities (see Chapter 4.3 and Figure 4.2).

Theme: *Wealth of land and sea*

Value: *Aboriginal trade in pearl shell*

Kimberley pearl shell (Pinctada maxima) *has associations with water, rain-making, ancestral Creator Beings, stories and songs. The significance of the modified pearl shell changes as it is traded from its source, where it was created by powerful Dreamtime Beings. Highly valued by Aboriginal people as the 'emblem of life' with potent correlations with water, and the power to regenerate, renew, and transform; modified Kimberley pearl is the most widely distributed commodity in Aboriginal Australia, covering two-thirds of the Australian continent.*

Statement of national significance: *Pearl shell beds at a number of identified sites from Bidyadanga to Cape Londonderry, where in Aboriginal law and culture, the shell is believed to have been created by Dreamtime Beings and is collected by Traditional Owners, have outstanding heritage value to the nation under criterion (a) as the source of the item most widely distributed by Aboriginal people in the course of Australia's cultural history* (COMMONWEALTH OF AUSTRALIA 2011).

Commentary: While the coastline described in the NHL gazettal notice intersects with the DCNHMP management area, pearl-shell bed sites have not been identified to date. However, the Yawuru CMP lists pearl-shell collection as an important cultural value for the Roebuck Bay area (refer Chapter 4.3.2; Yawuru RNTBC 2016: 178).

[IMG] Figure 4.3 Aboriginal trade in pearl shell is identified as an NHV of the West Kimberley cultural landscape (Photo: Western Australian shell pendant from the Australian National Maritime Museum Collection 00045196)

> ***Theme:*** *Contact, change and continuity*
>
> ***Value:*** *European explorers*
>
> *In the sixteenth century long, dangerous and difficult voyages across uncharted oceans began to shape 'new worlds' on the maps of European navigators. In the pursuit of knowledge and wealth beyond the borders of Europe, early expeditions by the Portuguese, Spanish, Dutch, French and British began to reveal the outline of the Australian continent.*
>
> ***Statement of national significance:*** *The Kimberley coast is recognised for its association with early European exploration of the continent. The William Dampier (Cygnet) (1688) landing place, around Pender Bay, Karrakatta Bay, King Sound, the Buccaneer Archipelago and nearby coast, has outstanding heritage value to the nation under criterion (a) for its association with William Dampier and the influence of his published observations. The environment observed by Dampier is substantially unmodified since his 1688 landing and can be seen today* (COMMONWEALTH OF AUSTRALIA 2011).

Commentary: While the Dampier Peninsula, Dampier Creek and Roebuck Bay are associated by name with William Dampier, the NHV described above is linked to the explorer's first 1688 voyage on the *Cygnet*. His 1699 voyage on the *HMS Roebuck* landed at Shark Bay and followed the coast north to Lagrange Bay (just south of what is now called Roebuck Bay) before heading out to sea. The DCNHMP management area is therefore considered to have associative value, but not considered to contain physical attributes of National Heritage significance under this theme as described in the NHL gazettal notice.

4.2.2 National Heritage criterion (b): rarity

The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural and cultural history.

> ***Theme:*** *Ecology, biogeography and evolution*
>
> ***Value:*** *Dampier Coast*
>
> *The early* [sic: Lower] *Cretaceous Broome Sandstone of the Dampier Coast contains the only sauropod prints found in Australia – these are common in the discontinuous outcrops that stretch for up to 200 kilometres along the west coast of the Dampier Peninsula (Molnar 1991; Thulborn et al 1994; Long 1998). With some hind foot tracks as long as 1.75 metres, the Dampier Coast tracks may be the world's largest sauropod prints. The world's smallest sauropod tracks have also been found here, indicating a broader population sample than that of any other*

known sauropod track site. It preserves rare examples of the coexistence of sauropod and ornithopods. The Dampier Coast is the only site with extensive evidence of western Australian dinosaurs and the large number of tracks provides an otherwise unobtainable census of dinosaur populations and communities.

Statement of national significance: *The Dampier Coast dinosaur tracks have outstanding heritage value to the nation under criterion (b) as the best and most extensive evidence of dinosaurs from the western half of the continent, some of which are unknown from body fossils; for the diversity and exceptional sizes of the sauropod prints; and the unique census of the dinosaur community that they provide* (COMMONWEALTH OF AUSTRALIA 2011).

Commentary: The citation of heritage value under Criterion (b) extracted above is considered to be out of date. However, the *Statement of national significance* under this criterion still stands. Sauropod tracks are now known from the Winton Formation of Central West Queensland (Poropat et al 2021) and the claim regarding the world's smallest sauropod tracks remains unconfirmed. Management, protection, research and education around, and promotion of, the extraordinary diversity of dinosaur tracks along the Dampier Coast, both within the gazetted NHL area and the wider project management area is considered to be the prime focus of the DCNHMP.

Value: *The Dampier Coast's human footprint sites*

Rare in Australia, fossil human tracks are important for both scientific and symbolic reasons. There are three occurrences of fossil human tracks documented in the literature. The Dampier Coast site is the only example yet found in Western Australia. Less clearly documented accounts of human tracks at other locations along the coast also appear in the literature (Mayor & Sarjeant 2001; Long 2002). The Pleistocene and Holocene human record which the Dampier Coast tracks help to elaborate is very patchy. Documenting track sites through human history can begin to reveal population data across a continent and through time, to supplement other kinds of archaeological and historical evidence. Tracks have the potential to reveal data which is hidden from those who only study body fossils: about gait, anatomy, stature, size, population and speed. In other words, they evoke 'the living behaviour of our ancestors' (Kim et al 2008; Webb et al 2006).

Statement of national significance: *The fossil human footprint sites of the Dampier Coast have outstanding heritage value to the nation under criterion (b) as one of only three documented human track sites in Australia and the only documented evidence of human tracks from the west coast of Australia* (COMMONWEALTH OF AUSTRALIA 2011).

Commentary: Fossil human footprints in Holocene deposits are present within the DCNHMP management area (Assoc. Prof. Steven Salisbury, UQ Dinosaur Lab), and this discovery is the subject of a confidential report commissioned by the Department of Transport (DOT) and GMIC (Archae-aus 2023).

4.2.3 National Heritage criterion (d): principal characteristics of a class of places

The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: (i) a class of Australia's natural and cultural places; or (ii) a class of Australia's natural and cultural environments.

Theme: *Ecology, biogeography and evolution*

Value: *Dampier Coast Cretaceous landscape*

The ichnofossils (trace fossils including dinosaur tracks) preserved in the Broome Sandstone exposed in the intertidal zone of the Dampier Coast (from Roebuck Bay to Cape Leveque) represent up to 15 different types of dinosaur (Thulborn et al 1994; Tyler 2000; Long 1998, 2004). The Cretaceous landscapes that occurred here were buried intact and reveal original topography, with soils, leaf-litter and even fossils of plants in their growth positions (roots can be seen descending into the substrate). In places, dinosaur tracks meander around these plants so that one may walk across these ancient landscapes following their paths through clumps of vegetation (Thulborn pers. comm. 2009).

The plant and sedimentological evidence allows reconstruction of the environments in which dinosaurs lived and fed, providing a fuller palaeoecological picture of a suite of Cretaceous coastal environments. The Broome Sandstone coastal exposures of dinosaur tracks and associated fossils therefore tell an integrated story of the animals, plants and physical environment of this area during the Early Cretaceous period, approximately 132 million years ago.

Statement of national significance: *The dinosaur tracks and associated ichnofossils, plant macrofossils and Cretaceous depositional environments of the Broome Sandstone exposed in the intertidal zone of the Dampier Coast have outstanding heritage value to the nation under criterion (d) for preserving snapshots of the ecology of the Mesozoic* (COMMONWEALTH OF AUSTRALIA 2011).

Commentary: The value citation under Criterion (d) above is considered to be out of date. However, the *Statement of national significance* under this criterion still stands. Salisbury et al (2017) and Salisbury and Romilio (2019) document at least 11 and possibly as many as 21 different dinosaurian tracks, six of which do not occur anywhere else in the world.

Value: *Roebuck Bay migratory hub*

Sixty-four waterbird species have been recorded at Roebuck Bay, 34 of which have been listed under international treaties (JAMBA, CAMBA and ROKAMBA). Roebuck Bay has the highest number of species of international importance visiting its shores of any site in Australia, including Pied Oystercatcher (Haematopus longirostris)*, Mongolian Plover* (Charadrius mongolus) *and the Ruddy Turnstone* (Arenaria interpres)*. Australian National Heritage Assessment Tool (ANHAT) analysis returned the second highest score for Charadiiformes (waders) richness at Roebuck Bay (61 species). Along with international visitors, Roebuck Bay also returned nationally high endemism scores for a collection of bird groups, including Passeriformes (perching birds), Meliphagidae (honeyeaters), Pittidae (pittas) and to a lesser extent Sylviidae (old world warblers). The endemism significance can in some cases be explained by a number of bird species, such as the Common Redshank* (Tringa totanus) *and the Asian Dowitcher* (Limnodromus semipalmatus)*, that within Australia almost exclusively visit the Canning coast area, before returning to other countries within their flyway zone.*

[IMG] Figure 4.4 Management, protection, research, education and promotion of the extraordinary diversity of dinosaur tracks along the Dampier Coast is considered to be the prime focus of the DCNHMP (Source: DCMG)

[IMG] Figure 4.4a Eroded sauropod track at Entrance Point. The 'true track' – the surface on which the sauropod walked – has weathered away

[IMG] Figure 4.5 Artist's rendition of the species diversity of the Dampier Peninsula's Dinosaur Coast in the Lower Cretaceous period (Source: DCMG)

> ***Statement of national significance:*** *Roebuck Bay has outstanding heritage value to the nation under criterion (d) due to the place's importance as a class of avian habitat (a migratory hub or staging post), and for the regular presence of migratory, protected or endangered avifauna* (COMMONWEALTH OF AUSTRALIA 2011).

Commentary: While the Roebuck Bay migratory bird hub is considered to be an important NHV that intersects with DCNHMP Roebuck Bay Zone, this NHV is already well-recognised and managed under several international treaties including the Ramsar Convention. The Yawuru Nagulagun/Roebuck Bay Marine Park JMP (DPW 2016b) and *Ecological Description for Roebuck Bay* (Bennelongia 2009) are viewed as the primary management documents for this value. However, management strategies for the Ramsar Site are likely to intersect with strategies to protect and manage access to the Broome Sandstone Lower Cretaceous heritage.

4.2.4 National Heritage criterion (g): social value

The place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.

[IMG] Figure 4.6 The migratory bird hub at Roebuck Bay is a recognised NHV and is also a Ramsar Site (Photo: Stephanie Cartledge)

> ***Theme:*** *Wealth of Land and Sea*
>
> ***Value:*** *European pearling*
>
> *Memories and stories of pearling along the pearling coast in the Kimberley region have a special iconic association with the Australian community. Today the Australian community continues to be drawn to the region in search of the iconic association with pearling and the attraction of the pearls themselves. This is enlivened by the place's outback location, remoteness of the area and beauty of the coast. A demonstration of this community connection is the high visitation to the area, where a diverse cultural heritage is celebrated in the annual Shinju Matsuri Festival.*
>
> ***Statement of national significance:*** *The pearling coast within the West Kimberley place has outstanding (intangible) heritage value to the nation under criterion (g) as a place which has a special association with the Australian community for evoking memories of pearling. These memories are enlivened by the place's remoteness and beauty at the gateway to the Kimberley's outback* (COMMONWEALTH OF AUSTRALIA 2011).

Commentary: Given its proximity to the pearling port of Broome, the DCNHMP management area is considered to have intangible associative values with the theme of European pearling. The Shinju Matsuri festival is expanding to include celebration of Broome's ancient Cretaceous heritage while the Broome Museum includes a permanent dinosaur display alongside its pearling history exhibits. Morgan's Camp, in the Chinatown Conservation Area was an historic pearling camp on Dampier Creek which included Aboriginal residents (Yawuru RNTBC 2016: 170).

[IMG] Figure 4.7 The Sailmaker's Shed in the Broome Museum houses an exhibition of pearl lugger sailmaking

4.2.5 National Heritage criterion (h): significant people

The place has outstanding heritage value to the nation because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history

> ***Theme:*** *Contact, Change and continuity*
>
> ***Value:*** *Association with European explorers*
>
> ***Statement of national significance:*** *The William Dampier (Cygnet) 1688 landing place has outstanding heritage value to the nation under criterion (h) for its special association with the life and work of William Dampier* (COMMONWEALTH OF AUSTRALIA 2011).

Commentary: While the Dampier Peninsula, Dampier Creek and Roebuck Bay are associated by name with William Dampier, the described NHVs are mostly linked to the explorer's first 1688 voyage on the *Cygnet*. As his 1699 voyage on the *HMS Roebuck* landed at Shark Bay and followed the coast north to Lagrange Bay (just south of what is now called Roebuck Bay) before heading out to sea, the DCNHMP management area is considered to hold associative value with the theme of exploration but is not considered to contain physical attributes of National Heritage significance as described in the NHL gazettal notice.

4.3 Other documented heritage values within the DCNHMP management area

4.3.1 Values documented at the national and international level

The EPBC Act is the key national legal framework for protecting and managing unique plants, animals, habitats and places including national and world heritage sites, marine areas, some wetlands as well as listed threatened and migratory species. These are all defined as 'matters of national environmental significance' under the Act.

Roebuck Bay Ramsar Site

Apart from the NHVs associated with the ITZ described in Chapter 4.2, and summary comparative analysis of dinosaur tracks and other ichnofossils in Chapter 3.3, documented heritage and conservation values of national and international significance are largely connected to the Roebuck Bay Ramsar Site, which occurs across marine and terrestrial reserves, and which is regarded as having one of the most biologically diverse and productive intertidal flats in the world (Bennelongia 2009). The formal Ramsar criteria and associated values managed and protected under the EPBC Act are:

> ***Criterion 1: Wetland values.*** *The site is a superb example of a tropical marine embayment within the Northwest (IMCRA) bioregion. It is one of only a dozen intertidal flats worldwide where benthic food sources are found in sufficient densities that they regularly support internationally significant numbers of waders.*

Criterion 2: Threatened species/communities. *Loggerhead Turtles (*Caretta caretta*, nationally endangered) and Green Turtles (*Chelonia mydas*, nationally vulnerable) regularly use the site as a seasonal feeding area and as a transit area on migration. Flatback Turtles (*Natator depressus*, nationally vulnerable) regularly nest in small numbers around Cape Villaret during the summer months. Sawfish (*Pristis clavate*, nationally endangered) regularly use the tidal creeks and mangrove areas for breeding and refuge.*

Criterion 3: Regional biodiversity. *The site supports a significant component of the region's (Northwest IMCRA bioregion) intertidal and shallow marine biodiversity in terms of the marine mammals (dugong, turtles and dolphin), marine invertebrate infauna, and avian fauna across the site. The total density of macrobenthic animals (1,287 individuals/m²) is high by global standards for a tropical mudflat and species richness is very high (estimated to be between 300–500 species).*

Criterion 4: Key habitat in life cycle. *The site is one of the most important migration stopover areas for shorebirds in Australia and globally. It is the arrival and departure point for large proportions of the Australian populations of several shorebird species, notably Bar-tailed Godwit* (Limosa lapponica) *and Great Knot* (Calidris tenuirostris)*. The site provides essential energy replenishment for many migrating species, some of which fly non-stop between continental East Asia and Australia.*

Criterion 5: Supports >20,000 waterbirds. *The site regularly supports over 100,000 waterbirds. The highest number of shorebirds counted at the site was 170,915 in October 1983 and allowing for turnover, the total number of shorebirds using the site may exceed 300,000 annually. It is the fourth most important site for waders in Australia in terms of absolute numbers and the most important in terms of the number of species it supports in internationally significant numbers (see Criterion 6).*

Criterion 6: The site regularly supports 1% of the population of at least 22 wader species *(20 migratory and 2 resident species).*

Criterion 8: *The site is important as a nursery and/or breeding and/or feeding ground for at least five species of fish and for mud crabs and prawns. The site's mangal system is particularly important as a nursery area for marine fishes and prawns* (BENNELONGIA 2009)*.*

Other documented matters of national environmental significance

Monsoon vine thickets on coastal sand dunes of the Dampier Peninsula are protected under the EPBC Act as threatened ecological communities present within and adjacent to the DCNHMP management area.

The *Willie Creek Wetland Complex*, partly within the DCNHMP Waterbank Zone, is recognised as a nationally important wetland providing a unique, permanent freshwater swamp and important wader habitat with unusual vegetation in its vicinity (DBCA 2020).

The DCNHMP ITZ in its entirety provides habitat for 34 listed threatened species and 66 listed migratory species. A summary of items protected under the EPBC Act within the DCNHMP management area is provided in Table 4.1.

Table 4.1 Summary table of EPBC Act Protected Matters for the DCNHMP management area

Matter of national environmental significance	Relevance to management area
World Heritage Properties	None
National Heritage Places	The West Kimberley
Wetlands of International Importance (Ramsar Sites)	Roebuck Bay
Threatened species	• Several (12) bird species with habitats known to or likely to occur are listed as vulnerable, endangered or highly endangered • One fish species likely to occur within area • Several (5) marine and land mammals likely to occur • One flora species known to occur within area (fringed fire-bush) is listed as critically endangered • Several (5) turtle species known to or likely to breed in addition to endangered Loggerhead Turtle known to forage in the area; critically endangered Leaf-scaled Sea snake may occur • Vulnerable and conservation dependent shark species are likely to occur or breeding known to occur
Migratory species	• Migratory marine birds (7 species) may or are known to occur • Migratory marine species (23) known or likely to occur • Migratory terrestrial bird species (5) are known to occur or may occur • Migratory wetlands species (33) inhabit, forage, feed or related behaviour in the area
Habitat critical to survival	Flatback Turtle nesting known to occur
Biologically important areas	Several species of dolphins (9), dugongs (2), sawfish (5) and whale (2) known to breed, calve, forage and/or migrate
EPBC Act referrals (current or recent)	• 2021: Broome Boating Facility; controlled action • 2020: Kimberley Marine Offloading Facility • 2018: Port of Broome Channel Optimisation Project

Underwater cultural heritage

The Australasian Underwater Cultural Heritage Database (AUCHD) contains historical and environmental information about shipwrecks, sunken aircraft and other types of underwater heritage site and serves as the register of protected underwater cultural heritage for the federal *Underwater Cultural Heritage Act 2018* (UCH Act). Roebuck Bay's globally significant Flying Boat Wreckage Site (also known as the Catalina Wrecks) is located in the ITZ management area of this management plan and protected under national, state and local frameworks. Visible only at extreme low tides, the wrecks are located on the mudflats about one kilometre out from Town Beach.

[IMG] Figure 4.8 Roebuck Bay's Flying Boat Wreckage Site (Source: Visit Broome)

4.3.2 Values documented at the state, regional and local level

Aboriginal cultural heritage management guidelines

The DCNHMP recognises that the Lower Cretaceous ichnofossils and fauna fossils of the Broome Sandstone have high Aboriginal cultural significance, even though these values were not recognised in the West Kimberley National Heritage listing (and it is recommended in Chapter 4.4.1 below that these values should be added). Nevertheless, the **National Heritage management principles (Schedule 5B, EPBC Act)** specify that:

> *5. The management of National Heritage Places should make timely and appropriate provision for community involvement, especially by people who:*
>
> *(a) have a particular interest in, or association with, the place; and*
>
> *(b) may be affected by the management of the place.*
>
> *6. Indigenous people are the primary source of information on the value of their heritage and the active participation of Indigenous people in identification, assessment and management is integral to the effective protection of Indigenous heritage values.*

Those principles require that a national heritage management plan engages with and respects Indigenous cultural values, including situations where those values may be multifaceted and layered across the Aboriginal community.

Article 13 of the Burra Charter (AICOMOS 2013a) specifically acknowledges that co-existing cultural values may apply to a specific situation:

> *Co-existence of cultural values should always be recognised, respected and encouraged. This is especially important in cases where they conflict.*
>
> *(Explanatory Note: For some places, conflicting cultural values may affect policy development and management decisions. In Article 13, the term cultural values refers to those beliefs which are important to a cultural group, including but not limited to political, religious, spiritual and moral beliefs. This is broader than values associated with cultural significance.)* (AICOMOS 2013A: ARTICLE 13).

AICOMOS has produced a **Code on the Ethics of Co-existence in Conserving Significant Places** that provides a series of ethical principles and practice guidelines for situations with multiple or conflicting sets of cultural values (AICOMOS 1998). The articles of this code emphasise the importance of a fully inclusive approach, including:

- *identifying and acknowledging each associated cultural group and its values, while accepting the cultural right of groups to withhold certain information (Article 9);*
- *enabling each cultural group to gain access to pertinent information and facilitating the exchange of information among groups (Article 10);*
- *enabling each cultural group to gain access to, and be included and participate in, the decision-making processes which may affect the place (Article 11); and*
- *where appropriate, seeking co-existence of differing perceptions of cultural significance rather than resolution (Article 14).*

These principles are developed further in the AICOMOS Burra Charter Practice Notes (AICOMOS 2013b, 2013c, 2017).

Consistent with these principles and respecting the multifaceted Aboriginal cultural traditions involving Lower Cretaceous ichnofossils that coincide in the Broome area, the processes involved in the implementation and continued evolution of the DCNHMP should engage with both Yawuru (RNTBC) and Goolarabooloo in relation to these cultural values. These organisations carry cultural responsibilities for areas associated with what they respectfully refer to as the Northern and Southern traditions and associated songlines (Yawuru RNTBC 2016: 30–31).

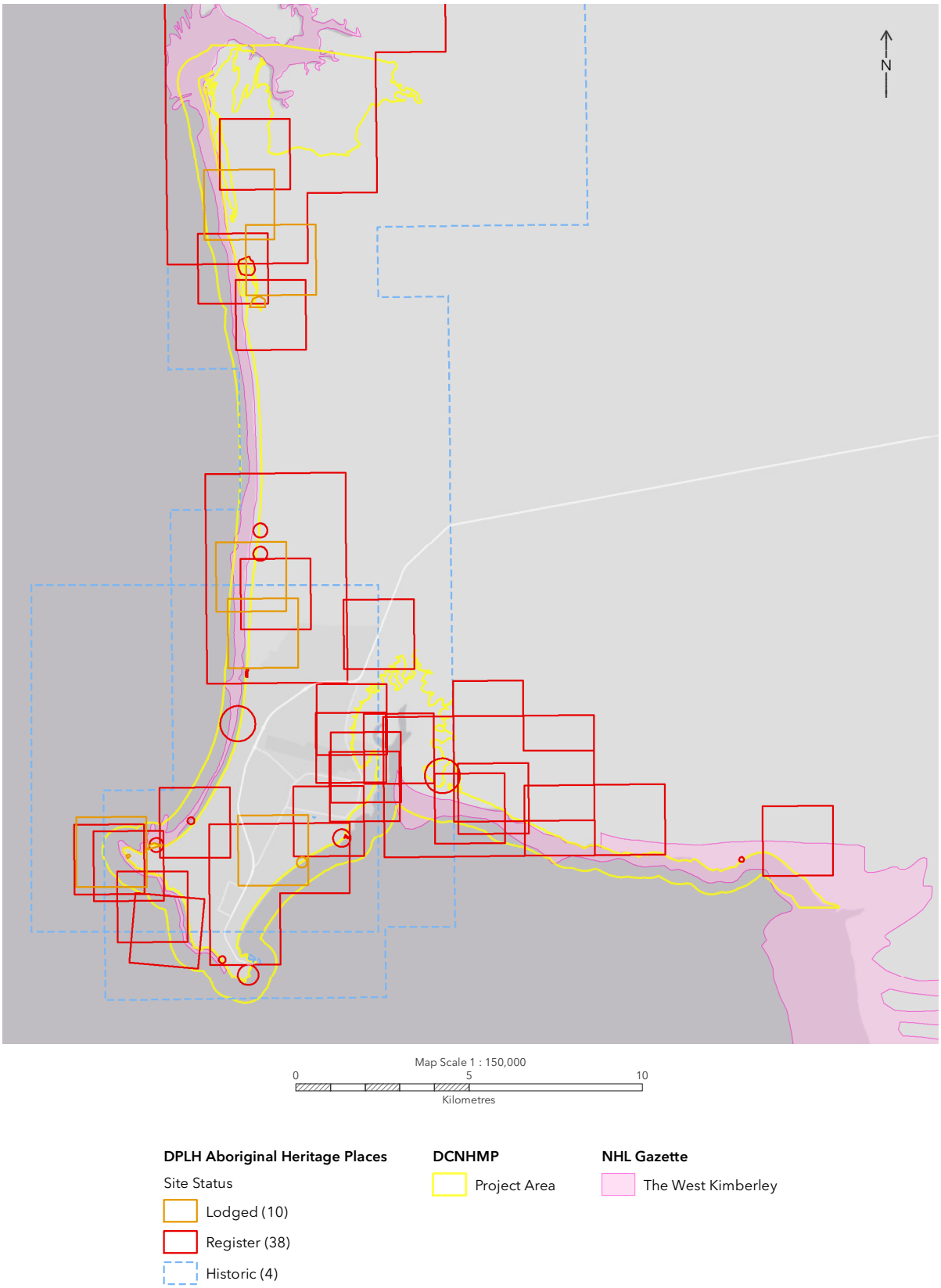
Aboriginal cultural heritage legislation and site register

The *Aboriginal Heritage Act 1972* (AH Act) has been updated in 2024. The Aboriginal Cultural Heritage Inquiry System (ACHIS) maintained by the Western Australian DPLH provides information on Aboriginal heritage places in Western Australia that have been lodged or assessed under the AH Act. This publicly available register is a cumulative listing of significant Aboriginal heritage sites that have been reported to date, but is not a comprehensive list of all significant cultural heritage places. In many circumstances Aboriginal people and their representative organisations have been reluctant to record significant cultural heritage places and related confidential cultural knowledge on a Government-maintained register.

DPLH now has three separate Aboriginal cultural heritage site register categories:

- Historic: Places assessed as not meeting Section 5 of the AH Act, and places previously on the Register that are no longer in existence.
- Register: Places assessed as meeting Section 5 of the AH Act.
- Lodged: Information received in relation to a place, but an assessment was not completed to determine if it met Section 5 of the AH Act.

Existing ACHIS site records that intersect the DCNHMP management area include 38 Register sites, 10 Lodged sites and 4 Historic sites. The intersecting site records from the public ACHIS online are shown in Map 4.1 and are listed in Table 4.2.



Map 4.1 DPLH ACHIS sites

Table 4.2 Summary table of DPLH ACHIS sites in the DCNHMP management area

Place ID	Name	Status	Type
432	RED POINT	Lodged	Creation / Dreaming Narrative
433	GANTHEAUME PT. 3	Lodged	Creation / Dreaming Narrative
12410	LINTAPITJIN/LOT 2065PORT DR	Register	Artefacts / Scatter; Ritual / Ceremonial; Creation / Dreaming Narrative; Midden
12416	GANTHEAUME PT: DOG DREAMING	Lodged	Creation / Dreaming Narrative
12590	RED BANK.	Register	Camp; Creation / Dreaming Narrative; Fish Trap; Midden
12591	BROOME OLD JETTY.	Register	Artefacts / Scatter; Ritual / Ceremonial; Creation / Dreaming Narrative; Midden; Water Source
12698	KUMBILLEBILLEKAN.	Lodged	Burial; Camp
12793	UNDANDA.	Register	Camp; Ritual / Ceremonial; Creation / Dreaming Narrative; Grinding Areas / Groves; Midden
12832	MILIBUNYARI.	Lodged	Camp
12839	BILLINGURRU.	Register	Camp; Ritual / Ceremonial; Creation / Dreaming Narrative
12840	YARRARRA.	Lodged	Camp; Creation / Dreaming Narrative
12841	MARNALAKUN.	Lodged	Burial; Camp
12872	GANTHEAUME POINT 2.	Register	Artefacts / Scatter; Camp; Midden
12873	ENTRANCE POINT/YINARA.	Register	Artefacts / Scatter; Midden
12874	ROEBUCK BAY MIDDEN	Lodged	Artefacts / Scatter; Midden
12886	ILLANGARAMI	Historic	Creation / Dreaming Narrative
12887	BALLIWANDUNA	Lodged	Creation / Dreaming Narrative
12888	BALJARKURUKUN.	Register	Artefacts / Scatter; Midden; Quarry
12889	NUNUKURAKUN	Lodged	Ritual / Ceremonial; Creation / Dreaming Narrative

Place ID	Name	Status	Type
12906	WILLIES CREEK COMPLEX.	Register	Burial; Artefacts / Scatter; Camp; Ritual / Ceremonial; Creation / Dreaming Narrative; Hunting Place; Midden; Water Source
12908	COCONUT WELL 1.	Register	Artefacts / Scatter; Creation / Dreaming Narrative; Midden; Water Source
12909	COCONUT WELL ISLAND	Register	Artefacts / Scatter; Midden
12915	NORTH CABLE BEACH 2	Register	Artefacts / Scatter; Midden
12916	NORTH CABLE BEACH 1	Register	Midden
12917	CABLE BEACH 6.	Register	Camp; Meeting Place; Midden; Water Source
12918	CABLE BEACH 4.	Register	Artefacts / Scatter; Camp; Midden; Other; Water Source,
12919	CABLE BEACH 2	Register	Artefacts / Scatter; Midden; Other
12920	CABLE BEACH 1	Register	Artefacts / Scatter; Midden; Other
12921	MINYIRR.	Register	Creation / Dreaming Narrative; Other; Water Source
12922	JUNGKURR	Register	Creation / Dreaming Narrative; Other
12923	NGAKALYALYA	Register	Creation / Dreaming Narrative; Other
12924	GANTHEAUME POINT 1	Register	Artefacts / Scatter; Creation / Dreaming Narrative; Midden; Other
13075	MANGALAGUN + IWALANGANJDANJ.	Register	Artefacts / Scatter; Creation / Dreaming Narrative; Midden; Water Source
13320	WUNDORDA	Register	Artefacts / Scatter; Ritual / Ceremonial; Midden
13321	BULGURGUN.	Register	Artefacts / Scatter; Creation / Dreaming Narrative; Midden; Water Source
13351	NGILIRIRRBANJIN	Register	Ritual / Ceremonial
13465	WIRGANJU GROUND	Register	

Place ID	Name	Status	Type
13729	RESERVE 21801 BROOME	Register	Artefacts / Scatter; Ritual / Ceremonial; Creation / Dreaming Narrative; Traditional Structure; Other
14240	FISHERMENS BEND 2	Register	Burial; Ritual / Ceremonial; Other
14241	FISHERMENS BEND 3	Register	Ritual / Ceremonial; Creation / Dreaming Narrative; Other; Repository / Storage Place
14242	FISHERMENS BEND 4	Register	Creation / Dreaming Narrative; Other
14243	FISHERMENS BEND 5	Register	Creation / Dreaming Narrative; Other
14291	FISHERMENS BEND 1.	Register	Artefacts / Scatter; Camp; Creation / Dreaming Narrative; Midden; Other; Water Source
14557	CABLE BEACH 5.	Register	Artefacts / Scatter; Camp; Ritual / Ceremonial; Creation / Dreaming Narrative; Hunting Place; Midden; Other
14558	BROOME JETTY	Historic	
14560	TITIRRKUN/KENNEDY HILL.	Register	Artefacts / Scatter; Ritual / Ceremonial; Creation / Dreaming Narrative; Grinding areas / Grooves; Hunting Place; Midden; Other; Water Source
14561	SACRED STORES/ BROOME	Register	Ritual / Ceremonial; Repository / Storage Place
14609	CABLE BEACH 3.	Register	Artefacts / Scatter; Camp; Creation / Dreaming Narrative; Midden; Other
19799	Mungullagun Blackberry Tree Midden	Register	Artefacts / Scatter; Midden
21408	Broome Crocodile Farm	Register	Camp; Ritual / Ceremonial; Creation / Dreaming Narrative
30274	LSC11	Historic	Burial; Sub surface cultural material; Artefacts / Scatter; Camp; Ritual / Ceremonial; Creation / Dreaming Narrative; Fish Trap; Meeting Place; Midden; Landscape / Seascape Feature; Ochre; Plant Resource; Quarry; Repository / Storage Place; Shell; Water Source

Place ID	Name	Status	Type
32839	Gurrjungu SA-0111	Historic	Fish Trap

[IMG] Figure 4.9 Shell midden in the Church Hill Sand eroding onto the underlying Mowanjum Sand, Broome Sandstone and Cable Beach Sand on the beach near Crab Creek, Roebuck Bay (Photo: Neale Draper)

These recorded Aboriginal heritage sites include archaeological campsites and shell middens, as well as significant cultural (mythological and ceremonial) places for local Aboriginal people. The exact locations of the sites shown in Map 4.1 are obscured by large, 'dithered' squares, rectangles or circles, indicating that the precise locations of those sites are culturally confidential. Some of the archaeological sites (shell middens, stone artefacts, etc.) situated in the coastal dunes above the HWM have 'spilled' into the upper part of the ITZ as a result of water and wind erosion (Figure 4.9; Clifford & Semeniuk 2019). Some significant cultural sites are located in the coastal sand dunes.

Some cultural sites that Goolaraboolo have reported for protection purposes are rock formations within the ITZ (e.g., Figure 4.10) which include Broome Sandstone with dinosaur tracks and other Lower Cretaceous ichnofossils. Note that historically, Yawuru and the Kimberley Land Council generally have been reluctant to record significant cultural sites on the ACHIS (Table 4.2).

Aboriginal cultural heritage values related to the DCNHMP

The Federal Court of Australia recognised Aboriginal Native Title in the Broome region through the Rubibi Native Title Determination (Merkel 2006) and in subsequent ILUAs in 2010, which led to the establishment of the Yawuru Conservation Estate parks (DPW 2021). Rubibi Native Title claim applicant and senior Yawuru Law man, Patrick Dodson, later described local cultural values in his foreword to the Yawuru CMP (Yawuru RNTBC 2016):

> *Our Native Title, whilst found in western law, is grounded in the all-encompassing power and richness of* Bugarrigarra *and the interdependent elements of our world that flow from that – Community, Country and Law.* Bugarrigarra *is the core of Yawuru cosmology and our experience of* Liyan *is essential to our wellbeing in our Country.*
>
> Bugarrigarra *is the time before time, when the creative forces shaped and gave meaning and form to the landscape, putting the languages to the people within those landscapes and creating the protocol and laws for living within this environment.* Bugarrigarra *is not an historic event that created our world at the beginning of time. It is not detached from contemporary life. It continues to exist and is the spiritual force that shapes our ongoing cultural values and practice, our relationships with each other and the obligations and responsibilities that we have to each other that form our Community. It requires respect at the interface of change and development.*
>
> *Within this broad framework that is defined by Yawuru belief in* Bugarrigarra *are three fundamental components of Yawuru existence that define our Native Title.*
>
> *The first is* ***Community****. Yawuru people relate to each other through our common belief systems, ceremony, language, history and, importantly, through kinship, which culturally and socially determines obligations and responsibilities to all others.*

> *The second is **Country**. Our connection to Country – how we use and occupy the seas and lands on Yawuru Country – is fundamental to who we are as a people. The protection of our Country is an imperative. This means we have to constantly talk about sustainable development and balance between cultural imperatives and development opportunities. Culture and Heritage are important to Country.*
>
> *The third is **Liyan**. This concept relates to Yawuru and other Aboriginal people's view of their wellbeing: the way we feel about ourselves and our relationship with community and the wider world. In a philosophical sense, it is part of our being and the means through which we experience our being.* Liyan *is about relationships, family, community and what gives meaning to people's lives. Yawuru people's connection to country and joy celebrating in our culture and society is fundamental to having good* liyan*. When we feel disrespected or abused our* liyan *is bad, which can be insidious and corrosive for both the individual and the community. When our* liyan *is good our wellbeing and everything else is in a good space* (YAWURU RNTBC 2016: FOREWORD).

The Yawuru CMP describes Yawuru cultural traditions and values (Yawuru RNTBC 2016), and also acknowledges Goolarabooloo aspects of those multifaceted cultural traditions and values (Yawuru RNTBC 2016: 24, and below).

> *The Yawuru people, as the Native Title Holders of the land and sea in and around Broome, have a responsibility in our Law to protect, promote and sustain the law and culture that has come to us from the* Bugarrigarra*. This has been the responsibility of the Yawuru for millennia. Only the Yawuru hold these rights and responsibilities on Yawuru land. This is the nature of our Law* (YAWURU RNTBC 2016: 124).
>
> *In Yawuru country, the* Bugarrigarra *laid down three traditions of law, which hold esoteric knowledge of our country and guide our customary practices. They all relate secret/sacred narratives, sometimes called "songlines".*
>
> *The **Northern Tradition** is associated with the northern parts of the claim area, and is allied with the people who live to its north, particularly the Bardi. The **Southern Tradition** is associated with areas to the south of the claim and is an important part of the beliefs and practices of our southern neighbours, the Karajarri, as well as inland groups including the Nyikina and Mangala and the more southerly Nyangumarta. These traditions are also understood and practised by groups as far away as Balgo to the east and Yandeyarra to the south, in the Pilbara.*
>
> *The third tradition arises in Broome itself and travels east toward the desert and Uluru in Central Australia. Knowledge and practices of all traditions is shared with groups outside Yawuru country.*
>
> *Both the northern and southern traditions are rich in narratives, songs, objects and places that we call our Law, which continues to play a central role in our lives. Practitioners of our Law are known as 'Law men and women' or 'bosses'. They are our senior people with the authority, based on their ritual qualifications, to make decisions for the whole of the Yawuru community. Both Laws are steeped in sacredness, and strict rules govern all religious observances. Senior practitioners of both Laws exercise extreme care in all matters relating to the exercise of their beliefs* (YAWURU RNTBC 2016: 30–31).

The Yawuru CMP also refers to four key cultural values:

1. Yawuru country is a living cultural landscape.

2. Yawuru traditional ecological knowledge is the foundation for ecologically sustainable resource management.

3. Yawuru have the right to enjoy Yawuru country and to maintain their customary practices.

4. Yawuru are responsible for looking after Yawuru country.

The ITZ of the DCNHMP is part of the Yawuru cultural landscape – the Nagulagun Buru or sea country. Some important Yawuru cultural places along the coastline and their recorded cultural values are summarised below, starting from Wirrjinmir (Willie Creek) to Bilingurr (Station Hill) in the sandhills to the north of the Cable Beach Foreshore Zone. This coastal area corresponds with the Waterbank Zone in the DCNHMP.

> *This is the northernmost area of Yawuru country, and much of the coastline marks the travels of the creative beings of the Northern Tradition. This area of the Yawuru Conservation Estate carries exclusive Native Title. There are several Law grounds,* jila *and significant historic living areas on the old Waterbank lease that need to be protected* (YAWURU RNTBC 2016: 166)*.*

The following cultural values are identified for this section of the coastline:

- several Law grounds associated with the Northern Tradition;

- *Bugarrigarra* sites associated with the Northern Tradition (often referred to as the Song Cycle or Songline) and other traditions;

- permanent water sources and their surrounding habitats;

- customary fishing in the creek, on the reefs and along the beach;

- Lurujarri Heritage Trail, provides guided walking tours of the coastal country (under Goolaraboolloo custodianship);

- archaeological sites: middens, and other evidence of habitation; and

- past living areas on Waterbank station and on the outskirts of Broome.

The historical and ecological values listed for this section of coastline include 'Fossil remains, including dinosaur footprints, found on the coastal reefs' (Yawuru RNTBC 2016: 166).

The second section of coastline described in the Yawuru CMP is from Walmanyjun (Cable Beach) to Burrgugun (Morgan's Camp), a significant cultural site, and an historic pearling camp on Dampier Creek in the Chinatown Conservation Area (SOB 2019b: Heritage Place 04851), including Aboriginal residents. This area includes DCNHMP zones Cable Beach Foreshore, Cable Beach South, Gantheaume Point (Minyirr), Reddell Beach, Entrance Point, Town Beach and Dampier Creek.

> *Our* Bugarrigarra *sites line the shore and cross the peninsula between Cable Beach and Morgan's Camp, particularly along the coastal dunes. Ancient middens and hearths can be found along the shore, close to areas where we continue to fish, hunt and have our 'dinner camps'. From the high dunes of Kennedy Hill and above New Jetty we were able to communicate across the bay with our countrymen travelling from Thangoo using fire signals* (YAWURU RNTBC 2016: 170).
> *[The 'new jetty' in this instance refers to the Broome Port wharf, not the more recently built new jetty at Town Beach.]*

The following cultural values are associated with this area:

- *Bugarrigarra* sites and tracks associated with the Northern and Southern Traditions; some restricted sites; other cultural stories;
- *Jurru*: metaphysical serpents, protectors of the country, inhabit areas near Cable Beach and the entrance to Dampier Creek;
- *Rayi* (spirit being) places for people and particular species, such as oysters;
- customary fishing: marine resources harvested from the reef, beach, mangroves, the creek; cooking fish, crab and shellfish on the beach;
- the multi-layered cultural heritage of Roebuck Bay foreshore;
- Kennedy Hill: a cultural place and home for many members of the Yawuru community;
- our stories and memories of growing up in Broome;
- *Jila* and soaks, formed by the *Bugarrigarra* woman spilling water from her *bin-ga* (baler shell water carrier) as she crossed the peninsula and creeks;
- Minyirr Park and its walking trails and interpretation signage; and
- the coastal dunes between the new jetty and Kennedy Hill and the trees that grow there are culturally significant, as well as providing a natural barrier for the town against ocean surges and inclement weather. [The 'new jetty' in this instance refers to the Broome Port wharf, not the more recently built new jetty at Town Beach.]

East of Dampier Creek, there are significant Yawuru cultural places along the coastline of Roebuck Bay, from Kunin (Fisherman's Bend) to Crab Creek (Mangalagun) – the DCNHMP Roebuck Bay Zone – and extending east and south from there.

> *The stretch of country along the foreshore between two tidal creeks, Dampier Creek and Crab Creek, is lined with middens that are testament to the presence of Yawuru people and their ancestors, who have occupied the foreshore of Roebuck Bay for thousands of years. Rich in* Bugarrigarra *stories, many sites are associated with both Northern and Southern Traditions. There are birthplaces, childhood playgrounds, hunting areas and meeting places near Mangalagun and Nulunggu* jila*. As Yawuru people moved off Thangoo and Roebuck Plains, Kunin became the major Law ground for Yawuru people* (YAWURU RNTBC 2016: 176).

The cultural values listed for this area include:

- Law grounds associated with the Southern Tradition;
- camping and living areas at Kunin and along the foreshore to Mangalagun (Crab Creek);
- *Bugarrigarra* sites: e.g., Kunin, Mangalagun, Buga Wamba and Gabunyanya;
- primary harvesting area for fish and shellfish along the reef at Black Ledge, the mangrove-lined creeks, and the sandy and muddy beaches;
- meeting grounds to sort out arguments and misdemeanours at Mangalagun and Nulunggu;
- old fishtraps near Kunin;
- various wetlands: springs, freshwater seepages and *jila*;
- *Jurru*: metaphysical serpents inhabiting Dampier Creek and the springs on Roebuck Plains;
- ochre sites; and
- pearl shell collection (Yawuru RNTBC 2016: 177).

Listed historical values include dinosaur footprint sites; protecting them is one of the listed management actions and aspirations for this area (Yawuru RNTBC 2016: 178).

For the dinosaur tracks display in the Western Australian Museum in Perth, Yawuru Law Boss Neil McKenzie made the following comment:

> *The renowned dinosaur tracks of the intertidal areas of the Broome region are more than a fossil record. These culturally significant tracks stem from* Bugarrigarra*, the Dreaming – time immemorial. They link our ongoing strength in connection to country with the stories of the formation of our world* (McKenzie n.d.).

Yawuru want cultural values added to the NHVs recognised in relation to the dinosaur tracks and other Lower Cretaceous ichnofossils.

The Goolarabooloo Community, represented through GMIC, is based at Millibinyarri (Coconut Well), north of Broome. The community was established by Paddy Roe OAM (deceased) (Roe & Muecke 1983), who also established the Lurujarri Heritage Trail to follow the songline of the Northern Tradition along the coastline of the southern Dampier Peninsula in 1987 (HCWA 1999). The southern section of the Lurujarri Trail extends from Wirrjinymirr (Wirrkinymirri/Willie Creek) to Yinara (southern end of Reddell Beach) in the DCNHMP area.

> *The Goolarabooloo Law Bosses hold the responsibility for the continuity of the Songline and its capacity to sustain life in its fullest. This includes keeping the coastal land clear of any development that would interfere with their law and culture, or damage their Song Cycle, places and sites.*

> *The body of cultural knowledge that the old people hold and pass on, is preserved and kept alive within the Song Cycle that connects to specific sites (Law Grounds) in a continuous linear system up the coast of the Dampier Peninsula* (GOOLARABOOLOO.ORG.AU 05.06.2022).

The cultural connections between the Northern Tradition Songline and the fossil sites are summarised by Salisbury et al (2017; see also HCWA 1999: 6). The primary Songline route extends down the coastline of the Dampier Peninsula, and as described above, intersects with other Dreaming tracks.

> *Three other song cycles emanate from Minyirr Djugun Buru (the greater Broome area): Dabber dabber goon, which travels east, cutting through Uluru (Ayers Rock, Northern Territory) until it reaches the Pacific Ocean; Billingun, which follows the same path as Dabber dabber goon until it reaches Uluru where it splits three ways (see Crane 2013: pl. 27); and Nunnungurugoon, which travels along its own path northeast, through the Kimberley.*
>
> ***Marala, The Emu Man*** [alternative: Marella] – *One of the important* Bugarrigarra *beings within the Song Cycle is called Marala* [Marella] *(Mountford 1973; Anonymous 1996; Mayor & Sarjeant 2001) (Fig. 2A). Marala, also referred to as 'Emu Man,' was the 'lawgiver,' and instilled in country the codes of conduct for behaviour needed to help ensure its well-being, and there are numerous* Bugarrigarra *stories and parts of stories in which he features. In the process of moving through the Song Cycle from south to north, as well as in and out of the sea, Marala left behind three-toed tracks. He also left behind the grooved impressions of his tail feathers (his '*ramu*' or ceremonial engravings) when he sat down to rest and create his Law ground. Today, three-toed dinosaur tracks (typically those assigned to* Megalosauropus broomensis*) and impressions of cycad-like bennettitaleans (Marala's tail feather impressions and* ramu*) are seen as testimony to Marala's journey as narrated in the Song Cycle. A concentration of* M. broomensis *tracks at a Song Cycle place on Cable Beach is also known as Maralagun* [place of Marala]*. Marala's tracks at Minyirr (Gantheaume Point) and Reddell Beach are referred to in a number of* Bugarrigarra *stories, some of which are publicly known, others of which are known only to a restricted number of people* (SALISBURY ET AL 2017: 2).

One particular story concerning Marala and the Nadji Women involves the fossilised theropod tracks at Minyirr (Gantheaume Point) and stone pillars at the southern end of Reddell Beach that overlie the Broome Sandstones (Figure 4.10; see also Salisbury et al 2017: Figure 2).

> *A Creator spirit called Marala* [Marella] – *commonly referred to as Emu man – made his appearance at various points along the coast, creating features and aspects of the Law as he went. South of Minyirr (Gantheaume Point) he saw seven Naji women, Yinara and her six daughters, who were spirits from the sea. The girls had been warned by Yinara not to take any notice of anyone on the land, but they disobeyed and watched the emu man. The result was that, as he walked past … Yinara turned herself and her daughters to pillars of stone, which can be seen today, the mother standing taller than her daughters, at what became known as Yinara. Nearby, at Minyirr, Marala's three-toed footprints can also be seen.*

> *Marala composed a song about this incident which is still sung, and which makes Minyirr an important place in the Law. Minyirr (Gantheaume Point) is also much visited by tourists who come to see the three-toed footprints from Yinara to Minyirr point, which European scientists believe to be those of a dinosaur. In the Aboriginal belief system, Marala, the Law-giving Emu man, is also represented by three stars which rise before the morning star, and his shadow may be seen in the Milky Way, his head laying next to the Southern Cross* (HCWA 1999: 5).

[IMG] Figure 4.10 The stone pillars of Yinara (on the left) and her six daughters at Reddell Beach are formed from unnamed Pliocene–Quaternary Conglomerate and eroded Broome Sandstone (Photo: Daniel Roe)

These fossilised theropod tracks and plant fossils have very high cultural significance.

> *Because of their significance to the Song Cycle, many of the dinosaurian tracks and plant fossils described herein are well known to certain indigenous people of the Dampier Peninsula. Knowledge of the Song Cycle and the dinosaurian tracks and associated fossils is thought to provide insight into* Bugarrigarra*. As such, much of this knowledge is considered sacred. Although some locations along the Song Cycle where dinosaurian tracks and plant fossils occur are Law grounds, more broadly it is the presence of these trace fossils in the country through which the Song Cycle passes that is the most important thing. The disappearance of some tracks through natural processes is seen as part of ongoing unfolding of* Bugarrigarra*, as is the appearance of new ones. It is accepted that tracks will come and go as knowledge of them is needed. For these reasons, the removal or desecration of tracks from country for any reason is considered a great offence, in most instances punishable by spearing (J. Roe, quoted in Anonymous* [HCWA] 1996*). It can also bring illness and misfortune, not only to the perpetrators but also to the Maja under whose custodianship the crime occurred* (SALISBURY ET AL 2017: 3, 'MAJA' ARE THE LAW BOSSES).

Goolarabooloo custodians identify with the following cultural values for the coastline within the DCNHMP area (Daniel Roe, email 05.08.2022):

- several Law grounds associated with the Northern Tradition under custodianship of GMIC;
- *Bugarrigarra* sites associated with the Northern Tradition under custodianship of GMIC (often referred to as a Songline or Song Cycle) and other traditions;
- other Aboriginal Sites, some being culturally restricted sites (Table 4.2);
- the LSC11 Aboriginal heritage place lodged with DPLH (Table 4.2) that covers the Song Cycle area and associated;
- spiritual beings and their associated places;
- *Rayi* spirit being places;
- Lurujarri Heritage Trail, a public walking trail led by Goolarabooloo custodians in the spirit of cultural exchange and reconciliation;
- water sources (*jila*, *bilarra*, *ingu* and *ngumbun*) and surrounding ecosystems and cultural landscapes;

- Djugun traditional culture;
- customary fishing areas and fish traps;
- other cultural sites including habitation area;
- pearl shell collection;
- Minyirr Park and other cultural areas;
- areas where traditional bush food and medicines are collected; and
- areas where wood and other plants are collected to make traditional cultural objects such as boomerangs.

At Baljagurrgun there are small outcrops of Broome Sandstone along the eastern edge of the lagoon within the supratidal zone on the landward margin of the ITZ, which is affected by the highest tidal surges. The exposed Broome Sandstone outcrops at this location, while outside of the definition of the DCNHMP management area, have the potential to contain ichnofossils and have significant cultural heritage values. Baljagurrgun (lodged site record DPLH-12888 Baliarkurukun) is an archaeological site with shell midden, artefacts and axe-grinding grooves and grinding patches on the Broome Sandstone. The second outcrop is Nunungurugun (lodged site record DPLH-12889 Nunukurakun), a site particularly associated with the Northern tradition (see Table 4.2). Both sites were recorded with Paddy Roe.

The broader location also has exposures of the overlying Sandfire Calcilutite and Horsewater Soak Calcarenite, the former containing many invertebrate body fossils and the latter containing invertebrate traces and body fossils. Although not listed in the NHVs, these fossils are also scientifically significant.

Cultural heritage places listed under the Heritage Act 2018 and Planning and Development Act 2005

In addition to sites listed through the *Aboriginal Cultural Heritage Act 2021* (ACH Act), other cultural heritage places in Western Australia are recorded under several different heritage listings. Some of these give statutory protection and others are simply lists with unofficial or semi-official designations arising from local, community-based or thematic surveys. Some of these listings may also relate to Aboriginal cultural heritage. Statutory listings and their respective legislation located within the DCNHMP management area are summarised in Table 4.3.

Table 4.3 Summary table of cultural heritage listings outside the ACH Act located within the DCNHMP management area

National Heritage Places	***Environment Protection and Biodiversity Conservation Act 1999***
106063	The West Kimberley

WA State Register of Heritage Places	***Heritage Act 2018***
291	Chinatown Conservation Area
4553	Streeter's Jetty
4859	Flying Boat Wreckage Site
8782	Male Sheds and Jetty

Local heritage items	***Planning and Development Act 2005; Local Planning Schemes***
291	Chinatown Conservation Area
26353	Dampier Coast – Broome Sandstone Dinosaur Footprints
4553	Streeter's Jetty
4855	New Jetty
4859	Flying Boat Wreckage Site
4860	Old Broome Jetty site, now known as the Groyne Area.
4861	Town Beach Site
26422	Common Gate
26423	Tram Line
6720	Port of Broome
7190	Buccaneer Rock
26457	Lurujarri Heritage Trail
8782	Male Sheds and Jetty
16869	Roebuck Bay Foreshore

Geoheritage

DEMIRS maintains a geoheritage database for managing, preserving and protecting exceptional geological features. A listed geoheritage site has geological features considered to be unique and of outstanding scientific and educational value within Western Australia. However, Gantheaume Point is listed as Geosite No. 44 and described as being of national significance:

Table 4.4 DEMIRS Geosite No. 44

Tectonic unit	Canning Basin
GEOLOGY DESCRIPTION	Dinosaur footprints in Broome Sandstone, low-tide exposure; large tridactyl, theropod and sauropod footprints identified; plant macrofossils
GEOLOGY AGE	Cretaceous
SIGNIFICANCE DESCRIPTION	National
GEOHERITAGE SOURCE	Carter, J. D. 1987 Important geological localities beyond the Perth Region. Geological Society of Australia, p. 263

4.4 Potential additional NHVs

4.4.1 Cultural heritage values of ichnofossil sites

In the Broome region, dinosaur tracks and other Cretaceous fossils are recognised in the NHVs as scientifically significant but their cultural heritage significance is not recognised. This is attributed to the very short time span in which these NHVs were added to the West Kimberley NHL nomination, which did not allow for adequate time to properly map the physical extent of the significant ichnofossils or to document their important Aboriginal cultural values.

Yawuru recognise the cultural significance of the dinosaur tracks of the Broome area ITZ (Chapter 4.3.2; Yawuru RNTBC 2016), and consider that (Chapter 4.3.2) cultural values should be a part of the NHVs for the Cretaceous ichnofossils.

> *The renowned dinosaur tracks of the intertidal areas of the Broome region are more than a fossil record. These culturally significant tracks stem from* Bugarrigarra*, the Dreaming – time immemorial. They link our ongoing strength in connection to country with the stories of the formation of our world* (McKenzie n.d.).

Goolarabooloo consider the Cretaceous ichnofossils to have high cultural significance to Northern Tradition Songline sites (see Chapter 4.3.2 above). Salisbury and Romilio (2019) have summarised this Goolarabooloo cultural significance:

> *In addition to their scientific value, dinosaurian tracks in the Broome Sandstone also have a unique cultural significance. Three-toed tracks assigned to* Megalosauropus broomensis *form part of a Song Cycle that extends along the coast and then inland for 450 km, tracing the travels of a* Bugarrigarra *(Dreamtime) creator being called Marala, the Emu Man (Anonymous 1996; Mayor & Sarjeant 2001; Salisbury et al 2017).*
>
> *Marala's tracks at Minyirr (Gantheaume Point) and Reddell Beach are referred to in a number of* Bugarrigarra *stories that form part of the Northern Tradition of the Song Cycle. The most notable of the publicly known stories involves Marala and some female sea spirits. At Bungurunan, a small beach just to the north of Reddell Point, Marala encountered a group of Ngadjayi – spirit women from the sea who had come out of the water to harden their skin in the sun and delouse each other with* jungkur *(lice sticks). When Yinara, the most senior woman in the group, sensed that Marala was coming, she told the younger women to turn towards the land and to not look at him. Marala saw the women and walked over to them. Although Yinara positioned herself between Marala and the others, he was still able to get very close. Curious to see him, some of the women turned to watch Marala as he walked past. Yinara was able to drive Marala away, but was angry with the younger women and shamed them for disobeying her. The spirits of Yinara and the other Ngadjayi moved into the sky and can be seen today as the constellation known as Pleiades. Stone pillars representing the Ngadjayi still stand today at the top of the beach at Bungurunan, and the rock platforms nearby preserve three-toed tracks that show where Marala walked (Salisbury et al 2017; Fig. 2)* (SALISBURY & ROMILIO 2019: 2).

As well as the three-toed dinosaur tracks (*Megalosauropus broomensis*), Marala's [Marella's] journey is marked by fossil impressions of cycad-like bennettitaleans seen as his tail feather impressions and *ramu* (ceremonial engravings) (Salisbury et al 2017: 1–2).

These examples demonstrate that there is a strong potential for adding cultural significance as an NHV, or indeed as part of the justification for outstanding universal value for at least some of the Broome Sandstone ichnofossils. To date, this cultural significance has been documented as part of the palaeontological research (Salisbury et al 2017; Salisbury & Romilio 2019; Glauert 1952), in the Yawuru interpretation material accompanying the dinosaur tracks display in the Western Australian Museum (Perth). However, this important set of cultural values has not been the subject of any specific anthropological recording, which would be a valuable next step. Such research also should pay close attention to the cultural sensitivity boundaries related to allowed public information and restricted cultural knowledge concerning the cultural significance of the Cretaceous ichnofossils and the locations at which they occur.

4.4.2 Human footprint sites in the DCNHMP area

One of the NHVs concerns the Dampier Coast's human footprint sites. Rare in Australia, fossil human tracks are important for both scientific and cultural reasons. The fossil human footprint sites of the Dampier Coast have outstanding heritage value to the nation under criterion (b) as one of only three documented human track sites in Australia and the only documented evidence of human tracks from the west coast of Australia (Commonwealth of Australia 2011; see Chapter 4.2.2 above).

Previously, the only fossil human footprint sites that were recorded occur near the northern end of the Dampier Peninsula coastline (Welch 1999). It is understood that fossil human footprints in Holocene deposits are present within the DCNHMP management area (Assoc. Prof. Steven Salisbury, UQ Dinosaur Lab), and this discovery has been further documented in a confidential report commissioned by the DOT and GMIC (Archae-aus 2023). The presence of human footprint fossils adds a significant potential NHV to the Broome area and should inform any update of the NHL boundary. The discovery has important scientific and cultural heritage value.

[IMG] Figure 5.1 Car and trailer tracks going straight over a sauropod track at Roebuck Bay (Photo Damian Kelly)

5 Key issues, opportunities and constraints

5.1 Statutory context

5.1.1 EPBC Act

The Dinosaur Coast ITZ is protected under the EPBC Act; however, the exact extent of the area currently under protection remains unclear due to discrepancies between the written and spatial data of the Commonwealth Gazettal notice for the West Kimberley National Heritage Place (see Chapter 1.3.3). When deciding whether or not a proposed action is likely to have a significant impact on the gazetted NHVs, the precautionary principle is relevant. It is therefore recommended that until the inaccuracies described in Chapter 1.3.3 for the mapped gazettal boundary are corrected, the referral process for assessment of development actions under the EPBC Act needs to follow the gazetted written description of the NHL boundary for this section of the Dampier Coast as being the ITZ bounded by the highest and lowest astronomical tides.

Approval is required under the EPBC Act for any action occurring within, or outside, the existing boundaries of the West Kimberley National Heritage Place that has, will have, or is likely to have a significant impact on its NHVs or any other matters of national environmental significance. (Other relevant matters of national environmental significance are described in Chapter 4.3.) An action is defined broadly as a project, a development, an undertaking, an activity or series of activities, or an alteration of any of these things. An action is likely to have a significant impact on the NHVs of a National Heritage Place if there is a real chance or possibility that it will cause:

- one or more of the NHVs to be lost;
- one or more of the NHVs to be degraded or damaged; or
- one or more of the NHVs to be notably altered, modified, obscured or diminished.

In the context of the Dampier Coast ITZ, the person appointed with the responsibility for a proposed action (the proponent) needs to undertake a 'self-assessment' and decide whether a proposed action is likely to have a significant adverse impact on the NHVs or any other matters of national environmental significance present in this part of the much larger West Kimberley National Heritage Place. If so, that action must be referred to the federal Minister for the Environment and Water for a decision (see Appendix C). In order to decide whether an action is likely to have a significant impact, the proponent needs to take into account the nature and magnitude of potential impacts and to consider matters such as:

- the sensitivity of the environment that will be affected;
- the timing, duration and frequency of the action and its effects;
- all on-site and off-site impacts;
- all direct and indirect impacts;

- the total effect which can be attributed to the action over the entire geographic area affected, and over time;

- existing levels of impact from other sources; and

- the degree of confidence with which the impacts of the action are known and understood.

As the gazetted cultural heritage values of the Dampier Coast are essentially associative values related to the coast's Aboriginal pearl-shell trade and European exploration history and pearling history, the impacts on the gazetted natural values are viewed as more likely to require referrals under the EPBC Act. An action is likely to have a significant impact on the natural heritage values of a National Heritage Place if there is a real chance or possibility that the action will

- damage, modify, alter or obscure important geological formations;

- damage, modify, alter or obscure landforms or landscape features; for example, by clearing, excavating or infilling the land surface;

- modify, alter or inhibit landscape processes; for example, by accelerating or increasing susceptibility to erosion, or stabilising mobile landforms, such as sand dunes;

- divert, impound or channelise a river, wetland or other water body;

- substantially increase concentrations of suspended sediment, nutrients, heavy metals, hydrocarbons, or other pollutants or substances in a river, wetland or water body;

- permanently damage or obscure rock art or other cultural or ceremonial features with NHVs;

- modify or inhibit ecological processes;

- reduce the diversity or modify the composition of plant and animal species;

- fragment or damage habitat important for the conservation of biological diversity;

- cause a long-term reduction in rare, endemic or unique plant or animal populations or species;

- fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species;

- involve construction of buildings, roads or other structures, vegetation clearance, or other actions with substantial and/or long-term impacts on relevant values; or

- introduce noise, odours, pollutants or other intrusive elements with substantial and/or long-term impacts on relevant values.

In the context of the precautionary principle, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is unlikely to have a significant impact. Additionally, when deciding whether or not a proposed action is likely to have a significant impact on the gazetted NHVs, a proponent should consider only the adverse impacts that the action is likely to have, as beneficial impacts cannot be offset against adverse impacts.

5.1.2 Process for decision-making around NHV impacts

[IMG] Figure 5.2 Students from Wangkatjungka Remote Community School on a field excursion with DCMG volunteers (Photo: DCMG)

The self-assessment process presents a significant risk to the conservation of the Dampier Coast NHVs. There are multiple land managers within and adjacent to the Damper Coast ITZ. The current management arrangements of the public realm and the various components of the Yawuru Conservation Estate are complex. The spatial data sets used to define the current NHL boundary were inadequate (as outlined in Chapters 1.3.3 and 1.3.4) and to understand potential impacts on the listed NHVs requires specialist knowledge.

Protection of the NHVs currently has some existing heritage oversight at a local government level as the boundaries of the Dampier Coast section of the West Kimberley National Heritage Place currently coincide with those of the SOB's Municipal Inventory of Heritage Places 2019 Place No. 73 'Dampier Coast – Broome Sandstone and Dinosaur Footprints the landscape'. The same site is identified as Place No. 26353 for 'Dampier Coast – Broome Sandstone Dinosaur Footprints' on the State Register of Heritage Places (see Table 4.3 above). Any development within that boundary requires a planning application to be submitted to the SOB.

Given the Western Australian planning system does not support or accommodate an integrated development assessment process (between local, state and Commonwealth) it is suggested that staff inform proponents of the DCNHMP and the associated spatial data available on Data WA's Shared Location Information Platform (SLIP). Proponents should be advised to consider their legal obligations in respect of self-assessment and referral under the EPBC Act, where civil and criminal penalties may apply when there are breaches of the legislation. Similarly, a public link or reference to the National Heritage database Place ID No. 106063, to an online version of the DCNHMP, and to the relevant link on the Data WA SLIP could be provided at the SOB's Municipal Inventory of Heritage Places 2019 Place No. 73 and the State Register of Heritage Places Local Heritage Place No. 26353. Similarly, it is recommended that the DEMIRS Geoheritage database Geosite No. 44 links or references National Heritage database Place ID No. 106063 and the DCNHMP. Annual information sessions for SOB and DPLH development assessment officers on the requirements and obligations under the EPBC Act are recommended, and the use of this DCNHMP and Data WA SLIP cataloguing of areas with geological and palaeontological features relevant to the National Heritage listing would facilitate this. DCMG could develop a slide presentation for agencies to use and could also continue to offer familiarisation excursions to SOB Officers either annually or every two years.

The SOB under the Local Government *Property and Public Places Local Law 2016* and *Trading, Outdoor Dining and Street Entertainment Local Law 2016* allows, subject to a permit being obtained, events to be held in public places. The SOB has 'Wedding Locations in Broome' and 'Hiring of Public Spaces' web pages which indicate that gatherings of up to 100 participants will be considered within the ITZ at a number of locations which have been identified as having outstanding geological and palaeontological NHVs. It is important that the SOB updates its advice to ensure that NHVs are protected and that DCMG brief SOB staff on an annual or biennial basis to ensure staff are aware of the NHVs and EPBC Act obligations.

More guidance on referrals and penalties under the EPBC Act can be found at the DCCEEW website: dcceew.gov.au/parks-heritage/heritage/management/national while a flow chart of the referral process is at Appendix C.

5.1.3 Additional protection mechanisms at the state and local level

Recognition of the Dampier Coast ITZ and defined DCNHMP management area as a place of state significance under the Western Australian State Register of Heritage Places and *Heritage Act 2018* and/or as a significant site under the ACH Act should be investigated further, subject to the outcomes of the cultural heritage process referred to in Chapters 1.3.2 and 4.3.2. DCMG nominated the Broome Sandstone and ichnofossils for inclusion in the State Register on 30 August 2019. DPLH determined in October 2019 the nomination warranted assessment, but this has yet to occur.

It should also be noted that at the time of writing the *Environmental Protection Act 1986* (EP Act) requires that all planning schemes be assessed by the EPA. These policies are however subject to change and will need to be reviewed and updated whenever the DCNHMP is reviewed and updated.

[IMG] Figure 5.3 SOB Councillors and staff on a familiarisation excursion with DCMG volunteers at Reddell Beach (Photo: Damian Kelly)

5.2 Existing management frameworks

In April 2006, the Federal Court of Australia determined the Yawuru community to be the recognised Native Title Holders of specific areas of land and water in and around Broome. As explained in Chapter 1.4.1, Native Title has for the most part been extinguished throughout the DCNHMP management area, apart from in the Waterbank Zone, and a section at the south-eastern end of the Roebuck Bay Zone where it has been determined to be non-exclusive to the Yawuru community (Map 1.3).

Following the Rubibi determination, two ILUAs were signed between the Yawuru RNTBC, the Government of Western Australia and other parties. A suite of four Yawuru Conservation Estate JMPs were prepared in accordance with the ILUAs and associated Joint Management Agreements, and a range of joint management partnerships now oversee implementation of those plans (see Table 5.1).

All four JMPs are guided by the overarching Yawuru CMP (Yawuru RNTBC 2016). The first edition of this foundation document for management of the Yawuru Conservation Estate as a living cultural landscape was published in 2011, around the same time as the West Kimberley National Heritage listing.

The plan offers several objectives and strategies relevant to the protection and management of natural and cultural heritage values in the ITZ, including a proposal to extend the Conservation Estate to include areas of the ITZ currently under the authority of the Port of Broome. This affects areas between the Cable Beach Foreshore and Entrance Point, and between Simpson's Beach and Dampier Creek.

Additionally, each JMP: (i) describes the legislative and management context of each plan; (ii) summarises the key cultural, ecological and socio-economic values and management issues particular to each component of the Conservation Estate; and (iii) outlines conservation management programs for those identified values.

The marine and terrestrial components of the Conservation Estate that currently intersect or abut the DCNHMP intertidal management zones are summarised in Table 5.1. As mentioned above a small section of Dampier Creek Zone between Streeters Jetty and Town Beach Jetty, along with the entire ITZ from Town Beach Zone to the northern end of the Cable Beach South Zone currently come under the separate jurisdiction of the *Port Authorities Act 1999* administered by the KPA.

[IMG] Figure 5.4 Yawuru rangers Jasmyn Cook and Jason Fong observing activities in Roebuck Bay (Photo: Julia Rau)

Table 5.1 Existing conservation management frameworks for areas abutting or intersecting with the DCNHMP management area and areas where the CV Act applies

DCNHMP zone	Existing management frameworks and CV Act	Management partners
Roebuck Bay	Yawuru Nagulagun/Roebuck Bay Marine Park JMP Yawuru Birragun Conservation Park JMP	Yawuru and DBCA Yawuru and DBCA
Dampier Creek	Yawuru Nagulagun/Roebuck Bay Marine Park JMP Yawuru Birragun Conservation Park JMP Yawuru Minyirr Buru Conservation Park JMP	Yawuru and DBCA Yawuru and DBCA Yawuru, SOB and DBCA
Town Beach	Yawuru Minyirr Buru Conservation Park JMP KPA Environmental Management Plan	Yawuru, SOB and DBCA KPA
Entrance Point	Yawuru Minyirr Buru Conservation Park JMP KPA Environmental Management Plan	Yawuru, SOB and DBCA KPA
Reddell Beach	Yawuru Minyirr Buru Conservation Park JMP KPA Environmental Management Plan CV Act applies	Yawuru, SOB and DBCA KPA SOB
Gantheaume Point	Yawuru Minyirr Buru Conservation Park JMP KPA Environmental Management Plan CV Act applies	Yawuru, SOB and DBCA KPA SOB
Cable Beach South	Yawuru Minyirr Buru Conservation Park JMP KPA Environmental Management Plan CV Act applies	Yawuru, SOB and DBCA KPA SOB

DCNHMP zone	Existing management frameworks and CV Act	Management partners
Cable Beach Foreshore	Yawuru Minyirr Buru Conservation Park JMP SOB Cable Beach Foreshore Master Plan CV Act applies	Yawuru, SOB and DBCA SOB SOB
Waterbank	Guniyan Binba Conservation Park JMP Yawuru Birragun Conservation Park JMP	Yawuru, SOB and DBCA Yawuru and DBCA

5.3 Incorporation of Broome Sandstone NHVs management into existing JMPs and Yawuru CMP

The Yawuru cultural management framework (Yawuru RNTBC 2016) references many of the NHVs without necessarily identifying them as such. For example, 'fossil remains, including dinosaur footprints, found on coastal reefs' are listed as 'Historical values' for the northern Wirrjinmur – Bilungurr (Willie Creek to Station Hill area, Yawuru RNTBC 2016: 168) and also as 'Ecological values' (Yawuru RNTBC 2016: 84). 'Pearling lay-up camps (Willie Creek)' are also listed as a Historical value. Similarly, 'Fossil sites including dinosaur footprints' are recorded as a Historical value for Minyirr (Gantheaume Point) (Yawuru RNTBC 2016: 172, 174). Listed management action/aspiration 4 reads: 'Rehabilitate trails, re-do signage, develop management plan to protect fossils (dinosaur footprints) in the Minyirr Park area and at Gantheaume Point (Strategies 1.5, 2.1, 3.3, 3.11)' (Yawuru RNTBC 2016: 174).

There are also a number of proposed management actions and aspirations (with an accompanying map) for the Walmanyjun (Cable Beach) to Burrgugan (at Dampier Creek) zone that intersect the DCNHMP management area including:

> *10 Develop walking trails around the peninsula from Gantheaume Point to the new jetty, and along the beach to Town Beach* (Strategy 1.5)
> [The 'new jetty' here and in 14 below refers to the Broome Port wharf, not the more recently built new jetty at Town Beach.]
>
> *11 Protect rocks at Reddell Beach* (Strategy 1.5)
>
> *12 Extend the Conservation Estate to include the Port of Broome conservation areas set aside to protect cultural and ecological values* (Strategy 3.9)
>
> *13 Protect the middens and other sites of antiquity within the Port of Broome lands* (Strategy 3.6)
>
> *14 Protect the reef around the New Jetty and Entrance Point as a major harvest site for marine resources* (Strategy 1.5)
>
> *15 Protect the fish trap, Black Rocks area and other significant rocks near the jetty* (Strategy 1.5)

> *16 Establish a Yawuru Management Zone 3, protected for Yawuru customary use, between Black Rocks and the Hovercraft base, where cooking will be permitted on the beach* (Strategies 1.5, 3.6)
>
> *17 In partnership with the Port of Broome, develop Simpson's Beach access and infrastructure to rehabilitate eroded areas; develop a new access track to Simpson's Beach; build a new car park and establish a ranger station in one of the old houses* (Strategies 3.3, 3.6)
>
> *18 Extend the Yawuru Conservation Estate to include the ITZ between Simpson's Beach and Dampier Creek, to be included in the Yawuru Conservation Estate. This is a significant traditional harvesting area, currently under the authority of the Port of Broome. Negotiate management arrangements with the Shire of Broome, DEC, the Department of Transport and other relevant authorities* (Strategy 3.9) (YAWURU RNTBC 2016: 175).

The section covering Kunin – Gumaranganyjal (Roebuck Bay) also lists 'Dinosaur footprint sites' as a historical value with a management aspiration to '7 Negotiate agreement with Hovercraft personnel [sic] for access to and protection of the fossil dinosaur footprints area (Strategy 3.6)' (Yawuru RNTBC 2016: 178–181). Dinosaur tracks are consistently linked to Strategy 1.5: 'Protect cultural heritage places and ecologically sensitive areas, especially those that are at immediate risk of harm', under Objective 1: 'To maintain Yawuru country as a cultural landscape that is respected, protected and connected' (Yawuru RNTBC 2016: 145).

The West Kimberley National Heritage listing, including the Broome Sandstone ichnofossils and associated Lower Cretaceous heritage are referenced in all four JMPs, and strategies for management of the impacts of human activities on the Broome Sandstone environment are incorporated in the management programs for conservation of geomorphology and geomorphological processes. These include management and monitoring the impacts of:

- sediment deposits and erosion from road runoff and other forms of water drainage;
- coastal infrastructure and urban development including dredging, dredge spoil and urban drainage works;
- mineral exploration and mining activities including petroleum exploration; and
- physical disturbance from vehicle and pedestrian access, as well as horse and camel access.

Geomorphology conservation management strategies also aim to ensure that urban and resource development proposals that have the potential to disturb the geomorphology 'are appropriately assessed in accordance with the EP Act'. References are also made to ensuring EPBC Act obligations are met, although this does not appear as a specific strategy and nor does it appear in management strategies as prominently as the EP Act obligations and Ramsar Convention obligations. 'Undertaking research activities to characterise geomorphic features and processes' is listed as a specific strategy; however, the Yawuru Nagulagun/Roebuck Bay Marine Park JMP (DPW 2016b) notes:

> *Fossil dinosaur footprints are preserved in the rocks in the intertidal areas of the marine park, however, the significance, condition and locations of these features are not currently well known.*

The various JMP management programs also cover general objectives and strategies for (i) collaborative management, (ii) education and interpretation, (iii) public participation, (iv) patrol, enforcement and ranger training, (v) visitor risk, access and infrastructure, and (vi) research and monitoring. These programs could all be fine-tuned for protection, management and interpretation of Broome Sandstone Lower Cretaceous heritage and other relevant West Kimberley NHVs.

[IMG] Figure 5.5 Assoc. Prof. Steven Salisbury from UQ is assisting DCMG to develop protocols for viewing and monitoring fragile track sites (Photo: Damian Kelly)

5.4 Key issues

5.4.1 Fragility and dynamic nature of the intertidal sandstone environment

While the Broome Sandstone dates back to approximately 130 million years ago, it is still fragile and vulnerable to both natural and human activities and processes. The massive tides of the Kimberley mean that many sandstone exposures and fossils are underwater much of the time, and these environments, when exposed, tend to be the most fragile. At other times and locations the sandstone and fossils are buried or partially hidden by sand which protects them from erosion. The sand moves constantly and the repetitive removal of sand by people to view fossilised tracks can damage them. The resilience of the sandstone also varies enormously, with some tracks and trackways located on solid platforms, and others on platforms that are undermined. Wet season weather events such as storms and cyclones can result in new exposures as well as breakages of known exposures and when platforms start breaking up, they move and shift when people walk or stand on them. Climate change and rising sea levels are also causing changes in tides, erosion and deposition. Rates of coastal erosion for the DCNHMP management area have been modelled in the SOB's Coastal Vulnerability Study (Cardno 2015). The 'Shoreline Monitoring' joint project with NBY monitors the situation.

5.4.2 Lack of understanding of the NHVs and EPBC Act processes

The West Kimberley cultural landscape was listed as a National Heritage Place in 2011 and a wide range of cultural and natural themes and values are gazetted as nationally significant and worthy of protection under the EPBC Act. The sheer size of the landscape listed, and the diverse values identified can lead to confusion over which values apply in which locations, and what kind of changes or impacts on the landscape might be acceptable. While some of the recognised values may be evident in the landscape, others can be invisible to casual observers or the uninitiated. This can apply not only to cultural values associated with particular landforms or locations, but also to fossils and geological features (such as the Broome Sandstone and its ichnofossils) that appear to be permanent features of the landscape.

Additionally, as detailed in Chapter 5.1.2, the self-assessment process for federal referrals is viewed as presenting a significant risk to the Dampier Coast NHVs, particularly in the context of a general lack of understanding of both the nature and significance of the ichnofossils, and obligations under the EPBC Act. The high turnover of staff in the organisations located in this remote location can also lead to a lack of corporate memory with regard to NHVs and EPBC Act processes.

5.4.3 Anomalies in the NHL gazettal boundary and a lack of dynamic shared spatial data

Adding further to this risk are the current discrepancies between the written description of the NHVs and the mapped NHL boundary that create legal uncertainties for those undertaking developments (see Chapters 1.3.3 and 1.3.4). There is also the need for a shared source of spatial information and data for land managers who need to understand where the Broome Sandstone and associated tracks are located in order to monitor and manage them. Management of the spatial information should be dynamic and able to respond to the changing environment with controlled access and protocols in place for consultation.

[IMG] Figure 5.6 Expanding urban infrastructure and new housing estates are changing the ecology of the ITZ

[IMG] Figure 5.7 Quad bikes are able to access all areas of the ITZ (Photo: Dianne Bennett)

5.4.4 Pressures of population growth and urban development

At the 2016 Census the population of the Broome Local Government Area was 16,222 and 16,959 at the 2021 Census. According to *Western Australia Tomorrow 2031* forecasts, this could reach 20,650 by 2031 (DPLH 2020). The rapid growth of Broome as a regional centre has led to greater use of, and competition for, resources and space, including a growing demand for recreational use of coastal and marine areas, with an increasing number of vehicles on beaches and an expansion of recreational boating and fishing.

Expanding urban and coastal infrastructure and new housing estates are also changing the ecology of the ITZ and adjacent conservation reserves. Approvals for development projects occur incrementally rather than subject to a strategic overview of managing the impacts on these ecosystems and on the fragile Broome Sandstone environment. The SOB's Local Planning Strategy 2023, however gives consideration to the impacts of development on coastal landscapes, and this is guided by State Planning Policy. Nevertheless, due to an absence of triggers in the local and state planning systems, the EPBC Act requirements for self-assessment and referral of development proposals that could impact on NHVs and other matters of national environment significance are often overlooked (refer to the summary of specific development proposals in Chapter 5.5).

5.4.5 Disturbance and damage from vehicular access

Disturbance from recreational and commercial activities is increasing with more and more pedestrians, cars, buses, quad bikes, dirt bikes, boats, jet skis, horses and camels accessing the ITZ. The growing popularity and size of events within the ITZ such as dinners, sporting events, festivals and weddings is also putting pressure on the areas where exposures of Broome Sandstone and dinosaur fossils are located.

5.4.6 Growth of tourism and growth of interest in dinosaur fossils

[IMG] Figure 5.8 Damage caused by scraping track fossils with a sharp instrument (Photo: Dianne Bennett)

Together with population growth, the rapid (approximately 60%) growth of the Broome tourism industry over the past 10 years has meant a heavier use of resources, which has compounded impacts on the culturally and environmentally sensitive ITZ (RDA Kimberley 2019). It is commonly

said that the population of Broome swells to twice its size during the tourism season and this is reflected in RDA Kimberley (2019) tourism figures for the past decade. Visitor interest in Broome's dinosaur fossils is on an exponential trajectory according to online search data from ANW which showed an increase from 100 views of their dinosaur footprints information page in 2017 to 11,700 page views in the 2020/21 financial year (O'Brien 2022). Visiting Reddell Beach is also high on the Tripadvisor list of things to do in Broome.

There is also anecdotal evidence of an increase in the numbers and length of stay of illegal and unsupervised campers, both in the vicinity of Broome and at remote sites along the Dampier Peninsula. This issue has been exacerbated by improvements to access such as the sealing of remote roads and upgrades to car parks and beach access tracks.

[IMG] Figure 5.9 There are safety issues when tourists scramble over the cliffs and rocks around Gantheaume Point searching for dinosaur tracks (Photo: Steve Salisbury)

A few local tourism operators offer itineraries that access track sites however DCMG has not had the capacity to develop protocols for behaviour and operation. The number of people that can be accommodated on site visits is limited where rock platforms are friable, and the DCMG has found leading excursions of more than 20 is difficult to manage. There is also the potential for theft, deliberate defacement and unintentional damage to trackways in remote locations or on public beaches.

5.4.7 Land tenure, resourcing and management of the public realm

As a voluntary organisation, the DCMG is not resourced to continue responding to development and management issues on a case by case basis, and considers that a more strategic management approach in partnership with land managers is needed for all parties to appropriately respond to the challenges and opportunities of the increasing interest in the tracks, and ensure ongoing protection.

Another key issue is the lack of clear management responsibility for the supervision and monitoring of tracks in the ITZ, especially outside business hours. Finally, an ongoing loss of corporate memory due to the high staff turnover of land managers, tourism bodies and other local stakeholders contributes to a lack of knowledge of the NHVs, EPBC Act obligations and DCMG protocols for visitor behaviour.

5.4.8 Public safety issues

Public safety issues are emerging as increasing numbers of visitors undertake 'DIY tracking'. These include friable cliffs, slippery rocks, fast-moving tides and a lack of direction of the public to safe viewing locations.

5.5 Summary of proposals for change, and potential pressures on the Broome Sandstone environment

5.5.1 Roebuck Bay Zone

Proposal

The 2018 upgrade to the boat ramp near the BBO has resulted in an increasing number of cars and trailers on the beach.

Issue

Boulders placed to discourage vehicular access to sensitive areas are regularly removed, posing a risk of damage to NHVs associated with dinosaur tracks in this area which are deemed to be of outstanding heritage value.

Opportunities and actions

- Apply DCNHMP spatial data for the areas with geological and palaeontological features relevant to the National Heritage listing to guide vehicle access management, enforcement and compliance.
- Develop key messages to guide boat ramp users and bird watchers.
- Monitor sites and train park rangers and Country managers to do that.
- DCMG and JM Partners need to identify low-cost interim interventions.

5.5.2 Town Beach Zone

Proposal

The SOB's Town Beach Geotech Investigations and Coastal Adaptation Options Assessment Report investigates the options for managing the erosion occurring in front of the Roebuck Bay Caravan Park.

Issue

Management options and related sand movement could reveal exposures of Broome Sandstone that contain dinosaur tracks.

Opportunities and actions

Explore mechanisms by which the DCNHMP spatial data for areas with geological and palaeontological features relevant to the National Heritage listing can be retained in the SOB mapping system and other similar corporate memory tools.

[IMG] Figure 5.10 Boulders placed to discourage vehicular access to sensitive areas of Roebuck Bay are regularly removed

5.5.3 Entrance Point Zone

Proposal

In 2020 the SOB, in collaboration with the Department of Transport, KPA and other stakeholders decided to relocate a proposed boat launching facility from Reddell Beach to Entrance Point to avoid direct impacts on known cultural heritage sites and dinosaur tracks at Reddell Beach.

Issue

The construction of large 12-metre-high groynes will change coastal movements and could still adversely affect the offshore reef that contains an area with outstanding geological and palaeontological features relevant to the National Heritage listing.

Opportunities and actions

- This has been determined to be a controlled action requiring assessment and approval under the EPBC Act before it can proceed (DAWE 2022).

- Environmental assessment should consider DCNHMP spatial data stored on the Data WA SLIP that identifies the areas with geological and palaeontological features relevant to the National Heritage listing.

- Incorporate key interpretive messages around geological and palaeontological features into any new visitor signage.

- Monitor the identified areas with geological and palaeontological features relevant to the National Heritage listing for impacts during and post construction.

Proposal

The KMSB is constructing new port infrastructure within the Port of Broome that is designed to complement the existing government-owned wharf. This incorporates a 300-metre-long causeway which connects to a 165 x 50 metres floating wharf platform.

Issue

In early 2024 KMSB and DCMG agreed to share information so the construction process could avoid known dinosaur tracks. This did not eventuate.

Opportunities and actions

- Incorporate key interpretive messages around geological and palaeontological features into any new visitor signage.

- Monitor the identified areas with geological and paleontological features relevant to the National Heritage listing for impacts post-construction.

5.5.4 Reddell Beach Zone

Proposal

Concept plans for the Reddell Beach area by Yawuru Conservation Estate JMPs to improve visitor access.

Issue

These and any future improvements could result in a large increase in the number of visitors or events on the beach that result in damage to friable rock platforms or areas with geological and palaeontological features relevant to the National Heritage listing.

Opportunities and actions

- Manage access to areas with geological and palaeontological features while protecting culturally sensitive areas.

- JMPs need to reference the DCNHMP spatial data stored on the Data WA SLIP.

- Develop key interpretive messages to guide visitor signage.
- Manage and supervise outstanding heritage value areas through training of park rangers and Country managers.
- Support DCMG input into ongoing proposed plans/improvements.

[IMG] Figure 5.11 Improved vehicular access to Reddell Beach could impact on areas with geological and palaeontological features

5.5.5 Gantheaume Point Zone

Proposal

Replacement of the current visitor information shelter and upgrading of Gantheaume Point visitor access management.

Issues

- Decisions may be made about interpretive signage for dinosaur tracks with incomplete and/or outdated scientific information.
- An upgrade could make it easier for more visitors to access Gantheaume Point, the most dangerous and difficult site for viewing tracks.

Opportunities and actions

- Ensure the DCNHMP spatial data stored on the Data WA SLIP is referenced and used by all JM Partners.
- Improve the mechanisms for limiting pedestrian access to unsafe areas and areas of outstanding heritage value and cultural sensitivity.
- Remove existing incorrect concrete tracks (all theropod left feet) and replace with accurate casts of theropod and sauropod trackways.
- Develop key interpretive messages to guide signage including around safety issues such as slippery rocks, rapid tides etc.
- Manage and supervise sites and train park rangers and Country managers to be able to do so.
- Direct self-guided tourists to safer track site locations.
- Support DCMG input into the development of the plans.

[IMG] Figure 5.12 There is an opportunity to improve the control of pedestrian access to unsafe areas and areas with outstanding geological and palaeontological features at Gantheaume Point

Proposal

The Broome Turf Club Master Plan being prepared by the SOB is considering whether portions of the current lease area could provide opportunities for diversification of land use.

Issue

New land uses could affect multiple access points to areas with outstanding geological and palaeontological features, including the southern end of the Cable Beach South Zone, Gantheaume Point Zone and the northern end of Reddell Beach Zone.

Opportunities and actions

- Manage access to areas with outstanding heritage features while protecting culturally sensitive areas.
- Develop key interpretive messages to guide signage, including safety; slippery rocks, rapid tides etc., and to direct visitors to safer locations.
- Develop a self-guided ecotourism walking trail from Gantheaume Point to Entrance Point that directs walkers away from unsafe or sensitive sites.
- Management and supervision of all sites, and offer training to rangers.
- Support DCMG input into the development of any plans.

5.5.6 Cable Beach Foreshore Zone

Proposal

The Cable Beach Foreshore Redevelopment Plan includes the construction of a reprofiled dune, a seawall to manage erosion around the drainage outlet, park improvements, redesign of the car park and interpretive signs and features.

Issue

The beach immediately abutting the reprofiled dune toe contains extensive Broome Sandstone platforms that can be exposed under extreme tides or storm events. Consideration should be given to the potential for damage in the final project design and ongoing replenishment plans. There is also an area with outstanding geological and palaeontological features within the abutting ITZ which will require the ongoing prohibition of vehicle access.

Opportunities and actions

- Ensure DCNHMP spatial data for areas with geological and palaeontological features stored on the Data WA SLIP is accessed and used by the SOB and other JM Partners and ensure no vehicles (tourist, maintenance) are permitted 30 metres west of the Foreshore reserve cadastral boundary.
- Explore mechanisms through which DCNHMP spatial data stored on the Data WA SLIP can be retained in the SOB mapping system and other similar corporate memory tools.
- DCMG to offer ongoing input into the development of the plans through the Cable Beach Community and Stakeholder Reference Group.
- Ensure self-assessment under the EPBC Act forms part of the design of any concept.
- Incorporate key interpretive messages around NHVs into any new visitor signage.

[IMG] Figure 5.13 Dinosaur tracks in the Cable Beach Foreshore Zone become vulnerable to large numbers of tourists when exposed through sand movements (Photo: Shayne Thompson)

5.6 Key opportunities

DCNHMP steering group members and other stakeholders have identified the following potential opportunities in the context of documented strengths, vulnerabilities, issues and threats related to the management of the heritage landscape.

5.6.1 Branding of Broome

A key aspiration of the DCNHMP is to guide the way in which increasing interest in Broome's dinosaur tracks can offer opportunities for local enterprise to emerge and flourish. Broome's pearling history and Japanese Matsuri festival are an established association for most visitors, as is the sunset at Cable Beach. Broome is also viewed as a gateway to the Kimberley as well as a destination in its own right. While there are numerous tropical beach destinations in Australia and nearby Asia, none can boast of 130 million-year-old dinosaur tracks. The tracks are a unique selling point for Broome that could be used to encourage a greater diversity of visitors to linger longer.

[IMG] Figure 5.14 Broome's dinosaur tracks are a unique selling point that could be used to encourage a greater diversity of visitors to linger longer

5.6.2 NHVs as an in situ museum

As public awareness of the National Heritage listed dinosaur tracks builds, more people will want to come and experience this unique part of Australia. For most people, dinosaurs are typically a museum experience, far away from the often inaccessible sites where bone and track fossils are located. The Dinosaur Coast offers an easily accessible heritage tourism experience in a stunning natural landscape – the landscape itself is the museum.

[IMG] Figure 5.15 Ongoing engagement with the Broome community will be essential to successful implementation of the management plan (Photo: Wade Freeman)

5.6.3 Community engagement

The local community plays a key role in protecting and promoting the NHVs so facilitating their ongoing engagement with the DCNHMP is essential to its successful implementation. Community information sessions were held in October 2022. Advertised through social media platforms and local community networks, three Broome based media outlets also ran news items. To help people easily understand what the DCNHMP proposed, a package of easy-to-read products were created.

The extremely popular Broome Museum Open Day marked the commencement of the Community information sessions with volunteers spending the three hours talking to interested people. This was followed by a presentation at the Broome Public Library, and stalls run by volunteers at Entrance Point, Reddell Beach and Cable Beach over several evenings. A stall in the Broome Boulevard Shopping Centre on a Saturday morning concluded these sessions. Concurrently, an online survey was posted on the DCMG website with 79% of respondents aware that the tracks are National Heritage listed and of these, 68% suggested 'protection' as the most important matter needing addressing in the management plan. Overall, the Broome community recognises the importance of the Broome dinosaur tracks, supporting the development of the management plan and DCMG.

5.6.4 Cultural, scientific and economic enterprise

The promotion of England's Jurassic Coast and Korea's Cretaceous Coast are models of how to use geological and palaeontological features to underpin cultural, scientific and economic enterprise. Korea's Dinosaur World Expo offers a variety of attractions and educational activities, drawing as many as two million visitors from Korea and overseas every four years. Sideline events include the dinosaur robot Olympics, a national surfing competition, the Goseong Dinosaur Land mountain-climbing festival and an academic symposium where scholars and palaeontologists from Korea, China, Japan, Mongolia, the United States and the Netherlands gather. On the other side of the world the Jurassic Coast is home to a 'String of Pearls' network of museums and visitor centres that share resources and host regular expert-guided fossil hunting walks, academic conferences, exhibitions, a fossil festival and digital fossil collections.

[IMG] Figure 5.16 Geological and palaeontological features can underpin cultural, scientific and economic enterprise (Photo: Damian Kelly)

[IMG] Figure 5.17 There are emerging opportunities for geoheritage tourism in Broome's in situ dinosaur museum (Photo: Kandy Curran)

5.6.5 Tourism and interpretation

The recent change of name of local boat tourism operator Broome Hovercraft Eco Adventure Tours to Dinosaur Adventures Broome reflects the emerging opportunities for tourism in Broome's palaeontological heritage. DCMG has developed an App for self-guided dinosaur tracking, and there is scope for developing self-guided and guided walks between coastal dinosaur track locations, possibly using the model of Broome's award-winning Jetty to Jetty Trail. It is, however, important to distinguish between track locations that may be suitable for self-guided tourism and those that need informed guidance.

Additionally, proposed upgrades of existing geological and palaeontological interpretation at Gantheaume Point, a Kimberley Centre for Arts and Story and redevelopment of the Cable Beach Foreshore Reserve could all be aligned with objectives for increasing understanding and awareness of the NHVs. Investment in park ranger and Country manager education, tourism operator training and direct cross-cultural engagement programs could complement these 'bricks and mortar' initiatives. There is also a need to develop key interpretive messages to guide signage and online interpretation of the NHVs, and to establish and promote protocols for public and tourism operator behaviour.

[IMG] Figure 5.18 Assoc. Prof. Steven Salisbury explaining the details of a sauropod track to a community field excursion organised by DCMG (Photo: Kandy Curran)

[IMG] Figure 5.19 Dr Anthony Romilio (left) and Assoc. Prof. Steven Salisbury (right) from UQ Dinosaur Lab documenting a sauropod trackway on the northern shore of Roebuck Bay (Photo: Damian Kelly)

5.6.6 Education and research

In addition to the opportunities that a cultural centre could provide, there is scope for a palaeontological interpretive centre and/or research laboratory for use by scientists, schools and the community in general. This could be an extension of the Broome Museum or an independent endeavour like the Cygnet Bay Marine Research Station. DCMG is also investigating the feasibility of a citizen-science project that would build the organisation's connections with dinosaur enthusiasts (both adults and children) and as a first step towards establishing a local scientific base. This would

all aim to complement existing school programs and the ongoing role of UQ and other JM Partners in furthering research and monitoring of the Broome Sandstone and associated geological units.

5.6.7 Management and monitoring

A clear opportunity exists to establish a DCMRG from the existing DCNHMP Steering Group to oversee implementation of the DCNHMP over the next ten years. An early task of the group would be to rectify the anomalies of the current NHL gazetted boundary and to incorporate NHVs management into the existing Yawuru Conservation Estate management plans and programs, and into SOB and state government planning schemes and planning processes. There is also an opportunity to integrate protection of the Broome Sandstone and other NHVs in the area with existing biodiversity protection programs for the ITZ. This would include other matters of national environmental significance such as migratory birds, threatened marine species, mangrove communities and vine thickets.

Establishment of a shared spatial database and online public portal and monitoring system to manage the identified areas with geological and palaeontological features should be a high priority as the JM Partners work towards implementing a multi-faceted approach to visitor management that employs adaptive management principles. This would combine education and enforcement to manage access and protect sensitive areas, and needs to use a live online database that can be updated with new research and management information to facilitate adaptive management responses.

An online monitoring system that employs and trains local people would support the JM Partners' management and monitoring system by focussing on key sites and collecting data on the condition of the tracks and the number and behaviour of tourists. (Model: BirdLife Australia's management and monitoring of public behaviour around Hooded Plover nesting sites, which operates in collaboration with local and state government agencies.)

5.6.8 Global significance

Finally, there is an opportunity to explore the feasibility of World Heritage nomination of the West Kimberley Dinosaur Coast, based on comparisons with other globally significant ichnofossil sites.

6 Conservation management policy

[IMG] Figure 6.1 As the sun rises on Reddell Beach a film crew is intent on photographing one theropod track (Photo: Tourism WA)

6.1 Overview

The EPBC Act Regulations, Schedule 5A (Management plans for National Heritage Places) and Schedule 5B (National Heritage management principles – see Appendix B) prescribe the statutory framework, with the assistance of the Working Together guidelines (DEWHA 2008). The Working Together guidelines are consistent with the management plan development guidelines in the AICOMOS Burra Charter (AICOMOS 2013a) and the Australian Natural Heritage Charter (Cairnes 2002). Those two Charter documents and the AICOMOS Practice Notes that expand the Burra Charter describe detailed conservation management protocols and processes.

The Working Together guidelines describe the following performance objectives for management plans and guidelines towards achieving those objectives:

> *The aim of a management plan is to:*
>
> - *Respect all heritage values of a place by protecting, conserving, presenting and transmitting the heritage values of a place to current and future generations;*
> - *Ensure that the use of the place is consistent with its heritage values; and*
> - *Provide a process for ongoing monitoring, reviewing and reporting on the heritage values.*
>
> *Occasionally new research may reveal potential new NHVs of a place, in which case the place will require formal re-assessment and revision of the management plan.*
>
> *A management plan can achieve these aims by:*
>
> - *Using recognised best practice resources and models;*
> - *Remaining current. Changes in the condition of the heritage values, identification of new values or the loss of heritage values should be recorded;*
> - *Arranging for community and interested party consultation in the identification and management process; and*
> - *Involving relevant Indigenous people in the identification, assessment and management of places with Indigenous heritage value.* (DEWHA 2008: 4).

The identification of best-practice management policies should include the following considerations (DEWHA 2008: 11):

> - *Best practice management and conservation processes, utilising the Burra Charter, Natural Heritage Charter or Ask First and other charters as appropriate.*

- *Current ownership and management structure, and the measures that have been put in place to protect and manage the cultural heritage values of the place, and the manner in which they work.*
- *How and under what circumstances heritage advice is to be sought.*
- *How records of intervention and maintenance are to be kept.*
- *How unforeseen discoveries or disturbances of heritage are to be managed.*
- *Research, training and resources.*
- *How the condition of those elements representing NHVs, and other values, are to be monitored and reported.*
- *The implications of the various heritage listings for the place, including legislative and regulatory measures and the manner in which they work.*
- *What research, induction and staff training will be applied by the managing agency.*
- *What financial resources will be applied by the managing agency to improve recognition of heritage and the management of heritage values including maintenance and conservation works.*

Note that the guidelines (EPBC Act s324X) assume that a single, state-level managing agency would be identified, whereas this plan shares management roles among its stakeholders in state and local government, independent agencies (KPA), Aboriginal Traditional Owners, Cultural Custodians and a community volunteer organisation (DCMG), as identified below in Chapter 7. There are WA state government agencies involved in the development and implementation processes for this plan. The existing DBCA and the DBCA/Yawuru jointly-managed conservation management areas and plans form a very important part of the heritage management framework and future potential (Chapter 5.2). The DOT Maritime section has been consulted because of their management role in relation to current local development proposals such as the Broome Boating Facility (formerly known as Broome Boat Harbour project).

In the present case, the initiative has come from DCMG to seek Commonwealth grant funding to develop a management plan, rather than originating with the state government. Consequently, the tone of the document and the approach to stakeholder management is not prescriptive or state-government funded – it is cooperative among the stakeholders, and aspirational where additional processes would have to be devised and additional resources obtained in order to implement particular recommendations (Chapter 6 below and Chapter 7).

Addressing national heritage management plan requirements

In light of these guidelines, the development of this DCNHMP and the proposed management framework follows the best-practice guidelines referred to in Chapter 1.2.3. On this basis, the DCNHMP incorporates participation by Traditional Owners, Cultural Custodians and other key stakeholders, as described in Chapter 1.2.2.

The practical difficulties posed by incomplete and incorrect gazetted mapping for the extent and locations of the Cretaceous ichnofossils along this coastline are described in Chapters 1.33, 2.3 and

5.4.3 and the zone-by-zone maps in Chapter 3 allow the gazetted NHV areas to be compared with the much greater extent of the significant ichnofossils and Broome Sandstone surface outcrops along the coastline.

The current conditions of the sites relevant to the NHVs is presented in Chapter 2 (the scientific context), the zone descriptions in Chapter 3, and the key issues described in Chapters 5.4 and 5.5. Note that this is the first management plan to provide any specific condition assessment or conservation and management detail with regard to Cretaceous ichnofossils, although dinosaur tracks are referenced as significant in the DBCA/Yawuru and SOB joint conservation management plans. All of those JMP/CMP documents have review requirements that provide the opportunity to update them to align with this DCNHMP.

The implications of other heritage listings that intersect this landscape and their legislative contexts are described in Chapters 4.3 and 5.1. In Chapter 7, Objective 1 deals with education and research, while aspects of stakeholder training are included in the actions recommended for most of the objectives.

The application and effectiveness of current measures to protect and manage Cretaceous ichnofossil locations relevant to these NHVs are described in Chapters 2.2.2, 4.3, 5.1, 5.2, and 5.3. The goal of the DCNHMP is to combine the cooperative and coordinated efforts of the named stakeholders to provide an effective and evolving management framework for the future (Chapters 6 and 7). The core Indigenous stakeholders, the Yawuru and Goolarabooloo, both have been involved in the development of this plan and are members of the recommended DCMRG. This plan stipulates that both Indigenous groups should be engaged concerning all aspects of management for the Cretaceous ichnofossils, to ensure that cultural values are always taken into account.

The DCNHMP does not include a specific treatment of access and security arrangements because the fossil sites are located in the ITZ of public beaches along the coastline and are subject to regular tidal inundation. Security and access concerns about aspects of Aboriginal cultural significance for Traditional Owners and Cultural Custodians focus on preserving culturally confidential information relating to certain places, as well as the physical safety of those places from potentially destructive human activities on the beaches and in the ITZ (Chapters 2.2.2, 4.4.1, and 5.4–5.5). The public has access to these areas. Direct intervention and maintenance are not practical in this situation, but ancillary actions such as traffic control and signage will be recorded by the agencies taking the action and the coordinating DCMRG. Initiatives for monitoring the condition of the ichnofossil exposures are listed in Objective 3 in Chapter 7. Since 2016, DCMG has been using community education to increase awareness and a sense of community ownership to improve protection for the fossil sites.

This plan does not directly deal with sensitive information that requires specific management protocols. The DCNHMP is created as a public document, and does not contain either sensitive cultural information or detailed location information for any specific ichnofossils that might result in damage from unsupervised visitors. The appropriate database record repository for culturally significant places in Western Australia is the ACHIS maintained by DPLH. This plan utilises the public version provided by DPLH online (Chapter 4.3.2). The mapping of the distribution of significant ichnofossil sites and related Broome Sandstone outcrops presented in Chapter 3 has been designed to be useful for planning and general management purposes, but does not pinpoint specific fossil locations that might subsequently be impacted through significant unsupervised visitation. The discovery and recording of dinosaur tracks continues as an intermittent process, supervised and recorded by the scientific experts, UQ Dinosaur Lab. It is expected that if more detailed location information for ichnofossils is shared by UQ with other management stakeholders to improve specific planning and management measures in future, that such information-sharing would occur

on a confidential basis limited among stakeholders who need the information and have effective internal measures to keep it secure.

National heritage management plans are required to consider the planning and management of works, development, adaptive reuse and property divestment proposals. The issues of current and future development impacts and determining appropriate processes for identifying and mitigating such impacts are considered in Chapters 5.1, 5.2, 5.3 and 5.5. Community and stakeholder involvement should be assured through establishment of the DCMRG (Chapter 5.6). The DCNHMP should be subject to review within five years (s324W of the EPBC Act), or if the NHVs of the place change, or if major changes are proposed (DEWHA 2008: 12). Finally, for policy implementation:

> *The management plan should identify who will be responsible for implementing the conservation policies, a timeframe for the policy implementation, and the process involved* (DEWHA 2008: 12).

This is the subject of the table of objectives, strategies and associated actions in Chapter 7 (Table 7.1), which also identifies lead and partner agencies for each proposed action, and the associated time frames.

The matters of adaptive reuse and property divestments mostly are not relevant to ichnofossils in intertidal sandstone outcrops along the coast, with one possible exception. A key concept for managing the ichnofossils and sandstone outcrops is the acceptance that nature progressively erodes some fossils and sometimes exposes others in the process. Should a situation arise where the DCMRG and relevant government agencies agree to relocate a fossil under imminent threat of natural destruction at some time in the future, then a relevant policy and procedure would be needed. However, such actions are not contemplated in the scope of this management plan.

New heritage discoveries continue to be made, by periodic scientific fieldwork, exploration and monitoring by volunteers (DCMG) or reported to DCMG by members of the public. These discoveries are received, vetted and recorded, and field-investigated when the opportunity arises by Assoc. Prof. Steven Salisbury and UQ Dinosaur Lab, who collect the data that will allow for future updates to the DCNHMP mapping. There is no formal register for the ichnofossil sites related to the NHVs. UQ palaeontology researchers catalogue their information, and have provided it in summary form for management purposes in the maps in Chapter 3 of this plan. If that mapping becomes available online, with an interface that allows new information to be submitted for the scientists to consider, and that allows them to post updated information and mapping as it becomes available, that facility would provide a fundamental management and record-keeping tool for the DCMRG and the implementation and evolution of this management plan.

Potential disturbances to these heritage places could be from natural causes or disturbance from vehicles or pedestrians, or vandalism. Human disturbance might be observed by SOB or DBCA/Yawuru rangers, other SOB or KPA employees, Aboriginal Traditional Owners, Cultural Custodians, DCMG volunteers, or the public. If this constitutes criminal damage such activities should be reported to WA Police, who have jurisdiction for such matters.

The context for seeking expert heritage advice is addressed in Chapter 5.1 and in the key role of UQ Dinosaur Lab researchers within the DCMRG and in the identification, recording and management of ichnofossils within the Broome Sandstone. These experts also have a central role in the verification and recording of scientific discoveries.

There is no formal process for monitoring and reporting on the condition of the ichnofossil sites, and no agency or organisation has that role except for the volunteer DCMG. In fact, the condition and

appearance of the ichnofossil sites may be subject to significant changes, both progressive and cyclical, because of the dynamic environment in which they are exposed. The exposed Broome Sandstone which contains the ichnofossils is located on public beaches between the high and low water marks and subject to two tides per day and passing storms and cyclones. The rocks and platforms naturally move and erode, sometimes revealing previously unseen tracks. The sand is also constantly moving, changing from day to day and tide to tide.

This plan proposes that a periodically updated online database accessible to stakeholders would at least provide a place to record both new discoveries and changes in the condition of the ichnofossil exposure sites. It may be possible to add a capacity of discovery or monitoring information to be submitted by stakeholders, or even by interested members of the public. This plan recommends that the DCMRG consider the development of training in the recognition and reporting of ichnofossil discoveries or changes in condition for relevant government agency and local government staff and contractors, as well as tourist operators and volunteers.

The DCMRG of stakeholders is intended to meet at least annually (facilitated by DBCA) to progress and monitor the implementation of the DCNHMP, including the review and update of the document every five years. Public information and education about the NHVs constitute a primary means for the DCMRG and its constituent stakeholders to manage and protect the Broome Sandstone ichnofossils. Interested members of the public can download the web-based DCMG Track Guide App or join the DCMG as a volunteer for their educational, recording and management activities.

The financial resources associated with the DCNHMP are the costs of implementing the recommended actions for the objectives stated in Chapter 7, which also identify the lead and partner agencies involved and the proposed timeframes for those actions.

Comparisons with other places

The only other managed Cretaceous dinosaur track sites in Australia are near Winton in western Queensland, in the Winton formation. There are three track sites within the Dinosaur Stampede National Monument at this location: Seymour Quarry, New Quarry, and Lark Quarry. Seymour and New Quarries are small and have been reburied. Lark Quarry has been enclosed in a purpose-built building, although the track surface had been significantly and detrimentally modified prior to and since that time (Romilio et al 2013).

The second Winton Formation along Snake Creek had dinosaur trackways of sauropods, small-bodied ornithopods and small-bodied theropods. The surface has been removed from this site and reconstructed at the Australian Age of Dinosaurs Museum at Winton, within a purpose-built open structure (Poropat et al 2021).

At Winton, problems with access to and preservation of specific sites have thus been resolved by constructing a building over one track site, removing another for display at the local dinosaur museum, and others through reburial. These kinds of solutions only work for relatively compact sites in a stable physical environment. The Broome Sandstone trackways exist within a completely different landscape: in a very dynamic ITZ along the margins of public beaches and a regional port, urban centre and tourist destination. In addition, their cultural heritage values are incompatible with such forms of intervention.

The Dorset and East Devon Coast (also known as the Jurassic Coast) is a World Heritage Site on the southern English coastline, an approximately 153 kilometre stretch of cliffs displaying the geological and palaeontological history of the Triassic, Jurassic and Cretaceous periods, with access via ten gateway coastal towns for a multitude of visitors. This example has extra relevance given the

prospect of a future World Heritage Nomination for, or including, the Dinosaur Coast of the Dampier Peninsula. Although on a larger scale than the current DCNHMP, the baseline approach taken essentially is the same.

> *The approach taken for the Jurassic Coast is one that is firmly based in a locally led partnership which coordinates activity, facilitating partners to achieve mutually supportive aims, and providing specialist advice where necessary. The partnership is led by the local authorities, particularly Dorset and Devon county councils, but also comprises local, national and international agencies, as well as technical specialists. Local management means that not only are local issues able to be resolved effectively, but that the voice of the local community can be heard and play a part in the management of the Site* (JURASSIC COAST WORLD HERITAGE TEAM 2009: EXECUTIVE SUMMARY).

The Jurassic Coast World Heritage Site management plan is centred on eight long-term aims, each with a number of targets and indicators for measuring progress. These aims have informed the development of the current management plan.

- *AIM 1 To protect the Site*
- *AIM 2 To conserve the Site*
- *AIM 3 To improve understanding of its Outstanding Universal Value*
- *AIM 4 To support communities to realise benefits from the designation*
- *AIM 5 To improve access to the Site*
- *AIM 6 To improve the offer for visitors to the coast*
- *AIM 7 To increase awareness of the Site and World Heritage*
- *AIM 8 To demonstrate good World Heritage Site management*
  (JURASSIC COAST WORLD HERITAGE TEAM 2009: EXECUTIVE SUMMARY).

[IMG] Figure 6.2 Jurassic Coast World Heritage site (Source: Jurassic Coast Trust)

A crucial difference between the Jurassic Coast and the West Kimberley Dinosaur Coast is that the Jurassic Coast fossils include many small items such as ammonites constantly eroding onto the seashore, which are the focus of legal fossil collecting. This represents a very different visitor focus to the ichnofossils in the Broome Sandstone.

The southern coast of the Korean Peninsula has numerous Cretaceous dinosaur track sites (Huh et al 2003), which previously have been nominated for World Heritage listing.

> *The Cretaceous sites consist of fossil sites including dinosaurs, pterosaurs, birds, invertebrates, and plants, inorganic sedimentary structure sites, unique geological feature sites, and geologically scenic view sites. Dinosaur sites include bone sites, egg sites, and footprint sites. Among them dinosaur footprint sites are the most common. The most Natural Monuments are designated for their unique preservation of dinosaur footprints and they are world-class scale in preservation* (HUH 2011).

The Cultural Heritage Administration of the Korean Government designates most important dinosaur track sites as Natural Monuments for conservation and comprehensive survey, as well as long-term monitoring. The Natural Heritage Centre of Korea is dedicated to investigating, studying and educating people on natural heritage as well as to sharing the values and importance of natural heritage with the general public. Since 2007 this work has included data recording of the fossil sites, and educating volunteer locals monitoring the sites (Lim & Kong 2008: 130).

[IMG] Figure 6.3 Dinosaur footprints at Natural Monument 434, South Korea (Source: Cultural Heritage Administration of Korea)

Natural history education about these fossils comes from local museums established near two of the primary palaeontological and geological sites: the Goseong Dinosaur Museum and the Haenam Uhangri Dinosaur Museum. Huh (2011) documents the case for the development of a 'geopark' of these fossil sites, to promote geotourism from overseas and domestically. He notes that:

> *Although protection, development and promotion of these sites for scientific, geotourism and public education purposes has only taken place within the last decade they have already become very heavily used. All four sites are protected as National Monuments and have been developed for public education associated with its adjacent cultural and historical heritages, geographical and scenic sites* (HUH 2011).

[IMG] Figure 6.4 Goseong Dinosaur Museum, South Korea (Source: Cultural Heritage Administration of Korea)

6.2 Vision

The starting point for developing a conservation management policy is to develop a vision and to establish clear objectives, strategies and actions to realise that vision. The vision for this DCNHMP is:

> *To understand, protect and promote the Dinosaur Coast and create opportunities for the Broome community.*

6.3 Key objectives, strategies and actions

6.3.1 Objective to increase understanding and awareness of the Dinosaur Coast and its NHVs

Discussion

The Broome Sandstone and the associated Lower Cretaceous fossils related to the NHVs, as well as Holocene fossils, are not well understood by the growing number of tourists and local residents who interact with the ITZ on foot, or using motor vehicles, boats and jet skis etc. Improved knowledge and awareness is critical for the JM Partners who manage these activities and their potential impacts. Improved understanding and awareness of this National Heritage cultural landscape is a fundamental aspect of addressing each of the key management issues described above in Chapter 5.4.2.

There is an underlying issue also to be considered: that additional research and documentation is required to build a more adequate knowledge base for effective education and management. The gazetted mapping of the location and extent of NHVs for Broome Sandstone and associated fossils currently is manifestly inadequate and the best available mapping of the full extent of the ITZ and

exposed Broome Sandstone is approximate due to a large tidal range and variations due to weather events and movement of surface sediments (Chapters 1.3.3 and 5.4.3).

The dynamic nature of this ITZ influences the exposure of, and access to, the dinosaur tracks and related fossils and means that both research and management information need to be updated as the situation changes. Recorded track locations may suffer attrition from weathering and damage by tides, storms and human activities. Such activities also may reveal new sites with significant NHVs. New knowledge is added progressively by ongoing palaeontological research.

[IMG] Figure 6.5 Mapping tracks and trackways with ground and aerial laser scanning and remote sensing technologies (Photo: Damian Kelly)

New coastal development pressures bring new challenges, such as the examples described in Chapter 5.5.

Taking these factors into consideration, the following strategy and actions are identified.

Strategy

Support education and facilitate research

Actions

1.1. Enable access to Data WA's SLIP data sets for the DCNHMP into JM Partner GIS systems where capacity exists.

1.2. Continue mapping tracks and trackways using multiple methodologies including ground and aerial laser scanning and remote sensing technologies.

1.3. Establish a regular UQ Dinosaur Lab research residency in Broome supported by corporate and citizen philanthropy (e.g., billeting of research residents by locals).

1.4. Develop a citizen science program to support the mapping, monitoring, interpretation and research programs.

1.5. Develop a live, shared spatial database and online portal and monitoring system that can be updated with new information to adaptively manage identified features relevant to the National Heritage listing.

1.6. Involve Yawuru rangers, Country managers and citizen scientists in monitoring changes in condition and changing impacts on ichnofossil sites using an online monitoring system as described in Action 1.5.

1.7. Develop key interpretive messages to guide signage and online interpretation of the NHVs.

1.8. Establish protocols to discourage the use of commemorative plaques or other methods of identifying or naming specific sites.

1.9. Develop a 'myth busters' section on the DCMG website and future DCNHMP online portal to address the circulation of false or inaccurate information.

1.10. Establish and promote protocols for public and tourism operator behaviour and disseminate them through the DCMG website, tourism stakeholder websites, tourism apps, and future DCNHMP online portal. (Models: DBCA's 'Code of conduct' approach for turtle watching and BirdLife Australia's volunteer monitoring of public behaviour around Hooded Plover nesting sites.)

1.11. Continue strengthening community and educational links to the dinosaur story and experience through school field excursions, guided museum tours and classroom experiences.

1.12. Encourage further independent and institution-based specialist anthropological research and documentation as the next step towards appropriate recognition of the cultural values associated with these ichnofossils.

1.13. SOB to investigate establishing an interpretative centre and palaeontology research facility.

1.14. Continue to strengthen partnerships and facilitate educational opportunities with the BHS&M through the Museum Masterplan.

[IMG] (Photo: DCMG)

[IMG] (Photo: Kandy Curran)

[IMG] (Photo: DCMG)

[IMG] Figures 6.6 to 6.8 Strengthening community and educational links to the dinosaur story through field excursions, museum, library and classroom experiences

6.3.2 Objective to conserve and protect the NHVs of the Dinosaur Coast with best-practice adaptive management

Discussion

Adaptive management involves implementing a management plan, closely monitoring its effects, and then adapting future actions based on observed results. This will be achieved by maintaining the current DCNHMP steering group as the DCMRG that will meet at least on an annual basis over the next ten years to oversee the adaptive implementation of the DCNHMP and to respond to any new or emerging threats to conservation and protection of the NHVs and associated Broome Sandstone ichnofossil sites. Ongoing education and engagement with the broader Broome community as described in Chapter 6.3.1 will be an important part of this process.

Strategy

Incorporate conservation and management policy for NHVs and areas with relevant geological and palaeontological features into existing management frameworks

Actions

2.1. Maintain the current DCNHMP steering group as an ongoing DCMRG which meets on an annual basis to oversee adaptive implementation of the DCNHMP with DBCA as Chair.

2.2. Submit a nomination to the Australian Heritage Council (AHC) for additional areas, derived from updated spatial data that accurately describes the ITZ of the Dinosaur Coast to be added to the West Kimberley National Heritage Place. Corresponding additional values may also be nominated. This nomination to occur with the free, prior, and informed consent of Traditional Owners and Cultural Custodians.

2.3. Use DCNHMP spatial data sets on Data WA's SLIP to integrate palaeontological and geological heritage values management into the Yawuru CMP, Yawuru parks management plans and programs and relevant KPA management plans where appropriate.

2.4. Incorporate strategies and actions from the DCNHMP into the Yawuru CMP, Yawuru parks management plans and relevant KPA management plans where appropriate.

2.5. Incorporate education on the Dinosaur Coast NHVs and EPBC Act obligations into the induction of new KPA staff.

2.6. Identify intersections between the DCNHMP and strategies for the protection of other values (e.g., biodiversity monitoring and protection, visitor access management and coastal development assessment).

[IMG] Figure 6.9 Coastal erosion at Reddell Beach (Photo: DCMG)

6.3.3 Objective to monitor and manage the impacts of coastal erosion and other environmental processes

Discussion

The intertidal exposures of the Broome Sandstone and associated Cretaceous and Holocene fossils occur within a highly dynamic intertidal environment (see Chapter 5.4.1). Dinosaur track sites may be exposed most of the time in the upper ITZ, alternatively exposed or buried under a metre of sand after storm tides, or only rarely visible at very lowest tides, if not obscured by shifting mud or sand and encrusting invertebrates. These are baseline conditions that affect the management of heritage values, but they are large-scale natural processes that are beyond human intervention.

Potential impacts from environmental processes that can be managed or avoided are those that result from human intervention on adjacent land or waters that may induce detrimental changes in the environment of the places with NHVs. Such impacts might range from marine services constructions (breakwaters, jetties, boat ramps or sea walls (see Chapter 5.5.6, Cable Beach Foreshore, for an example) that may alter the effects of tides and currents and patterns of sediment distribution on nearby track sites, to foreshore development work impacting cliff zones or foredunes that may alter erosion or sedimentation (see Chapter 6.3.4 below). Chapter 5 gives a description of the management framework opportunities for recognising and assessing such impacts. Recommended actions for incorporating these opportunities into existing management frameworks are listed above in Chapter 6.3.2.

Potential impacts include environmental pressures or hazards that may contribute to change or deterioration of the sites and their landscape setting.

Strategy

Recognise and manage natural environmental impacts

Actions

3.1. Increase awareness of environmental impact factors by educating conservation managers and the public.

3.2. Establish a baseline for ongoing monitoring of the condition of the fossilised tracks and trackways.

3.3. Implement a 'stays on Country' approach to fossils affected by natural processes to maintain geological and cultural context. (In line with the wishes of Traditional Custodians, this means that any fossils, including dinosaur tracks, whether they occur in situ or on loose boulders, are not removed from the landscape.)

3.4. Establish policies for mapping and monitoring new exposures revealed through sea-level rise, tidal processes and coastal erosion.

6.3.4 Objective to manage the impacts of the expansion of Broome and associated coastal development and infrastructure

Discussion

A key vulnerability of the Dinosaur Coast NHVs in the plan area is their close proximity to Broome, with its expanding urbanisation and infrastructure and growing population. Coastal development projects may involve direct threats to NHVs and other areas with relevant geological and palaeontological features, or indirect impacts through changing local environmental conditions (currents, sedimentation – Chapter 6.3.3) or allowing increased access to pedestrians or vehicles (car parks, boat ramps and vehicle access to beaches, see current examples in Chapter 5.5). Incorporation of NHVs into existing management frameworks around Broome is described in Chapter 5.3.

Broome's role as a tourism hub is vital to its economy and is concentrated on the dry season, resulting in a large seasonal variation in population. More people mean additional threats to the coastal dinosaur track sites from car, bus, quad bike, dirt bike, boat, jet ski and pedestrians. Because many of these activities involve the beaches and ITZ, increasingly there are conflicting values relating to recreation versus conservation. Activities occurring on public beaches and coastline inherently are more difficult to manage, with users often ignorant of, or indifferent to, the scientific and cultural values of these popular spaces. An increasing number of people using these spaces also exacerbates public safety issues around the locations of tracks and failure to redirect the public from unsafe locations such as Gantheaume Point to safer locations such as Entrance Point and Reddell Beach. Managing these problems also implies a need to increase resources. Proposed actions to address these issues are provided in Chapter 6.3.5.

The immediate proximity of coastal Broome Sandstone outcrops and dinosaur track sites to Broome also offers opportunities for tourism development and branding for Broome to enhance cultural, scientific and economic enterprises. Key opportunities for Broome and the local region are listed in Chapter 5.6 and proposed actions are in Chapter 6.3.6.

Strategy

Include NHV management in planning and development assessment processes for Broome

Actions

4.1. Incorporate triggers into development assessment and permit assessment processes (for example through links to the Data WA SLIP data sets) so determinations can include advice notes to proponents on their obligations under the EPBC Act.

4.2. Incorporate education on the Dinosaur Coast NHVs and EPBC Act obligations into an annual information session for SOB employees and DPLH state government officers and encourage them to recommend application of the precautionary principle when determining whether to refer the action to the federal minister.

4.3. Provide updated boundary and place description so the SOB Municipal Inventory of Heritage Places, Place No. 73 aligns with DCNHMP boundary when the next review occurs.

4.4. Provide links to the NHL database Item 106063 in the State Register of Heritage Places Local Heritage Place No. 26353, and DEMIRS Geosite No. 44.

4.5. Use the DCNHMP boundary on Data WA's SLIP as the spatial data for the State Register of Heritage Places Local Heritage Place No. 26353.

4.6. Reassess current geoheritage site boundaries for DEMIRS Geosite No. 44 in the context of the DCNHMP boundary and spatial data on Data WA's SLIP.

4.7. Assess the potential for Geoheritage Reserve (Class C reserve) status for the DEMIRS Geosite No. 44.

4.8. Update the spatial and scientific details for the State Heritage Listing nomination lodged in 2019.

6.3.5 Objective to manage increasing visitor interest in the tracks and an increasing number of visitors

Discussion

Considering Broome's position as the gateway to the Kimberley region, an increasing number of tourists and growing interest in visiting dinosaur track locations around Broome is a given. This trend puts more pressure on the fragile dinosaur track sites, with a corresponding need for improved management of visitor access, education and interpretation, and safety, as well as tourism business opportunities and conservation management needs such as site monitoring. Without education, visitors are more likely than local residents to cause harm to dinosaur track sites through recreational use of land and water vehicles and pedestrian use of the ITZ. With the growth of all forms of tourism, and the posting of GPS locations for rare and scientifically-important theropod track sites on shared media sites and tourism information apps like WikiCamps means a 'do nothing' approach will no longer work. There is also a pattern of increasing illegal camping and unsupervised tourism along the coast (e.g., number and length of stay of young and grey nomads near Broome and at remote sites). Relevant issues are listed above in Chapters 5.4.5 and 5.4.6.

For each dinosaur track location subject to visitor/tourism pressures, there has to be consideration of the capacity of the place to absorb the current and potential number of visitors without adverse effects, and of how to manage those visitors. In areas with visitor impact and/or safety issues and many visitors (Gantheaume Point for example), the main considerations may be how to adapt current access and interpretation arrangements to retain the heritage values, including diversion of visitors to alternative locations if appropriate.

Two strategies are proposed for addressing these issues, each of them a matter of finding a balance for managing competing priorities: visitor management that combines education and enforcement, and managing and enhancing access to national heritage sites and values while protecting sensitive areas from visitor impacts.

Strategy

Implement a muti-faceted approach to visitor management combining education and enforcement

Actions

5.1. Install visual cues at beach access points to inform the public they are entering the West Kimberley National Heritage Area.

5.2. Place interpretive signage at strategic locations with QR code links to the Dinosaur Coast Track Guide App.

5.3. Continue to patrol and enforce vehicle access controls at Cable Beach Foreshore, Cable Beach South and Entrance Point.

5.4. Include Dinosaur Coast NHV education in Yawuru ranger and Country manager training and induction and train NHV-specialised Yawuru ranger(s) to supervise inductions.

Strategy

Manage access while protecting the identified areas with geological and palaeontological features relevant to the National Heritage listing

Actions

5.5. Throughout the DCNHMP area continue to manage vehicle access to areas of NHV through education and appropriate traffic management.

5.6. Continue to develop policies and signage to direct vehicles away from NHVs at the Cable Beach Foreshore, Cable Beach South, Entrance Point and Roebuck Bay access points.

5.7. Continue to monitor public vehicle access to the Cable Beach Foreshore and Cable Beach South as resident and visitor population pressure increases.

5.8. Develop a ‘Dinosaur Track Etiquette’ that explains how events and wedding organisers can ensure the NHVs are protected and make it available through the DCMG website and future DCNHMP portal.

5.9. Provide information sheets to wedding and events vendors as part of the trading in public places permits system that explains the DCNHMP spatial data, where features are located and how to ensure there is no damage.

5.10. Use the DCNHMP spatial data to review booking policies for events, tourism and trading in public places.

5.11. Use the DCNHMP Data WA SLIP data sets to inform plans being prepared for development adjacent to the intertidal area, e.g., Town Beach, Reddell Beach, Entrance Point, Cable Beach, Gantheaume Point, Roebuck Bay.

5.12. Improve mechanisms to limit pedestrian access to unsafe and culturally sensitive areas such as Gantheaume Point.

5.13. Implement zone by zone actions informed by a future online monitoring program to adaptively manage and protect areas of relevance to the National Heritage listing, and aeras of cultural sensitivity and vulnerability.

5.14. Incorporate DCNHMP's spatial data sets on Data WA's SLIP into the Yawuru CMP and Yawuru parks management plans, programs and strategies.

[IMG] Figure 6.10 The presence of the Broome Sandstone Cretaceous ichnofossils on Broome's doorstep creates tourism and educational opportunities (Photo: Lily Chin)

[IMG] Figure 6.11 The presence of the Broome Sandstone Cretaceous ichnofossils on Broome's doorstep creates tourism and educational opportunities (Photo: Damian Kelly)

6.3.6 Objective to create opportunities for the Broome community

Discussion

The presence of the Broome Sandstone/Cretaceous fossils NHVs literally on Broome's doorstep creates opportunities for combining conservation management with economic and educational advancement (Chapter 5.6). Taking advantage of these opportunities is the purpose of branding Broome as the gateway to the Dinosaur Coast. The cooperative, coordinated presentation of these NHVs for tourism and education is the main focus of these economic opportunities, as well as a critical part of effective management and protection of those values and places.

The recommended actions to implement this objective include promoting the NHVs and the DCNHMP and their objectives to the local business community, and to develop suitable visitor and site management protocols and service-provider training and accreditation prior to tourist promotion. There is potential to add value to existing services and events such as tour itineraries that operate in the vicinity of visitor-capable track sites and in the scope of existing local festivals. Track site tourism would need to coincide with suitable dates and tides, with perhaps the opportunity for a triennial Dinosaur festival to coincide with extreme low tides. Conference fieldtrips and even hosting a major palaeontology conference may offer additional economic and promotional opportunities.

Strategy

Branding of Broome as the gateway to the Dinosaur Coast

Actions

6.1. Launch DCNHMP at a community event involving BCCI, Broome Visitor Centre (BVC), ANW, BBO, Environs Kimberley, BHS&M and other community groups.

6.2. In collaboration with ANW, BCCI and BBO recognise the need to establish visitor and site management strategies, accreditation systems and Yawuru ranger and Country manager training before tourism promotion.

6.3. In collaboration with ANW and BCCI support tourism operators to incorporate appropriately managed dinosaur track site tourism into itineraries.

6.4. In collaboration with ANW, BCCI and BVC promote dinosaur track site tourism as a date- and tide-dependant attraction along with the Flying Boat Wrecks and Staircase to the Moon.

6.5. In collaboration with ANW, BCCI and BVC enrich tourism experiences and itineraries with geodiversity and geotourism concepts.

6.6. Continue to incorporate the celebration of Broome's Dinosaur Coast into existing Broome festivals.

6.7. Develop a stand-alone triennial Dinosaur Festival timed to coincide with extreme tides.

6.8. Continue hosting conference field trips.

6.9. Host a national (or international) palaeontology conference in Broome to coincide with the extreme tides (outside peak tourism season).

[IMG] Figure 6.12 There is an opportunity to support tourism operators to incorporate appropriately managed track site tourism into itineraries

[IMG] Figure 6.13 The Jetty to Jetty Trail could provide a model for a Dinosaur Coast self-guided walking trail between Gantheaume Point and Entrance Point

6.3.7 Objective to improve the experience of visitors to the Dinosaur Coast

Discussion

Improving the offerings and quality of experiences to visitors involves the identification of those sites that may be safely accessible to visitors and subject to least impact from visitors. Suitable visitor information and site interpretation are related priorities, which should be applied to appropriate self-guided sites through the Dinosaur Coast Track Guide App and signage, and a coastal walking trail. For sites included in guided tours (e.g., recommended by the App), tourism operator education and certification would be an important support both for participating business operators and for site protection and management. There are opportunities at Gantheaume Point for upgrading the aging visitor interpretive presentation, and to combine visitor itineraries to the BBO and dinosaur track sites. A feasibility study should be conducted for World Heritage Listing of the Dinosaur Coast.

Strategy

Identify and promote which track locations will work safely for self-guided tracking and which need a recommendation to use guided tours

Actions

7.1. Upgrade the Dinosaur Coast Track Guide App so that it can be downloaded from standard App stores and provide accurate maps and reference points for suitable locations for DIY tourism.

7.2. Design a 'Point to Point' Dinosaur Coast self-guided or guided walking trail between Gantheaume Point and Entrance Point with marked access points to the beach, warnings of culturally sensitive areas, and a link to the Dinosaur Coast Track Guide App. (Model: Jetty to Jetty Trail.)

7.3. With ANW, BVC, TAFE and BCCI explore options and models for the delivery of a Dinosaur Coast tourism operator education and accreditation scheme. (Models: Cruise Tourism or Marine Tourism accreditation.)

7.4. With BBO develop combined National Heritage listing and Ramsar Site/BBO itineraries for Roebuck Bay.

7.5. Upgrade and simplify visitor interpretive information at Gantheaume Point and integrate it into the conservation park. Remove incorrect concrete dinosaur casts.

7.6. Undertake a feasibility study for World Heritage listing of the West Kimberley Dinosaur Coast.

6.4 Review of the DCNHMP

According to the NHL management plan guidelines, the management plan should be subject to review within five years (s324W of the EPBC Act), if the NHVs of the place change, or if major changes are proposed (DEWHA 2008: 12). This can be an opportunity to engage once again with the AICOMOS Burra Charter process, which can be viewed as an adaptive management cycle engaging local communities in all its steps (Figure 6.14).

[IMG] Figure 6.14 The Burra Charter as an adaptive management cycle (Source: Elisa Palazzo and Stephanie Johnston, adapted from the AICOMOS Burra Charter 2013)

7 Implementation of the DCNHMP

The NHL management plan guidelines state that 'The management plan should identify who will be responsible for implementing the conservation policies, a timeframe for the policy implementation, and the process involved' (DEWHA 2008: 12). Table 7.1 outlines the lead management agency and partners as well as the proposed implementation time frames over a period of ten years for each of the actions identified to address each objective and strategy listed in Chapter 6.2.

The DCNHMP sets out how the dinosaur tracks and ichnofossils in Broome are to be protected and managed. Some actions are unfunded or are not within current budgets. The DCNHMP implementation plan provides a strong basis for agencies and organisations to seek additional funding.

Table 7.1 DCNHMP implementation plan

Actions		Lead and partners	Timeframe
VISION: To understand, protect and promote the Dinosaur Coast and create opportunities for the Broome community			
Objective 1: To increase understanding and awareness of the Dinosaur Coast and its NHVs **Strategy:** Support education and facilitate research			
1.1	Enable access to Data WA's SLIP data sets for the DCNHMP into JM Partner GIS systems where capacity exists.	DBCA with DCMRG	2 years
1.2	Continue mapping tracks and trackways using multiple methodologies including ground and aerial laser scanning and remote sensing technology.	UQ with GMIC and Yawuru	Ongoing
1.3	Establish a regular UQ Dinosaur Lab research residency in Broome supported by corporate and citizen philanthropy (e.g., billeting of research residents by locals).	UQ with DCMRG	Ongoing
1.4	Develop a citizen science program to support the mapping, monitoring, interpretation and research programs.	DCMG with UQ	5 years
1.5	Develop a live, shared spatial database and online portal and monitoring system that can be updated with new information to adaptively manage identified features relevant to the National Heritage listing.	UQ with DBCA	5 years
1.6	Involve Yawuru rangers, Country managers and citizen scientists in monitoring changes in condition and changing impacts on ichnofossil sites using an online monitoring system as described in Action 1.5.	DBCA with DCMRG	2 years

Actions		Lead and partners	Timeframe
1.7	Develop key interpretive messages to guide signage and online interpretation of the NHVs.	DCMRG with JM Partners	5 years
1.8	Establish protocols to discourage the use of commemorative plaques or other methods of identifying or naming specific sites.	DCMRG with JM Partners	2 years
1.9	Develop a 'myth busters' section on the DCMG website and future DCNHMP online portal to address the circulation of false or inaccurate information.	DCMRG with DCMG	Ongoing
1.10	Establish and promote protocols for public and tourism operator behaviour and disseminate them through the DCMG website, tourism stakeholder websites, tourism apps and future DCNHMP online portal. (Models: DBCA's 'Code of Conduct' approach to turtle watching and BirdLife Australia's volunteer monitoring of public behaviour around Hooded Plover nesting sites.)	DCMG and DBCA with DCMRG	Ongoing
1.11	Continue strengthening community and education links to the dinosaur story and experience through school field excursions, guided museum tours and classroom experiences.	DCMG and DBCA with GMIC and Yawuru	Ongoing
1.12	Encourage further independent and institution-based specialist anthropological research and documentation as the next step towards appropriate recognition of the cultural values associated with these ichnofossils.	GMIC and Yawuru with DCMRG	5 years
1.13	SOB to investigate establishing an interpretative centre and palaeontology research facility.	SOB with DCMG with DCMRG	5 years
1.14	Continue to strengthen partnerships and facilitate educational opportunities with the BHS&M, through the Museum Masterplan.	DCMG and SOB with Yawuru and GMIC	Ongoing
Objective 2: To conserve and protect the NHVs of the Dinosaur Coast with best-practice adaptive management **Strategy:** Incorporate conservation and management policy for NHVs and areas with relevant geological and palaeontological features into existing management frameworks			
2.1	Maintain the current DCNHMP steering group as an ongoing DCMRG which meets on an annual basis to oversee adaptive implementation of the DCNHMP with DBCA as Chair.	DBCA with DCMRG	Ongoing

Actions		Lead and partners	Timeframe
2.2	Submit a nomination to the AHC for additional areas, derived from updated spatial data that accurately describes the ITZ of the Dinosaur Coast to be added to the West Kimberley National Heritage Place. Corresponding additional values may also be nominated. This nomination to occur with the free, prior and informed consent of Traditional Owners and Cultural Custodians.	DCMG, Yawuru and GMIC with UQ	5 years
2.3	Use DCNHMP spatial data sets on Data WA's SLIP to integrate palaeontological and geological heritage values management into the Yawuru CMP, Yawuru parks management plans and programs and relevant KPA management plans where appropriate.	JM Partners and KPA	5 years
2.4	Incorporate strategies and actions from the DCNHMP into the Yawuru CMP, Yawuru parks management plans and relevant KPA management plans where appropriate.	JM Partners and KPA	5 years
2.5	Incorporate education on the Dinosaur Coast NHVs and EPBC Act obligations into the induction of new KPA staff.	KPA with UQ and DCMG	5 years
2.6	Identify intersections between the DCNHMP and strategies for the protection of other values (e.g., biodiversity monitoring and protection, visitor access management and coastal development assessment).	DCMRG with DBCA	5 years
Objective 3: To monitor and manage the impacts of coastal erosion and other environmental processes **Strategy:** Recognise and manage natural environmental impacts			
3.1	Increase awareness of environmental impact factors by educating conservation managers and the public.	DCMG with UQ	Ongoing
3.2	Establish a baseline for ongoing monitoring of the condition of the fossilised tracks and trackways.	UQ and DBCA with DCMRG	2 years
3.3	Implement a 'stays on Country' approach to fossils affected by natural processes to maintain geological and cultural context (see Chapter 6.3.3 Action 3.3 for more detail).	UQ and DBCA with DCMRG	Ongoing
3.4	Establish policies for mapping and monitoring new exposures revealed through sea-level rise, tidal processes and coastal erosion.	UQ and DBCA with DCMRG	2 years

Actions		Lead and partners	Timeframe
Objective 4: To manage the impacts of the expansion of Broome and associated coastal development and infrastructure **Strategy:** Include NHV management in planning and development assessment processes for Broome			
4.1	Incorporate triggers into development assessment and permit assessment processes (for example through links to the Data WA SLIP data sets) so determinations can include advice notes to proponents on their obligations under the EPBC Act.	SOB and KPA	5 years
4.2	Incorporate education on the Dinosaur Coast NHVs and EPBC Act obligations into an annual information session for SOB employees and DPLH state government officers and encourage them to recommend application of the precautionary principle when determining whether to refer the action to the federal minister.	SOB and DCMG with DCMRG	Ongoing
4.3	Provide updated boundary and place description so the SOB Municipal Inventory of Heritage Places, Place No. 73 aligns with DCNHMP boundary when the next review occurs.	DCMG with SOB	5 years
4.4	Provide links to the NHL database Item 106063 in the State Register of Heritage Places Local Heritage Place No. 26353, and DEMIRS Geosite No. 44.	DCMG	5 years
4.5	Use the DCNHMP boundary on Data WA's SLIP as the spatial data for the State Register of Heritage Places Local Heritage Place No. 26353.	DCMG	2 years
4.6	Reassess current geoheritage site boundaries for DEMIRS Geosite No. 44 in the context of the DCNHMP boundary and spatial data on Data WA's SLIP.	DCMG	10 years
4.7	Assess the potential for Geoheritage Reserve (Class C reserve) status for the DEMIRS Geosite No. 44.	DCMG	10 years
4.8	Update the spatial and scientific details for the State Heritage Listing nomination lodged in 2019.	DCMG	2 years

Actions		Lead and partners	Timeframe
Objective 5: To manage increasing visitor interest in the tracks and an increasing number of visitors **Strategy:** Implement a multi-faceted approach to visitor management combining education and enforcement			
5.1	Install visual cues at beach access points to inform the public they are entering the West Kimberley National Heritage Area.	DCMRG with JM Partners	Ongoing
5.2	Place interpretive signage at strategic locations with QR code links to the Dinosaur Coast Track Guide App.	DCMG with JM Partners	Ongoing
5.3	Continue to patrol and enforce vehicle access controls at Cable Beach Foreshore, Cable Beach South and Entrance Point.	SOB	Ongoing
5.4	Include Dinosaur Coast NHV education in Yawuru ranger and Country manager training and induction and train NHV-specialised Yawuru ranger(s) to supervise inductions.	DBCA with JM Partners	2 years
Strategy: Manage access while protecting the identified areas with geological and palaeontological features relevant to the National Heritage listing			
5.5	Throughout the DCNHMP area continue to manage vehicle access to areas of NHV through education and appropriate traffic management.	SOB with DCMRG	Ongoing
5.6	Continue to develop policies and signage to direct vehicles away from NHVs at the Cable Beach Foreshore, Cable Beach South, Entrance Point and Roebuck Bay access points.	DCMRG	2 years
5.7	Continue to monitor public vehicle access to the Cable Beach Foreshore and Cable Beach South as resident and visitor population pressure increases.	SOB	Ongoing
5.8	Develop a 'Dinosaur Track Etiquette' that explains how events and wedding organisers can ensure the NHVs are protected and make it available through the DCMG website and future DCNHMP portal.	DCMG	5 years
5.9	Provide information sheets to wedding and events vendors as part of the trading in public places permits system that explains the DCNHMP spatial data, where features are located and how to ensure there is no damage.	SOB and KPA with DCMG	5 years

Actions		Lead and partners	Timeframe
5.10	Use the DCNHMP spatial data to review booking policies for events, tourism and trading in public places.	SOB and KPA with DCMG	Immediate
5.11	Use the DCNHMP Data WA SLIP data sets to inform plans being prepared for development adjacent to the intertidal area, e.g., Town Beach, Reddell Beach, Entrance Point, Cable Beach, Gantheaume Point, Roebuck Bay.	SOB, DBCA and KPA	Immediate
5.12	Improve mechanisms to limit pedestrian access to unsafe and culturally sensitive areas such as Gantheaume Point.	JM Partners with DCMRG	2 years
5.13	Implement zone by zone actions informed by a future online monitoring program to adaptively manage and protect areas of relevance to the National Heritage listing, and areas of cultural sensitivity and vulnerability.	DCMG and UQ with DCMRG	5 years
5.14	Incorporate DCNHMP's spatial data sets on Data WA's SLIP into the Yawuru CMP and Yawuru parks management plans, programs and strategies.	UQ with JM Partners	5 years
Objective 6: To create opportunities for the Broome community **Strategy:** Branding of Broome as the gateway to the Dinosaur Coast			
6.1	Launch the DCNHMP at a community event including BCCI, BVC, ANW, BBO, Environs Kimberley, BHS&M and other community groups.	DCMG with DCMRG	Immediate
6.2	In collaboration with ANW, BCCI and BBO recognise the need to establish visitor and site management strategies, accreditation systems and Yawuru ranger and Country manager training before tourism promotion.	DCMRG	5 years
6.3	In collaboration with ANW and BCCI support tourism operators to incorporate appropriately managed dinosaur track site tourism into itineraries.	DCMG	5 years
6.4	In collaboration with ANW, BCCI and BVC promote dinosaur track site tourism as a date- and tide-dependant attraction along with the Flying Boat Wrecks and Staircase to the Moon.	DCMG	Ongoing

Actions		Lead and partners	Timeframe
6.5	In collaboration with ANW, BCCI and BVC enrich tourism experiences and itineraries with geodiversity and geotourism concepts.	DCMG	Ongoing
6.6	Continue to incorporate the celebration of Broome's Dinosaur Coast into existing Broome festivals.	DCMG	Ongoing
6.7	Develop a stand-alone triennial Dinosaur Festival timed to coincide with extreme tides.	DCMG	10 years
6.8	Continue hosting conference field trips.	UQ with DCMG	Ongoing
6.9	Host a national (or international) palaeontology conference in Broome to coincide with the extreme tides (outside peak tourism season).	UQ with DCMG	10 years
Objective 7: Improve the experience of visitors to the Dinosaur Coast **Strategy:** Identify and promote which track locations will work safely for self-guided tracking and which need a recommendation to use guided tours			
7.1	Upgrade the Dinosaur Coast Track Guide App so that it can be downloaded from standard App stores and provide accurate maps and reference points for suitable locations for DIY tourism.	DCMG	2 years
7.2	Design a 'point to point' Dinosaur Coast self-guided or guided walking trail between Gantheaume Point and Entrance Point with marked access points to the beach, warnings of culturally sensitive areas, and a link to the Dinosaur Coast Track Guide App. (Model: Jetty to Jetty Trail.)	DCMRG with DCMG	5 years
7.3	With ANW, BVC, TAFE and BCCI explore options and models for the delivery of a Dinosaur Coast tourism operator education and accreditation scheme. (Models: Cruise Tourism or Marine Tourism accreditation.)	DCMG	10 years
7.4	With BBO develop combined National Heritage listing and Ramsar Site/BBO itineraries for Roebuck Bay.	DCMG	2 years
7.5	Upgrade and simplify visitor interpretive information at Gantheaume Point and integrate it into the conservation park. Remove incorrect concrete dinosaur casts.	JM Partners with DCMRG	2 years

Actions		Lead and partners	Timeframe
7.6	Undertake a feasibility study for World Heritage listing of the West Kimberley Dinosaur Coast.	DCMRG with DCMG	5 years

Acknowledgements

The DCMG thanks the Australian Government for the Australian Heritage Grants that have supported us so we could prepare and complete this DCNHMP. Thanks also to the Heritage Branch officers of the DCCEEW who have advised us throughout the years.

The DCMG prepared this plan so that all the land managers, landowners and Custodians have a shared vision and commitment to protect the National Heritage-listed Broome Sandstone and ichnofossils and to ensure future generations can 'walk with dinosaurs' on some of Australia's most magnificent beaches.

We would like to thank the community members, volunteers and others who have laid the foundation for this management plan and in recent years helped us sometimes at unusual hours and under harsh conditions.

Prior to the establishment of the DCMG in 2015, a group of people had dedicated many years to working alongside the Goolarabooloo Custodians, locating and recording dinosaur tracks along the coastline of the Dampier Peninsula. Among these individuals were Paul Foulkes (deceased) and Louise Middleton who began their work in 1986, Prof. John Long in 1989, and Tony Thulborn from 1991 to 2012. These dedicated individuals worked closely with Paddy Roe OAM (deceased) from 1940 until 2000, Joseph Roe (deceased) from the 1990s until 2014, and Richard Hunter and Phillip Roe up to the present day. In 2011, Louise Middleton, Nik Wevers and Joseph Roe, in collaboration with Assoc. Prof. Steven Salisbury from UQ, played a key role in having the dinosaur trackways and ichnofossils included in the West Kimberley National Heritage Place.

Between 2014 and 2015, a diverse group of people, working with Nigel Clarke and Louise Middleton, formed the DCMG and established it as an Incorporated Association and Registered Charity. These people included (in alphabetical order) Dianne Bennett, Kandy Curran, Dave Dureau (deceased), Elsta Foy, Brian Kane, Damian Kelly, Pat Lowe, Rani Middleton (deceased), Bart Pigram, Anne Poelina, Jeff Skinner, Kevin Smith (deceased), Michelle Teoh, Shayne Thomson and Robyn Wells. The DCMG was to be the local voice, using the scientific knowledge of the research team from UQ Dinosaur Lab and Flinders University, to protect and promote the dinosaur tracks of the Dampier Peninsula and educate the community about their scientific and cultural importance (DCMG Mission Statement).

The DCMG committee members are also to be thanked. They have contributed their time and expertise to the organisation over many years. Chairpersons Louise Middleton (2016) and Micklo Corpus (deceased) (2016–2022); Treasurers Kevin Smith (deceased) (2016), Jon Hall (2016–2020), Leong Teoh (2020–2022, 2023–2025) and Francesca Guzzetta (2022–2023); and Secretaries Jan Lewis (2016) and Michelle Teoh (2016–2025). Also the hardworking committee members (in alphabetical order) Dianne Bennett, Lily Chin, John Curran, Troy Marinko, Diana Oliver, Ian Perdrisat, Anne Poelina, Nadia Rebasti, Neil Turner and Nik Wevers.

We would also like to express our heartfelt gratitude to the individuals from the wider 'dinosaur family' who have supported and worked with the DCMG over the years:

Dianne Bennett, thank you for your tireless efforts in documenting tracks and ichnofossils throughout the management plan area. These data have contributed to the paleontological information contained in Maps 3.1–3.21. We also acknowledge that you regularly assist Assoc. Prof. Steven Salisbury when he undertakes research work in Broome.

Pat Lowe, as the DCMG editor since the organisation's inception, you have ensured our messages are clear and effective for the intended audience. Your attention to detail, and understanding of language conventions, grammar rules and style preferences is greatly appreciated.

Damian Kelly, your ability to produce images that 'speak' and your enthusiasm for the dinosaur tracks have been an invaluable contribution to the management plan. We thank you for your unwavering support.

Franky O'Connor, Sherona Biddlecombe and Xavier Dhalluin of the Broome Community Resource Centre, thank you for being the unofficial DCMG 'office'. Without access to such a one-stop shop for printing, meetings and specialist administration assistance, the management plan would have been that much harder to complete.

Scott Sansoni of Sanz Web Development, we appreciate your graphic design and publishing expertise, which allowed us to complete this work. Sincere and heartfelt thanks.

In 2020, Micklo Corpus, Michelle Teoh and Wade Freeman, with letters of support from Yawuru RNTBC, SOB, DBCA and KPA, applied for an Australian Heritage Grant. Unbeknown to all, this was the start of a five-year journey that included a second successful grant application in 2023.

Throughout the five years a Steering Group made up of representatives of DBCA, GMIC, KPA, SOB, UQ and Yawuru RNTBC have discussed, debated and worked with the DCMG and our consultants to deliver this plan.

Stephanie Johnston & Associates, Neale Draper & Associates and Andrew Maland GIS were the South Australian consultants appointed to prepare the management plan. It was not easy, with COVID interruptions, shifting timelines and many extensions. I thank them for their hard work and their patience. Thanks also to Mark Thomas for the graphics and Paul Wallace for the editing of the September 2022 draft management plan.

UQ Dinosaur Lab provided the crucial geological and palaeontological data that became the basis for Chapters 2 and 3 and Maps 3.2–3.21. Assoc. Prof. Steven Salisbury also worked with GMIC on cultural heritage advice related to the Northern Tradition of the Song Cycle and collaborated with Neale Draper and GMIC on relevant sections of Chapter 4.

GMIC and their Bosses have had a close working relationship with UQ Dinosaur Lab since 2011 and with DCMG since 2015. Their input has been invaluable and their ongoing support is greatly appreciated. They have provided public cultural heritage information related to the Northern Tradition of the Song Cycle and collaborated with Neale Draper on sections of Chapter 4. Errol Roe and Daniel Roe, GMIC General Manager, attended numerous meetings and contributed to various drafts of the management plan.

Yawuru's support of our grant applications and involvement in the development of the management plan is greatly valued and appreciated. Yawuru representatives also collaborated with Neale Draper on the Yawuru cultural heritage content in Chapter 4. In the past, members of the Yawuru Community have also worked with UQ Dinosaur Lab and DCMG to document dinosaur tracks throughout the area.

Officers from the Broome office of DBCA have been active participants in Steering Group meetings and one-on-one working sessions, providing valuable advice and input. They have also made sure DCMG is able to contribute to projects that are being planned in the Conservation Estate. Such projects, while abutting the ITZ, need to be carefully considered, designed and constructed so that the NHVs of the Broome Sandstone and ichnofossils are protected.

DCMG has also sought to work collaboratively with SOB officers throughout the project. There have been numerous meetings that focused on the potential implications for Shire operations and the details of projects the Shire is planning adjacent to and within the ITZ. The feedback and in-depth review of the management plan provided by the officers has been appreciated.

KPA representatives have actively participated in multiple meetings and provided valuable input throughout the management plan development process. Their support and willingness to work cooperatively is greatly valued.

Wade Freeman and Ryan Crawford are to be commended for their contribution to the delivery of this management plan. Wade co-wrote the grant application in 2020 and from May to June 2021 took on the role of project manager. Ryan provided valued guidance as a Cultural Advisor from 2021 to 2022.

Sarah Taylor-Fuller played a crucial role as project manager from August 2021 to February 2023. She kept us on schedule and resolved issues. She facilitated discussions and meetings between the consultants, the steering group members and community groups. Sarah was also instrumental in creating community consultation brochures that summarised the management plan, zones and implementation plan. Her geological expertise was a bonus, as she worked alongside Assoc. Prof. Steven Salisbury and Ms Brooke Holland on geological mapping. As DCMG's representative she also provided advice to a number of development projects that could affect the NHVs of the Broome Sandstone and ichnofossils.

This has been a long journey and has tested the resilience of the DCMG. We are a small not-for-profit group reliant on volunteers and many people have helped us over many years. If we have inadvertently missed anyone, we offer our apologies, but also our sincere thanks. We are sincerely grateful for your support and your contribution to this first Dinosaur Coast National Heritage Management Plan.

Ketrina Keeley
Committee Member 2019–22
Chairperson 2022–2025

Glossary

Early Cretaceous: Term used for events that occurred *during* the time that the rocks were deposited or when the tracks were made by living dinosaurs.

Ichnofossil: A fossil record of biological presence or activity, but not the preserved remains of the plant or animal itself.

Ichnology: The study of fossilised tracks, trails, burrows, borings, or other trace fossils as evidence of the occurrence or behaviour of the organisms that produced them.

Lower Cretaceous: Term used for the geological era when referring to existing rocks and the fossils within them.

Natural cast (in reference to trace fossils): Mineral matter (rock) that has filled a natural mould made by organic activity. Natural casts of dinosaur tracks typically have positive relief, whereas the track itself, being a mould of the activity of the foot/hand of the dinosaur, has negative relief.

Natural mould (in reference to trace fossils): Impression (trace) of organic activity (in most instances herein, the feet and hands of non-avian dinosaurs) preserved in mineral matter (rock).

Stakeholder: Individual or group that has an interest in any decision or activity of an organisation, project or process.

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Abbreviations

ACH Act: *Aboriginal Cultural Heritage Act 2021* (WA)

AH Act: *Aboriginal Heritage Act 1972* (WA)

AHC: Australian Heritage Council (formerly Australian Heritage Commission)

AHD: Australian Heritage Database

ACHIS: Aboriginal Cultural Heritage Inquiry System (WA)

ANHAT: Australian National Heritage Assessment Tool

AICOMOS: Australia International Council on Monuments and Sites

ANW: Australia's North West Tourism

AMB: Australian Maritime Boundary

AUCHD: Australasian Underwater Cultural Heritage Database

BBO: Broome Bird Observatory

BCCI: Broome Chamber of Commerce and Industry

BHS&M: Broome Historical Society and Museum

BVC: Broome Visitor Centre

CAMBA: China Australia Migratory Bird Agreement

CMP: (Yawuru RNTBC) Cultural Management Plan

CV Act: *Control of Vehicles (Off-road Areas) Act 1978* (WA)

DAWE: (former) Department of Agriculture, Water and Environment (Cth)

DBCA: Department of Biodiversity, Conservation and Attractions (WA)

DCCEEW: Department of Climate Change, Energy, the Environment and Water (Cth)

DCMG: Dinosaur Coast Management Group Inc.

DCMRG: Dinosaur Coast Management Reference Group

DCNHMP: Dinosaur Coast National Heritage Management Plan

DEC: (former) Department of Environment and Conservation

DEMIRS: Department of Energy, Mines, Industry Regulation and Safety (WA)

DEWHA: (former) Department of Environment, Water, Heritage and the Arts (Cth)

DMIRS: (former) Department of Mines, Industry Regulation and Safety (WA)

DOT: Department of Transport (WA)

DPLH: Department of Planning, Lands and Heritage (WA)

DPW: (former) Department of Parks and Wildlife (WA)

EPA: Environmental Protection Authority (WA)

EP Act: *Environmental Protection Act 1986* (WA)

EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999* (Cth)

GBCP JMP: Guniyan Binba Conservation Park Joint Management Plan

GIS: geographic information system

GMIC: Goolarabooloo Millibinyarri Indigenous Corporation

HAT: Highest Astronomical Tide

HCWA: Heritage Council of Western Australia

HWM: High Water Mark

ICOMOS: International Council on Monuments and Sites

IMCRA: (former) Interim Marine and Coastal Regionalisation of Australia

ILUA: Indigenous Land Use Agreement

ITZ: Intertidal Zone

JAMBA: Japan Australia Migratory Bird Agreement

JM Partner: Joint Management Partner

JMP: Joint Management Plan

KMSB: Kimberley Marine Support Base

KPA: Kimberley Ports Authority

LAT: Lowest Astronomical Tide

LNG: Liquefied Natural Gas

LWM: Low Water Mark

NBY: Nyamba Buru Yawuru

NHL: National Heritage List

NHV: National Heritage value

Ramsar Convention: Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat

ROKAMBA: Republic of Korea Australia Migratory Bird Agreement

SLIP: Shared Location Information Platform

SOB: Shire of Broome

TAFE: Technical and Further Education (WA)

UCH Act: *Underwater Cultural Heritage Act 2018* (Cth)

UNESCO: United Nations Educational, Scientific and Cultural Organisation

UQ: The University of Queensland

UQ Dinosaur Lab: School of the Environment (formerly the School of Biological Sciences), The University of Queensland

WA: Western Australia

Yawuru/Yawuru RNTBC: Yawuru Registered Native Title Holders Body Corporate (often referred to as the Yawuru PBC)

YMBCP: Yawuru Minyirr Buru Conservation Park

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Appendix A: Commonwealth of Australia Gazette Notice for the West Kimberley

Commonwealth of Australia Gazette

No. S132, Wednesday, 31 August 2011
Published by the Commonwealth of Australia

SPECIAL

Environment Protection and Biodiversity Conservation Act 1999

INCLUSION OF A PLACE IN THE NATIONAL HERITAGE LIST

The West Kimberley

I, Tony Burke, Minister for Sustainability, Environment, Water, Population and Communities having considered, in relation to the place specified in the Schedule of this instrument:

(a) the Australian Heritage Council's assessment whether the place meets any of the National Heritage criteria; and

(b) the comments given to the Council under sections 324JG and 324JH of the *Environment Protection and Biodiversity Conservation Act 1999*; and

being satisfied that the place described in the Schedule has the National Heritage values specified in the Schedule, pursuant to section 324JJ of the *Environment Protection and Biodiversity Conservation Act 1999*, include the place and its National Heritage values in the National Heritage List.

Dated *31 August 2011*

[signed by]

Tony Burke
Minister for Sustainability, Environment, Water,
Population and Communities

Cat. No. S13211
ISSN 1032-2345

SCHEDULE

STATE / TERRITORY
Local Governments
Name
Location / Boundary
Criteria / Values

WESTERN AUSTRALIA

Broome Shire; Derby - West Kimberley Shire; Halls Creek Shire; Wyndham - East Kimberley Shire

The West Kimberley:

About 19,200,000ha, West Kimberley, comprising the following areas:

1. An area bounded by a line commencing at the intersection of Latitude 16.778S and the line 3 nautical miles seaward of the territorial sea baseline (approximate coordinate point 16.778S 122.509N), then north easterly via the 3 nautical mile limit line to its intersection with Longitude 126.078E (approximate coordinate point 13.700S 126.078N), then directly to the intersection of the 3 nautical mile limit line with Longitude 126.183E (approximate coordinate point 13.689S 126.183N), then easterly via the 3 nautical mile limit line to its intersection with Longitude 128.251E (approximate coordinates 14.614S 128.251N), then directly to coordinate point 14.715S 128.251E, then directly to the northern tip of Cape Dussejour (approximate coordinates 14.740S 128.225N), then southerly via the coastline of Cambridge Gulf and West Arm to its intersection with Latitude 15.487S (approximate coordinates 15.487S 128.038N), then via straight lines joining the following geographic coordinate points consecutively: 15.526S 128.061E, 15.569S 128.106E, 15.603S 128.152E, 15.877S 128.251E, 16.016S 128.251E, 16.016S 128.211E, 16.090S 128.211E, 16.090S 128.210E, 16.183S 128.210E, 16.183S 128.089E, 16.181S 127.909E, 16.497S 127.798E, 16.497S 127.768E, 16.550S 127.754E, 16.596S 127.734E, 16.708S 127.663E, 16.891S 127.535E, 17.047S 127.411E, 17.143S 127.343E, 17.236S 127.298E, 17.386S 127.233E, 17.444S 127.205E, 17.456S 127.194E, 17.467S 127.188E, 17.495S 127.154E, 17.494S 127.143E, 17.494S 127.136E, 17.498S 127.130E, 17.509S 127.120E, 17.526S 127.093E, 17.537S 127.064E, 17.557S 127.009E, 17.571S 126.959E, 17.578S 126.917E, 17.587S 126.887E, 17.604S 126.843E, 17.621S 126.808E, 17.640S 126.765E, 17.649S 126.748E, 17.649S 126.748E, 17.658S 126.733E, 17.677S 126.699E, 17.710S 126.654E, 17.734S 126.626E, 17.770S 126.593E, 17.787S 126.583E, 17.804S 126.574E, 17.833S 126.563E, 17.855S 126.560E, 17.871S 126.561E, 17.884S 126.562E, 17.940S 126.562E, 17.984S 126.565E, 17.978S 126.581E, 17.975S 126.596E, 17.967S 126.609E, 17.961S 126.621E, 17.954S 126.645E, 17.950S 126.668E, 17.950S 126.722E, 17.946S 126.732E, 17.938S 126.742E, 17.929S 126.756E, 17.944S 126.766E, 17.957S 126.768E, 17.964S 126.766E, 17.981S 126.771E, 17.982S 126.751E, 17.992S 126.745E, 18.005S 126.744E, 18.005S 126.700E, 18.003S 126.668E, 18.008S 126.650E, 18.024S 126.614E, 18.024S 126.608E, 18.029S 126.590E, 18.026S 126.565E, 18.023S 126.515E, 18.018S 126.482E, 18.033S 126.463E, 18.035S 126.457E, 18.036S 126.444E, 18.068S 126.439E, 18.182S 126.432E, 18.205S 126.438E, 18.217S 126.450E, 18.224S 126.465E, 18.232S 126.479E, 18.237S 126.484E, 18.247S 126.479E, 18.250S 126.473E, 18.255S 126.469E, 18.256S 126.466E, 18.266S 126.436E, 18.275S 126.427E, 18.326S 126.425E, 18.358S 126.428E, 18.379S 126.439E, 18.387S 126.457E, 18.374S 126.463E, 18.386S 126.484E, 18.403S 126.488E, 18.411S 126.500E, 18.411S 126.504E, 18.404S 126.508E, 18.393S 126.507E, 18.383S 126.545E, 18.382S 126.554E, 18.395S 126.581E, 18.394S 126.599E, 18.388S 126.612E, 18.379S 126.623E, 18.420S 126.702E, 18.422S 126.701E, 18.422S 126.700E, 18.427S 126.687E, 18.437S 126.676E, 18.447S 126.667E, 18.459S 126.658E, 18.465S 126.628E, 18.471S 126.592E, 18.475S 126.559E, 18.477S 126.541E, 18.481S 126.515E, 18.487S 126.495E, 18.488S 126.493E, 18.490S 126.478E, 18.489S 126.471E, 18.499S 126.417E, 18.498S 126.378E, 18.493S 126.340E, 18.554S 126.302E, 18.594S 126.261E, 18.597S 126.278E, 18.597S 126.287E, 18.598S 126.293E, 18.597S 126.312E, 18.624S 126.373E, 18.650S 126.396E, 18.678S 126.426E, 18.695S 126.437E, 18.701S 126.442E, 18.704S 126.442E, 18.717S 126.448E, 18.719S 126.444E, 18.723S 126.444E, 18.735S 126.408E, 18.733S 126.393E, 18.732S 126.386E, 18.728S 126.366E, 18.723S 126.332E, 18.721S 126.313E, 18.722S 126.305E, 18.718S 126.284E, 18.715S 126.250E, 18.707S 126.212E, 18.707S 126.190E, 18.710S 126.172E, 18.712S 126.169E, 18.730S 126.145E, 18.728S 126.123E, 18.744S 126.104E, 18.750S 126.100E, 18.761S 126.087E, 18.777S 126.074E, 18.779S 126.071E, 18.720S 125.963E, 18.713S 125.953E, 18.666S

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124.224E, 18.402S 124.219E, 18.399S 124.220E, 18.398S 124.220E, 18.394S 124.216E, 18.390S 124.215E, 18.386S 124.215E, 18.385S 124.212E, 18.382S 124.210E, 18.380S 124.208E, 18.375S 124.207E, 18.369S 124.202E, 18.362S 124.202E, 18.359S 124.199E, 18.358S 124.195E, 18.358S 124.191E, 18.354S 124.188E, 18.351S 124.187E, 18.350S 124.185E, 18.350S 124.177E, 18.350S 124.173E, 18.348S 124.170E, 18.345S 124.167E, 18.343S 124.161E, 18.343S 124.158E, 18.342S 124.154E, 18.338S 124.150E, 18.332S 124.145E, 18.327S 124.144E, 18.326S 124.141E, 18.320S 124.129E, 18.316S 124.124E, 18.312S 124.122E, 18.307S 124.116E, 18.298S 124.112E, 18.293S 124.112E, 18.290S 124.111E, 18.285S 124.109E, 18.279S 124.109E, 18.274S 124.111E, 18.270S 124.111E, 18.268S 124.109E, 18.265S 124.106E, 18.259S 124.105E, 18.256S 124.103E, 18.253S 124.097E, 18.253S 124.094E, 18.246S 124.088E, 18.242S 124.087E, 18.236S 124.085E, 18.228S 124.082E, 18.218S 124.076E, 18.211S 124.074E, 18.204S 124.071E, 18.200S 124.072E, 18.194S 124.073E, 18.191S 124.073E, 18.188S 124.077E, 18.181S 124.076E, 18.174S 124.074E, 18.165S 124.065E, 18.157S 124.061E, 18.151S 124.055E, 18.145S 124.038E, 18.145S 124.010E, 18.140S 123.989E, 18.134S 123.953E, 18.120S 123.933E, 18.103S 123.907E, 18.108S 123.903E, 18.120S 123.902E, 18.134S 123.907E, 18.141S 123.901E, 18.146S 123.889E, 18.155S 123.877E, 18.170S 123.867E, 18.182S 123.846E, 18.195S 123.828E, 18.201S 123.820E, 18.203S 123.810E, 18.211S 123.790E, 18.224S 123.775E, 18.232S 123.764E, 18.235S 123.754E, 18.242S 123.749E, 18.257S 123.750E, 18.274S 123.755E, 18.288S 123.756E, 18.300S 123.765E, 18.308S 123.764E, 18.318S 123.760E, 18.330S 123.754E, 18.345S 123.753E, 18.359S 123.756E, 18.380S 123.761E, 18.391S 123.761E, 18.407S 123.756E, 18.427S 123.756E, 18.451S 123.762E, 18.464S 123.770E, 18.479S 123.788E, 18.493S 123.804E, 18.502S 123.810E, 18.504S 123.804E, 18.495S 123.794E, 18.492S 123.781E, 18.494S 123.764E, 18.501S 123.753E, 18.518S 123.747E, 18.517S 123.695E, 18.502S 123.713E, 18.488S 123.721E, 18.472S 123.728E, 18.458S 123.727E, 18.453S 123.720E, 18.460S 123.705E, 18.461S 123.692E, 18.451S 123.692E, 18.446S 123.699E, 18.432S 123.703E, 18.419S 123.709E, 18.401S 123.715E, 18.385S 123.719E, 18.372S 123.719E, 18.356S 123.714E, 18.342S 123.712E, 18.328S 123.715E, 18.313S 123.719E, 18.300S 123.722E, 18.287S 123.722E, 18.275S 123.729E, 18.262S 123.732E, 18.245S 123.728E, 18.230S 123.732E, 18.214S 123.740E, 18.203S 123.753E, 18.198S 123.774E, 18.193S 123.793E, 18.191S 123.808E, 18.178S 123.818E, 18.166S 123.835E, 18.154S 123.853E, 18.148S 123.865E, 18.135S 123.870E, 18.126S 123.881E, 18.121S 123.887E, 18.109S 123.885E, 18.098S 123.874E, 18.089S 123.870E, 18.076S 123.871E, 18.071S 123.864E, 18.056S 123.835E, 18.041S 123.811E, 18.020S 123.798E, 18.002S 123.790E, 17.982S 123.779E, 17.969S 123.763E, 17.944S 123.739E, 17.899S 123.705E, 17.883S 123.688E, 17.882S 123.662E, 17.877S 123.649E, 17.863S 123.642E, 17.851S 123.630E, 17.826S 123.619E, 17.806S 123.610E, 17.789S 123.598E, 17.766S 123.574E, 17.756S 123.565E, 17.743S 123.562E, 17.725S 123.560E, 17.710S 123.553E, 17.698S 123.557E, 17.679S 123.563E, 17.655S 123.563E, 17.629S 123.564E, 17.589S 123.556E, 17.541S 123.541E, 17.497S 123.543E, then directly to the intersection of the western shoreline of King Sound with Latitude 17.482S (approximate coordinate point 17.482S 123.545E), then north westerly via the western shoreline of King Sound to its intersection with Longitude 123.103E (approximate coordinate point 16.764S 123.103E), then via straight lines joining the following geographic coordinate points consecutively: 16.761S 123.092E, 16.733S 123.024E, 16.712S 122.982E, 16.666S 122.915E, 16.715S 122.913E, 16.769S 122.899E, 16.814S 122.854E, 16.850S 122.782E, 16.862S 122.707E, 16.856S 122.638E, 16.830S 122.572E, then north westerly to the intersection of Longitude 122.569E with the Highest Astronomical Tide mark (approximate coordinate point 16.829S 122.569E), then southerly via the Highest Astronomical Tide mark to its intersection with Latitude 18.005S (approximate coordinate point 18.005S 122.205E), then south westerly directly to the intersection of Latitude 18.006S with the Lowest Astronomical Tide mark (approximate coordinate point 18.006S 122.204E), then northerly via the Lowest Astronomical Tide mark to its intersection with Latitude 16.813S (approximate coordinate point 16.813S 122.547E), then directly to coordinate point 16.800S 122.531E, then directly to the point of commencement.
Excluded from the above is an area bounded by a line commencing at coordinate point 17.435S 123.581E, then via straight lines joining the following coordinate points consecutively: 17.428S 123.617E, 17.442S 123.654E, 17.455S 123.664E, 17.482S 123.671E, 17.500S 123.673E, 17.508S 123.665E, 17.508S 123.653E, 17.523S 123.651E, 17.534S 123.644E, 17.556S 123.641E, 17.575S 123.652E, 17.589S 123.654E, 17.603S 123.648E, 17.624S 123.649E, 17.645S 123.645E, 17.623S 123.636E, 17.608S 123.628E, 17.583S 123.628E, 17.578S 123.621E, 17.587S 123.611E, 17.603S 123.602E, 17.624S 123.599E, 17.639S 123.606E, 17.655S 123.612E, 17.664S 123.608E, 17.679S 123.609E, 17.689S 123.609E, 17.696S 123.617E, 17.691S 123.624E, 17.687S 123.634E, 17.694S 123.644E, 17.709S 123.649E, 17.740S 123.657E, 17.763S 123.672E, 17.785S 123.690E, 17.804S 123.708E, 17.820S 123.735E, 17.830S 123.744E, 17.840S 123.742E, 17.856S 123.742E, 17.865S 123.751E, 17.904S 123.780E, 17.919S 123.788E, 17.929S 123.793E, 17.945S 123.813E, 17.971S 123.833E, 17.994S 123.848E, 18.003S 123.860E, 18.012S 123.877E, 18.032S 123.900E, 18.042S 123.914E, 18.043S 123.938E, 18.049S 123.954E, 18.052S 123.970E, 18.067S 123.981E, 18.083S 123.989E, 18.101S 124.005E, 18.107S 124.025E, 18.107S 124.041E, 18.108S 124.059E, 18.100S 124.083E,

18.092S 124.115E, 18.082S 124.142E, 18.073S 124.160E, 18.061S 124.170E, 18.047S 124.176E, 18.040S 124.192E, 18.024S 124.199E, 18.008S 124.202E, 17.997S 124.195E, 17.993S 124.201E, 17.988S 124.198E, 17.982S 124.198E, 17.972S 124.217E, 17.961S 124.233E, 17.961S 124.257E, 17.954S 124.272E, 17.943S 124.294E, 17.938S 124.325E, 17.931S 124.347E, 17.918S 124.353E, 17.914S 124.368E, 17.903S 124.377E, 17.903S 124.400E, 17.906S 124.430E, 17.921S 124.447E, 17.929S 124.453E, 17.936S 124.454E, 17.947S 124.444E, 17.953S 124.435E, 17.951S 124.428E, 17.962S 124.420E, 17.976S 124.411E, 17.990S 124.402E, 17.996S 124.392E, 18.009S 124.384E, 18.025S 124.372E, 18.035S 124.362E, 18.040S 124.363E, 18.042S 124.367E, 18.040S 124.383E, 18.051S 124.385E, 18.065S 124.380E, 18.072S 124.374E, 18.083S 124.387E, 18.090S 124.406E, 18.095S 124.428E, 18.101S 124.434E, 18.111S 124.437E, 18.114S 124.448E, 18.112S 124.457E, 18.106S 124.467E, 18.104S 124.483E, 18.106S 124.496E, 18.118S 124.506E, 18.121S 124.494E, 18.120S 124.484E, 18.124S 124.478E, 18.126S 124.469E, 18.128S 124.470E, 18.151S 124.479E, 18.166S 124.483E, 18.184S 124.495E, 18.196S 124.498E, 18.210S 124.499E, 18.217S 124.510E, 18.229S 124.517E, 18.262S 124.534E, 18.271S 124.545E, 18.282S 124.554E, 18.284S 124.554E, 18.280S 124.571E, 18.284S 124.577E, 18.290S 124.577E, 18.294S 124.581E, 18.296S 124.571E, 18.295S 124.565E, 18.291S 124.557E, 18.298S 124.560E, 18.323S 124.560E, 18.342S 124.556E, 18.372S 124.572E, 18.395S 124.600E, 18.406S 124.613E, 18.405S 124.620E, 18.407S 124.634E, 18.417S 124.653E, 18.426S 124.658E, 18.426S 124.671E, 18.420S 124.684E, 18.423S 124.692E, 18.433S 124.686E, 18.438S 124.707E, 18.435S 124.721E, 18.428S 124.717E, 18.419S 124.717E, 18.416S 124.736E, 18.416S 124.747E, 18.407S 124.755E, 18.408S 124.769E, 18.409S 124.785E, 18.416S 124.794E, 18.421S 124.789E, 18.423S 124.760E, 18.425S 124.761E, 18.434S 124.753E, 18.442S 124.762E, 18.445S 124.795E, 18.445S 124.814E, 18.451S 124.810E, 18.461S 124.801E, 18.462S 124.782E, 18.476S 124.783E, 18.477S 124.797E, 18.486S 124.800E, 18.482S 124.809E, 18.481S 124.818E, 18.497S 124.821E, 18.504S 124.833E, 18.503S 124.868E, 18.430S 124.867E, 18.430S 124.908E, 18.424S 124.909E, 18.419S 124.935E, 18.417S 124.949E, 18.421S 124.965E, 18.414S 124.968E, 18.409S 124.977E, 18.403S 124.977E, 18.398S 124.985E, 18.404S 124.997E, 18.402S 125.006E, 18.413S 125.022E, 18.418S 125.040E, 18.418S 125.045E, 18.429S 125.054E, 18.435S 125.067E, 18.429S 125.077E, 18.429S 125.092E, 18.435S 125.100E, 18.435S 125.111E, 18.427S 125.119E, 18.418S 125.140E, 18.421S 125.149E, 18.413S 125.156E, 18.397S 125.182E, 18.385S 125.185E, 18.375S 125.194E, 18.369S 125.207E, 18.374S 125.220E, 18.383S 125.227E, 18.376S 125.228E, 18.363S 125.237E, 18.360S 125.250E, 18.348S 125.257E, 18.340S 125.272E, 18.332S 125.277E, 18.325S 125.288E, 18.328S 125.299E, 18.338S 125.296E, 18.345S 125.295E, 18.343S 125.315E, 18.336S 125.335E, 18.329S 125.387E, 18.326S 125.422E, 18.319S 125.455E, 18.296S 125.488E, 18.287S 125.519E, 18.287S 125.519E, 18.282S 125.525E, 18.272S 125.523E, 18.263S 125.526E, 18.271S 125.540E, 18.262S 125.544E, 18.253S 125.541E, 18.237S 125.543E, 18.232S 125.544E, 18.226S 125.547E, 18.224S 125.548E, 18.222S 125.549E, 18.220S 125.549E, 18.218S 125.549E, 18.217S 125.551E, 18.216S 125.562E, 18.220S 125.562E, 18.220S 125.579E, 18.217S 125.583E, 18.215S 125.584E, 18.212S 125.583E, 18.208S 125.587E, 18.200S 125.587E, 18.196S 125.590E, 18.194S 125.590E, 18.191S 125.590E, 18.189S 125.592E, 18.183S 125.597E, 18.182S 125.600E, 18.178S 125.602E, 18.176S 125.601E, 18.174S 125.601E, 18.173S 125.598E, 18.172S 125.595E, 18.165S 125.574E, 18.163S 125.574E, 18.163S 125.562E, 18.163S 125.544E, 18.163S 125.535E, 18.158S 125.529E, 18.145S 125.521E, 18.108S 125.502E, 18.097S 125.496E, 18.094S 125.493E, 18.088S 125.491E, 18.077S 125.485E, 18.077S 125.485E, 18.052S 125.469E, 18.046S 125.465E, 18.034S 125.435E, 18.026S 125.434E, 18.001S 125.420E, 17.988S 125.401E, 17.988S 125.401E, 17.974S 125.380E, 17.939S 125.323E, 17.939S 125.322E, 17.925S 125.299E, 17.916S 125.287E, 17.900S 125.263E, 17.898S 125.259E, 17.896S 125.256E, 17.863S 125.205E, 17.829S 125.159E, 17.808S 125.131E, 17.762S 125.068E, 17.756S 125.049E, 17.747S 125.046E, 17.741S 125.024E, 17.700S 124.988E, 17.674S 124.933E, 17.659S 124.932E, 17.657S 124.929E, 17.632S 124.924E, 17.610S 125.003E, 17.585S 125.015E, 17.559S 125.006E, 17.480S 124.939E, 17.462S 124.926E, 17.454S 124.891E, 17.452S 124.794E, 17.427S 124.726E, 17.391S 124.662E, 17.385S 124.546E, 17.378S 124.448E, 17.407S 124.363E, 17.402S 124.291E, 17.409S 124.234E, 17.407S 124.174E, 17.409S 124.126E, 17.430S 124.082E, 17.387S 124.045E, 17.371S 123.980E, 17.320S 123.913E, 17.288S 123.884E, 17.229S 123.868E, 17.219S 123.871E, then directly to the point of commencement.

2. The Lacepede Islands extending to the Low Water Mark.
3. An area at Lagrange Bay comprising a circle of 2500 metres radius centred on coordinate point Latitude and Longitude 18.614S 121.752E.
4. Bungarun Derby Leprosarium Reserve comprising the whole of Lot P174646.
5. An area at Noonkanbah Gate comprising a circle of 100m radius centred on coordinate point Latitude and Longitude 18.094S 124.751E.
6. An area at Paliyarra Springs comprising an area of 100m radius centred on coordinate point Latitude and Longitude 18.703S 125.810E.

7. An area at Kurungal Springs comprising an area of 100m radius centred on coordinate point Latitude and Longitude 18.887S 125.905E.
8. The Roebuck Bay Ramsar Wetland.
9. An area bounded by a line commencing at the intersection of the High Water Mark with Latitude 17.953S (approximate coordinate point 17.953S 122.251E), then easterly via the High Water Mark to its intersection with the western boundary of the Roebuck Bay Ramsar Wetland, then southerly via the western boundary of the Roebuck Bay Ramsar Wetland to its intersection with the Low Water Mark, then westerly via the Low Water Mark to its intersection with Latitude 17.953S, then easterly directly to the point of commencement.
10. Sacred Heart Church at Beagle Bay.

All geographic coordinates are expressed in terms of the Geocentric Datum of Australia 1994 (GDA94) as described in the *Commonwealth of Australia Gazette* GN35 of 6 September 1995. Note all units display in decimal degrees.

CRITERION	VALUES
(a)	**Assembling a continent**
The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern of Australia's natural and cultural history.	*King Leopold orogen* The rocks of the King Leopold orogen represent the remnants of three major orogenies (mountain building processes) that took place in the Kimberley from c. 1870–560 million years ago (Ma). The King Leopold orogen provides strong evidence of Palaeoproterozoic plate tectonic activity (from about 2500–1600 Ma), at a period preceding formation of the Neoproterozoic supercontinent Rodinia, which came together around 1000–850 million years ago. Rodinia was a giant landmass containing most or all of Earth's continental crust at the time, centred south of the Equator. The land that became Australia was probably in the north-east of the landmass. The King Leopold orogen also preserves rocks from the Yampi and King Leopold orogenies that occurred later in the Proterozoic, which record events that helped build the modern Kimberley topography (Maher and Copp 2009b). The events of these three Proterozoic orogenies are preserved in the spectacularly folded Proterozoic quartzites and sandstones of the Yampi Peninsula and the granite domes, gneiss hills and schist ridges of the King Leopold Range and the Fitzroy uplands province. There is little consensus among geologists on plate tectonic activity in the early Earth: rocks from the period from 2,700 Ma to about 700 Ma, such as those of the King Leopold orogen, are very important in understanding the timing and nature of modern plate tectonics (Witze 2006; Stanley 1999). The King Leopold orogen is a significant geological record of past orogenic processes which led to the Proterozoic assembly of Rodinia, representing key tectonic events in the evolution of the Australian continent and a major stage of Earth's history. This record is displayed in significant fault and fold structures in rocks exposed along the coast of Yampi Peninsula, in the King Leopold Range and the Fitzroy Uplands. These geological features highlight the powerful tectonic forces and the physical geological structures formed during orogenic processes (Maher and Copp 2010). ***The King Leopold orogen of the west Kimberley has outstanding heritage value to the nation under criterion (a) for recording pre-Rodinian and Proterozoic plate tectonic processes, key events in the evolution of the Australian continent.*** **Ecology, biogeography and evolution** *Devonian reef* The Devonian reef sequence preserved in the Oscar, Napier, Emmanuel and Pillara ranges is a continuous record from the Frasnian to the Famennian stage of the Late Devonian period (around 380 – 360 million years ago), covering two significant marine mass extinction events. Famennian reefs are rare throughout the world and none is present elsewhere in Australia. In addition, valleys cut through the reef at Windjana and Geikie Gorges by the Lennard and Fitzroy rivers provide

CRITERION **VALUES**

(a) cont. sections through the deposit that give palaeontologists and geologists a unique window on this sequence.

The Devonian Reef of the Kimberley has outstanding heritage value to the nation under criterion (a) because it is a continuous record of 20 million years of reef deposition and shows the response of a Late Devonian reef to a mass extinction event.

Gogo fossil sites
The Gogo fish fossil sites of the late Devonian period are one of the world's most important early vertebrate fossil localities. The deposits contain specimens of fish ancestral to tetrapods (vertebrate animals with four legs or leg-like appendages), fossils that clarify the anatomical transitions that took place at the base of this radiation.

The Gogo fossil sites have outstanding heritage value to the nation under criterion (a) for important transitional fossils that document the evolution of early tetrapodomorph fish.

The biological significance of the west Kimberley
Biodiversity analysis using the Australian Government's Australian Natural Heritage Assessment Tool (ANHAT), supported by the Australian Heritage Council's expert opinion, has shown the northern Kimberley coast and islands, the Kimberley Plateau and the west Kimberley Devonian reefs are nationally significant for species richness and endemism for many plant, mammal, reptile, frog and invertebrate groups. Island populations of critical weight range species such as the northern quoll (*Dasyurus hallucatus*), the golden bandicoot (*Isoodon auratus*), the scaly-tailed possum (*Wyulda squamicaudata*) and the golden–backed tree–rat (*Mesembriomys macrurus*) are of particular importance due to their decline on the mainland caused by an array of human–induced threatening processes.

The northern Kimberley coast and islands, the Kimberley Plateau and the west Kimberley Devonian reefs have outstanding heritage value to the nation under criterion (a) for plant, mammal, reptile, frog and invertebrate species richness and endemism; and as refugia protecting against human-induced environmental changes.

Many of the small immobile invertebrate species endemic to the Kimberley have only been recorded in its rainforest patches (vine thickets), including 90 per cent of the earthworms and 48 per cent of the land snails (Kenneally and McKenzie 1991). Survey and taxonomic work by Solem (1979, 1981, 1984, 1985) and more recent research (Graham 2001b; Köhler 2010) have helped highlight the national importance of the Kimberley Plateau and surrounding islands for land snail richness and endemism. ANHAT analyses have supported the findings of these researchers, showing the Kimberley Plateau is exceptionally high in richness and endemism for Camaenidae (air breathing land snails). This consistent spread of now locally restricted species may reflect long-term evolution through isolation (Köhler 2009; Köhler and Gibson in prep.). The west Kimberley was found to have the second highest richness in the country for the family Pupillidae (minute, air–breathing land snails).

Vine thickets of the northern Kimberley coast and islands and the Kimberley Plateau, and the Devonian reefs of the west Kimberley, are of outstanding heritage value to the nation under criterion (a) for their evolutionary refugial role that has resulted in high invertebrate richness and endemism.

The river systems of the north Kimberley serve as refuges to freshwater fish species, with a consequently high endemism found in several families. With 18 species that are endemic to the region, the west Kimberley has the highest number of endemic freshwater fish in comparison to any other region in Australia (Allen et al. 2002, Morgan 2008, Unmack 2001). The highly dissected nature of the landscape has served as an isolating mechanism between species, with the

CRITERION **VALUES**

(a) cont. numerous large and deep waterholes acting as refugia, resulting in centres of speciation that have existed since the fluctuating climate of the late Cenozoic (Allen and Leggett 1990). Rivers that are important for endemism include the Drysdale River (six species), the Prince Regent (six species), the Roe and Moran Rivers (four species), Carson River (four species) and Isdell River (three species) (Morgan 2008, Allen et al. 2002). The Mitchell, King Edward (including the Morgan and Carson Rivers) and Drysdale River systems also provide habitat for a number of endemic freshwater turtles (McCord and Joseph–Ouni 2007). ANHAT analysis returned the second highest national Chelidae (side–necked tortoises) endemism score.

The Drysdale, Prince Regent, Roe, Moran, Carson, Isdell, Mitchell and King Edward Rivers are of outstanding heritage value to the nation under criterion (a) as areas of evolutionary refugia demonstrated by nationally high values for freshwater fish and turtle endemism.

Wealth of land and sea

Movement of material (marine shell beads) by Aboriginal people
The occurrence of marine shell beads in occupation deposits at two inland rock shelters, Carpenter's Gap 1 and Riwi, dated to 30,000 BP is exceptional, providing testimony for the antiquity of long distance movement of material by Aboriginal people, perhaps in some kind of system of exchange during the Pleistocene period (McConnell and O'Connor 1997; O'Connor 1999; Balme 2000; Balme and Morse 2006).

In historical times, Aboriginal trading networks criss-crossed the continent moving valued commodities like pearl shell, ochre and stone tools over thousands of kilometres. These extensive economic and social systems of exchange are a characteristic feature of Aboriginal Australia.

Carpenter's Gap 1 and Riwi rock shelters have outstanding heritage value to the nation under criterion (a) as they demonstrate the operation of Aboriginal social and economic networks 30,000 years ago over distances of 500 kilometres.

Symbolic use of ochre
Archaeological excavations at Carpenter's Gap 1 rock shelter recovered a slab of roof material to which ochre had been deliberately applied. The slab had fallen to the floor of the rock shelter some time before 39,700 years BP. The ochre appears to have been blown onto the surface, probably in a similar method used by Aboriginal people in Australia in ethnographic times (O'Connor and Fankhauser 2001). This is the oldest trace of ochre intentionally applied to a rock surface presently known in Australia, and is one of the earliest examples on a world scale.

Carpenter's Gap 1 rock shelter has outstanding heritage value to the nation under criterion (a) as it provides evidence of the antiquity of the symbolic use of ochre on a rock surface, the earliest 'art' in Australia's cultural history.

Aboriginal trade in pearl shell
Kimberley pearl shell (*Pinctada maxima*) has associations with water, rain-making, ancestral Creator Beings, stories and songs. The significance of the modified pearl shell changes as it is traded from its source, where it was created by powerful Dreamtime Beings.

Highly valued by Aboriginal people as the 'emblem of life' with potent correlations with water, and the power to regenerate, renew, and transform; modified Kimberley pearl is the most widely distributed commodity in Aboriginal Australia, covering two-thirds of the Australian continent.

Pearl shell beds at a number of identified sites from Bidyadanga to Cape Londonderry, where in Aboriginal law and culture, the shell is believed to have been created by Dreamtime Beings and is collected by Traditional

CRITERION	VALUES
(a) cont.	***Owners, have outstanding heritage value to the nation under criterion (a) as the source of the item most widely distributed by Aboriginal people in the course of Australia's cultural history.***

Contact, change and continuity

European explorers
In the sixteenth century long, dangerous and difficult voyages across uncharted oceans began to shape 'new worlds' on the maps of European navigators. In the pursuit of knowledge and wealth beyond the borders of Europe, early expeditions by the Portuguese, Spanish, Dutch, French and British began to reveal the outline of the Australian continent.

The William Dampier (Cygnet) 1688 landing place
William Dampier stayed in the west Kimberley coast area for more than one month, landing first at Pender Bay, then sailing and anchoring in Karrakatta Bay. Dampier and the *Cygnet* crew lived at Karrakatta Bay, camped and careened the ship on land, 'canoed' and fished in the nearby sea, met a group of Aboriginal people on an island, observed Aboriginal people elsewhere and swimming between islands. Dampier also notes in his account old wells, low even land, sandy banks against the sea, rocky points, the careening beach, the islands in the bay, the 'dragon' trees and the Aboriginal stone fish traps described as 'weirs of stone across little coves or branches of the sea'. A full description of his observations is included in his account of his voyages around the world (Dampier 1697). The environment Dampier observed is substantially unmodified since his 1688 landing and can be seen today.

William Dampier's published accounts of his voyages around the world, which included his observations at Karrakatta Bay and nearby, were significant in stimulating European exploration interest in the Pacific and Australia which foreshadowed Cook's voyage to the Pacific and eventual establishment of a British colony in Australia in 1788. Dampier's observations at Karrakatta Bay and nearby were also influential in shaping late seventeenth and eighteenth century attitudes towards Australia and its Indigenous people. His observations made at Karrakatta Bay were also influential in the British Government's sponsorship of another voyage to Australia in 1699 during which Dampier collected some Australian plants, foreshadowing the birth of Australian botany.

The Kimberley coast is recognised for its association with early European exploration of the continent. The William Dampier *(Cygnet)* **(1688)** ***landing place, around Pender Bay, Karrakatta Bay, King Sound, the Buccaneer Archipelago and nearby coast, has outstanding heritage value to the nation under criterion (a) for its association with William Dampier and the influence of his published observations. The environment observed by Dampier is substantially unmodified since his 1688 landing and can be seen today.***

Fossil Downs Station
Fossil Downs Station is outstanding for its association with the longest droving journey in Australia. Undertaken over three years in the late nineteenth century the MacDonald brothers drove cattle from Goulburn, New South Wales to what is now known as Fossil Downs Station in the Kimberley. This journey of 5,600 kilometres ended near a tree marked F136 by explorer Alexander Forrest on 3 June 1886.

The place where the tree marked F136 once stood has outstanding heritage value to the nation under criterion (a) for its association with the pioneering overlanding journey undertaken by the MacDonald brothers in 1883-1886.

Bunuba resistance to the rolling frontier of European settlement
Conflict between Europeans and Aboriginal people was endemic on the frontier of European settlement (Reynolds 1976). As the wave of European settlement moved south and north from the Sydney colony it took many forms from passive resistance through to large-scale violent action, and was highly influenced by the terrain on which it occurred. (Reynolds 1982; Pedersen 2000; Grassby and Hill 1988; Connor 2002).

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(a) cont.	The Bunuba resistance would not have been a success without the impenetrable fortress-like qualities of their traditional country. The limestone landscape of the Napier and Oscar Ranges provided the Bunuba people with a refuge from which to defend their country and a fortress to attack would-be settlers and the police. Control of the Devonian Reef was crucial for the rolling frontier of European settlement to move forward. ***The limestone ranges of the Devonian Reef have outstanding heritage value to the nation under criterion (a) as the place where Bununba resistance held back the advance of European settlement for 13 years, an unusual achievement by Aboriginal people in the history of Australian frontier conflict.*** *Treatment of Aboriginal people after European settlement* The buildings and landscape elements of Bungarun (Derby Leprosarium), together with the area of the former residential units, the cemetery and the state listed Aboriginal heritage sites, tell the poignant story of the isolation of Aboriginal people during a period of Australia's history when government policy makers were dominated by the fear of disease and its spread into the Australian populace to the south. Aboriginal people from across the Kimberley were isolated at Bungarun, some for a few weeks, and others for up to forty years. The place highlights the government's rationale at the time, merging the logic of penal, quarantine, therapeutic and racial segregation into policies to manage disease amongst Aboriginal people. The place provides an ongoing testament to Aboriginal people's resilience and capacity to resist, adapt and survive despite the difficulties and personal suffering imposed by leprosy, separation from country and family, and the government's isolationist policies of the time. ***Bungarun (Derby Leprosarium) has outstanding heritage value to the nation under criterion (a) as the only extant facility to tell the national story of leprosy treatment of Aboriginal people in Australia's cultural history.*** *Aboriginal rights to practice law and culture* When Aboriginal people speak about 'Noonkanbah' they are referring to a series of events which took place on Noonkanbah station between 1978 and 1980. These events drew the attention of the nation to the struggle of Aboriginal people to protect their rights to practice traditional law and culture. Noonkanbah is one in a series of important steps in the national struggle of Aboriginal people to have their rights to practice traditional law and culture, and have their rights to traditional land ownership recognised. In addition, Noonkanbah brought about significant change to resource company policies and practices in relation to consultation and negotiation with Aboriginal people and in the protection of Aboriginal heritage. Yirrkala, Wave Hill, Noonkanbah and Mer Island each assume their own symbolic importance in the long, slow path towards the recognition of Aboriginal rights and the protection of Aboriginal heritage. ***The areas of Noonkanbah station encompassing the station gates, the crossing at Mickey's Pool, Pea Hill (Umpampurru) and the unsuccessful exploration well, have outstanding heritage value to the nation under criterion (a) as the site of the Noonkanbah dispute, an important event in the national struggle of Aboriginal people to have their rights to practice traditional law and culture recognised, and to protect their heritage for future generations.***
(b) The place has outstanding heritage value to the nation	**Ecology, biogeography and evolution** *Gogo fossil sites* At the late Devonian Gogo fish fossil sites, near–complete, articulated fossil fish are often found in limestone nodules and up to 50 different species are preserved. The spectacular Gogo fossils have recently been discovered to preserve soft tissue structures along with bone. This has revealed evidence for viviparity (live birth) and

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because of the place's possession of uncommon, rare or endangered aspects of Australia's natural and cultural history.	sexual dimorphism: embryos, an umbilical cord and a possible yolk sac have been preserved. This represents the earliest evidence for internal fertilization and live birth in vertebrates (Long et al. 2008). Extensive remains of soft tissue have allowed reconstruction of the body musculature in a stem vertebrate (these fish being ancestral to tetrapods) (Ahlberg 2009). The Gogo fossils are unique in preserving a diverse fossil fish fauna, complete with soft tissue anatomy. ***The late Devonian Gogo fish fossil sites have outstanding heritage value to the nation under criterion (b) for remarkable preservation of a diverse fauna of entire fossil fish skeletons complete with the rare preservation of extensive soft tissue.*** *Dampier Coast* The early Cretaceous Broome Sandstone of the Dampier Coast contains the only sauropod prints found in Australia – these are common in the discontinuous outcrops that stretch for up to 200 kilometres along the west coast of the Dampier Peninsula (Molnar 1991; Thulborn et al. 1994; Long 1998). With some hind foot tracks as long as 1.75 metres, the Dampier Coast tracks may be the world's largest sauropod prints. The world's smallest sauropod tracks have also been found here, indicating a broader population sample than that of any other known sauropod track site. It preserves rare examples of the coexistence of sauropod and ornithopods. The Dampier Coast is the only site with extensive evidence of western Australian dinosaurs and the large number of tracks provides an otherwise unobtainable census of dinosaur populations and communities. ***The Dampier Coast dinosaur tracks have outstanding heritage value to the nation under criterion (b) as the best and most extensive evidence of dinosaurs from the western half of the continent, some of which are unknown from body fossils; for the diversity and exceptional sizes of the sauropod prints; and the unique census of the dinosaur community that they provide.*** Rare in Australia, fossil human tracks are important for both scientific and symbolic reasons. There are three occurrences of fossil human tracks documented in the literature. The Dampier Coast site is the only example yet found in Western Australia. Less clearly documented accounts of human tracks at other locations along the coast also appear in the literature (Mayor and Sarjeant 2001; CNN 1996; Long 2002). The Pleistocene and Holocene human record which the Dampier Coast tracks help to elaborate is very patchy. Documenting track sites through human history can begin to reveal population data across a continent and through time, to supplement other kinds of archaeological and historical evidence. Tracks have the potential to reveal data which is hidden from those who only study body fossils: about gait, anatomy, stature, size, population and speed. In other words, they evoke 'the living behaviour of our ancestors' (Kim et al. 2008; Webb et al. 2006). ***The fossil human footprint sites of the Dampier Coast have outstanding heritage value to the nation under criterion (b) as one of only three documented human track sites in Australia and the only documented evidence of human tracks from the west coast of Australia.*** **Wealth of land and sea** *Botanical remains and Aboriginal plant procurement strategies* At Carpenter's Gap 1 rock shelter, also known as *Jambarurru* to Bunuba people (S. Pannell pers. comm. 5 May 2010) and *Tangalma* to the Unggumi (Playford 1960, 2007) in the Napier Range, a combination of protected dry deposits and high alkalinity have combined to preserve an exceptional collection of botanical materials including wood shavings, seeds and plant fibres (O'Connor 2007). ***Carpenter's Gap 1 rock shelter has outstanding heritage value to the nation under criterion (b) for its rare archaeological sequence of micro and macro-botanical remains spanning 40,000 years that contributes to our understanding of the impacts of climate change on flora composition though***
(b) cont.	***time, and the rare evidence it provides of plant procurement strategies used***

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	by Aboriginal people from the Pleistocene, through the last glacial maximum, a period when many occupation sites were abandoned across Australia, and into the Holocene.
	Contact, change and continuity
	Careening Bay and the Mermaid tree In 1820, during one of his coastal survey expeditions, Phillip Parker King careened his ship the *Mermaid* in Careening Bay on the Kimberley coast of Western Australia. Careening was an essential activity in the routine of maintenance and care of the ship. On this occasion a boab tree was carved with the initials *HMC Mermaid* to mark the crew's stay on what was then a very remote area of the Australian coast. Within the Kimberley other early land explorers made similar marks on trees which are still present in the landscape. The *Mermaid* tree however is rare as the only known in situ, physical reminder of King's survey expeditions along the Australian coastlines of the Kimberley, Northern Australia, the northern coastlines of Queensland and the Torres Strait.
	The Mermaid tree within Careening Bay has outstanding heritage value to the nation under criterion (b) as rare, in situ, physical evidence of nineteenth century hydrographers and in particular the survey work of Phillip Parker King, one of Australia's most important early marine surveyors.
(c) The place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural and cultural history.	**Ecology, biogeography, climate and evolution**
	Devonian coral reef The fossil reef assemblages of the Lennard Shelf, including the Napier, Oscar, Emmanuel and Pillara Ranges span the Givetian–Famennian stages of the Devonian period from about 390–359 million years ago, including the Frasnian–Famennian mass extinction. Studying this sequence can provide information about how reef communities react to climate change and to changes in sea level, both of which are key issues facing modern coral reefs such as the Great Barrier Reef (Wood 2000; Wood 2002; Veron 2008).
	The Devonian reef outcrops of the Lennard Shelf have outstanding heritage value to the nation under criterion (c) because of their potential to yield information that will contribute to an understanding of the climatological and biological processes that affect major reef systems.
	Gogo fossil sites The late Devonian Gogo fossil sites produce remarkable specimens with a potential for study that increases with each new technological development. The most recent advances use high–resolution scanning electron microscopy, high–resolution computer tomography, X–ray and Synchrotron CT scanning to reveal details of the soft tissue morphology that might otherwise be obscured by bone and buried within the supporting matrix (Trinajstic and Long 2009; Ahlberg 2009). Along with advancing studies of its own fossil fauna, the Gogo sites provide a way to test new techniques in studying these Devonian faunas, which may be applicable to other fossil types and sites in the future.
	The Gogo fish fossils have outstanding heritage value to the nation under criterion (c) as they have significant potential to yield new information about the natural history of Australia, the evolution of Australian vertebrates and about new technologies that can be used to study fossils.
(c) cont.	*Human ecology and adaptation* Only a small number of archaeological surveys have been undertaken in the west Kimberley region. Those few surveys have provided nationally significant evidence on the paleo-environment, human adaptation to climate change, marine resource use, development of symbolic behaviour and the antiquity of long distance exchange. Given the highly significant nature of these investigations, coupled with

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the argument that the west Kimberley is one of the most likely points through which humans first entered Australia, future archaeological surveys in the region may reveal sites of even greater scientific and archaeological significance. The exceptional preservation conditions offered by the Devonian reef complex also support the likelihood of further significant discoveries.

The coastline from Cape Londonderry to Cape Leveque and the Devonian reef complex have outstanding heritage value to the nation under criterion (c) for their potential to yield significant new archaeological information contributing to an understanding of Australia's natural and cultural history.

Rock paintings as a source of information about climate, ecology and technology
The fine graphic detail of the painted motifs in the Wanjina-Wunggurr homeland and the Balanggarra native title claim area provide invaluable insights into a number of nationally important areas of research including climate change and species extinction; early Aboriginal material culture and technology development; and the interactions between Aboriginal people and outsiders. The exceptional illustrative nature of the rock paintings has the potential to provide information at a level of resolution currently absent from the archaeology. Welch (1993, 29) supports this view, noting that early Kimberley rock art 'gives us an enormous insight into the material culture of early Australians'. While the rock paintings of Arnhem Land and the Kakadu region are also highly informative, Morwood (2002, 162) suggests that the Kimberley region may have greater potential in demonstrating changes in weapons used, accoutrements and ideology.

The rock paintings of the Wanjina-Wunggurr homeland and the Balanggarra native title claim area have outstanding heritage value to the nation under criterion (c) for their potential to yield information that will contribute to an understanding of climate change and species extinction; early Aboriginal material culture and technology development; and the interactions between Aboriginal people and outsiders.

Natural disasters in the late Holocene
Recent research in the Kimberley linking comets and tsunamis to Indigenous oral histories, painted rock images and stone arrangements provides exciting opportunities for future collaborative investigations between archaeologists, geologists and the Traditional Owners.

The west Kimberley coast between Cape Londonderry and Cape Leveque has outstanding heritage value to the nation under criterion (c) for its potential to yield information that will contribute to an understanding of the nature and the effect of mega-tsunami events.

Contact, change and continuity

Asian–Australian interaction
Indonesian fishermen, commonly referred to as Macassans, have been visiting the west Kimberley coast for perhaps hundreds of years to harvest marine resources including pearl and trochus shell, turtle shell, clam meat, shark fins and trepang, also known as sea cucumber or bêche-de-mer (Morwood 2002). The historical accounts and oral traditions of Kimberley Aboriginal people, together with the limited archaeological evidence, suggest that a very different kind of relationship existed between Indonesians and Kimberley Aboriginal people than that experienced between Macassans and Aboriginal people in Arnhem Land. In the Kimberley, the relationship appears to have been one of hostility and distrust on both sides. Few archaeological surveys have been conducted to investigate this important pre-European contact.

The west Kimberley coast from Cape Londonderry to the Lacepede Islands has outstanding heritage value to the nation under criterion (c) for its potential to yield information that will contribute to an understanding of Indonesian-Aboriginal interaction in Australia's cultural history.

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(d) The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: (i) a class of Australia's natural and cultural places; or (ii) a class of Australia's natural and cultural environments.	**Ancient landscapes, geological processes** *The Kimberley ria coast* The Kimberley ria coast, from the Helpman Islands in King Sound to Joseph Bonaparte Gulf is the most extensive region of well–expressed ria coast and, at more than 2,500 kilometres, probably the longest stretch of predominantly rocky coast in Australia (Sharples 2009; Woodroffe and Short 2009). Nowhere else in Australia, or possibly the world, is there the opportunity to study the effects of macrotidal tide–dominated rocky coastal processes, and repeatedly interacting sea–level changes and fluvial landform processes through time, on a predominantly rocky coast that lacks the disturbance caused by high density coastal infrastructure (Sharples 2009; DEWHA 2009c). There are many ria coasts in the world, and other ria coasts in Australia, but the Kimberley rocky coast is unique in Australia and rare in the world for preserving a continuous and intricate dominantly–rocky fluvial and drowned fluvial landscape over a length of more than 2500 kilometres. Due to the stability of the Kimberley craton over time, the sea floor to roughly the 30 metre bathymetric line has been a terrestrial land surface, subjected to subaerial terrestrial landform development, more than it has been subject to marine processes over the last half billion years. As such, it is the best expression in the country of this type of landscape and the processes that have shaped and continue to shape it during the Phanerozoic eon (the last 545 million years). ***The west Kimberley coast from Helpman Islands in King Sound to the western shore of Cambridge Gulf, including islands, peninsulas, inlets and inundated features, has outstanding heritage value to the nation under criterion (d) for demonstrating the principal characteristics of a major coastal landform type, in an extensive region without significant modification by coastal infrastructure.*** *Lennard Shelf* The Lennard Shelf contains the elements of a late Devonian carbonate ramp on an ancient tropical continental shelf. These limestone complexes lie off the ancient mainland represented by the folded and faulted, granitic and metamorphic Kimberley Block to the north (described under criterion (a) as the rocks of the King Leopold orogeny). An integrated picture of a proto–Australian continental shelf environment in an epicontinental sea from 390–370 million years ago is provided by a number of features and their spatial relationships. These features include: palaeoshores, palaeoinlets, platforms, atolls, interreef basins, debris flows, islands and archipelagos with fringing reefs (including the superbly preserved Mowanbini Archipelago of the Oscar Range), the remains of a barrier reef, including the forereef accumulations, lagoon deposits, patch reefs, bioherms (mud mounds) that grew on pinnacle reefs rising from the shallow sea floor of the backreef lagoon and limestone nodules preserving entire fish and crustaceans at the Gogo fossil localities (Playford and Lowry 1966; Webb 2001; Johnson and Webb 2007; Playford et al. 2009). ***The Devonian carbonate complexes of the Lennard Shelf have outstanding heritage value to the nation under criterion (d) for demonstrating the principal characteristics of a very well preserved proto-Australian carbonate ramp environment on an ancient continental shelf.*** **Ecology, biogeography and evolution** *Dampier Coast Cretaceous landscape* The ichnofossils (trace fossils including dinosaur tracks) preserved in the Broome Sandstone exposed in the intertidal zone of the Dampier Coast (from Roebuck Bay to Cape Leveque) represent up to 15 different types of dinosaur (Thulborn et al. 1994; Tyler 2000; Thulborn 1997; Long 1998; Long 2004). The Cretaceous landscapes that occurred here were buried intact and reveal original topography, with soils, leaf–litter and even fossils of plants in their growth positions (roots can be seen descending into the substrate). In places, dinosaur tracks meander around these plants so that one may walk across these ancient landscapes following their paths through clumps of vegetation (Thulborn pers. comm. 2009).

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(d) cont.

The plant and sedimentological evidence allows reconstruction of the environments in which dinosaurs lived and fed, providing a fuller palaeoecological picture of a suite of Cretaceous coastal environments. The Broome Sandstone coastal exposures of dinosaur tracks and associated fossils therefore tell an integrated story of the animals, plants and physical environment of this area during the Early Cretaceous period, approximately 132 million years ago.

The dinosaur tracks and associated ichnofossils, plant macrofossils and Cretaceous depositional environments of the Broome Sandstone exposed in the intertidal zone of the Dampier Coast have outstanding heritage value to the nation under criterion (d) for preserving snapshots of the ecology of the Mesozoic.

Roebuck Bay migratory hub
Sixty four waterbird species have been recorded at Roebuck Bay, 34 of which have been listed under international treaties (JAMBA, CAMBA and ROKAMBA). Roebuck Bay has the highest number of species of international importance visiting its shores of any site in Australia, including pied oystercatcher (*Haematopus longirostris*), Mongolian plover (*Charadrius mongolus*) and the ruddy turnstone (*Arenaria interpres*). ANHAT analysis returned the second highest score for Charadiiformes (waders) richness at Roebuck Bay (61 species). Along with international visitors, Roebuck Bay also returned nationally high endemism scores for a collection of bird groups, including Passeriformes (perching birds), Meliphagidae (honeyeaters), Pittidae (pittas) and to a lesser extent Sylviidae (old world warblers). The endemism significance can in some cases be explained by a number of bird species, such as the common redshank (*Tringa totanus*) and the Asian dowitcher (*Limnodromus semipalmatus*), that within Australia almost exclusively visit the Canning coast area, before returning to other countries within their flyway zone.

Roebuck Bay has outstanding heritage value to the nation under criterion (d) due to the place's importance as a class of avian habitat (a migratory hub or staging post), and for the regular presence of migratory, protected or endangered avifauna.

Rainbow Serpent traditions tied to Indigenous interpretations of the different way in which water flows within the catchment
The Rainbow Serpent is an important Creation Being for Aboriginal people across Australia and is closely linked to land, water, life, social relationships and fertility. There are many stories associated with the serpent, all of which communicate the significance and power of this Being within Aboriginal traditions.

Within the Fitzroy River catchment there are four distinct expressions of the Rainbow Serpent tradition. In the *jila-kalpurtu* domain of the Fitzroy catchment on the northern edge of the Great Sandy Desert, water flows are principally underground and the Rainbow Serpent (kalpurtu) is said to exist in the underground structure of the channels, linking excavated waterholes and other water sources of significance. Places like Kurrpurrngu, Mangunampi, Paliyarra and Kurungal are exemplars of this expression of the Rainbow Serpent.

The phenomenon of *Galaroo*, on the other hand, is linked to flowing surface water, in the form of major rivers, and to long and deep permanent waterholes in broad river channels, like Geikie Gorge (*Danggu*). The Rainbow Serpent of the Wanjina-Wunggurr belief system, known as Wunggurr, is typically found in discrete pools of water and is also associated with the sea and with Wanjina Creator Beings at

painted sites and in religious narratives.. The upper Hann river is an exemplar of this aspect of the Rainbow Serpent tradition, while the Woonyoomboo-Yoongoorroonkoo narrative of the lower Fitzroy primarily tells the story of the creation of the lower Fitzroy River and its floodplains and its links to the sea.

The Fitzroy River and a number of its tributaries, together with their

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(d) cont.	***floodplains and the jila sites of Kurrpurrngu, Mangunampi, Paliyarra and Kurungal, demonstrate four distinct expressions of the Rainbow Serpent tradition associated with Indigenous interpretations of the different ways in which water flows within the catchment and are of outstanding heritage value to the nation under criterion (d) for their exceptional ability to convey the diversity of the Rainbow Serpent tradition within a single freshwater hydrological system.***
(e) The place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.	**Wealth of land and sea** The West Kimberley, with its spectacular scenery and substantially unmodified landscapes, has outstanding heritage value to the nation under criterion (e) for its *inspirational landscapes*, as exemplified by the following places. Common aesthetic characteristics noted for the West Kimberley region include the colour in the landscape (reds, yellows, intensity and variety of hues) , the substantially unmodified nature of the natural landscapes, the experience of remoteness and the inspirational nature of the landscapes commonly described by words such as majesty, ancient, remarkable, awesome, endless vistas, jewel like sources of water, wild, spectacular, magnificent, iconic, scenic splendour, outback and grandeur. *Kimberley coast from the Buccaneer Archipelago to King George River* Particular aesthetic characteristics of the Kimberley coast valued by the Australian community include its rugged sandstone coast with rocky headlands, prominent peaks and striking landforms, sandy beaches, pristine rivers and drowned river valleys with rich flora and fauna, off shore reefs and numerous islands in extensive seascapes in a sea supporting diverse marine life. ***The Kimberley coast from the Buccaneer Archipelago to King George River has outstanding heritage value to the nation under criterion (e) for its aesthetic characteristics valued by the Australian community., including its rugged sandstone coast with rocky headlands and prominent peaks and striking landforms, sandy beaches, pristine rivers, waterfalls and drowned river valleys with rich flora and fauna, offshore reefs and numerous islands in extensive seascapes in a sea supporting diverse marine life. The unusual effect of tidal movement is also part of the aesthetic appreciation of some areas like the Horizontal Waterfall.*** *Mitchell River National Park* Particular aesthetic characteristics of the Mitchell River National Park valued by the Australian community include the rugged Kimberley Plateau, Mitchell River, Mitchell Falls (Punamii Unpuu), rocky features around Mitchell Falls and the Surveyors Pool (Aunauyu) and its falls. ***The Mitchell River National Park has outstanding heritage value to the nation under criterion (e) for its aesthetic characteristics valued by the Australian community.*** *King George Falls and King George River* Particular aesthetic characteristics of King George Falls and King George River valued by the Australian community include the rugged sandstone gorge of the King George River between the Falls and the ocean, the high colourful cliffs of the river gorge and the spectacular twin waterfalls cascading into the river. ***King George Falls and King George River have outstanding heritage value to the nation under criterion (e) for their aesthetic characteristics valued by the Australian community.*** *Geikie Gorge Conservation Park and Geikie Gorge National Park* Particular aesthetic characteristics of Geikie Gorge Conservation Park and Geikie Gorge National Park valued by the Australian community include Geikie Gorge

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(e) cont.	(*Danggu*), its colourful gorge cliffs and sculptured rock formations carved by water through an ancient limestone reef, the lush riverine vegetation along the gorge, the fossil decoration on the gorge walls and the deep permanent waters. ***Geikie Gorge Conservation Park and Geikie Gorge National Park have outstanding heritage value to the nation under criterion (e) for their aesthetic characteristics valued by the Australian community.*** *Windjana Gorge National Park* Particular aesthetic characteristics of Windjana Gorge National Park valued by the Australian community include the narrow gorge of the Lennard River, the colourful cliffs of the gorge and the fossil decoration on the gorge walls. ***Windjana Gorge National Park has outstanding heritage value to the nation under criterion (e) for its aesthetic characteristics valued by the Australian community.*** *King Leopold Ranges Conservation Park* Particular aesthetic characteristics of the King Leopold Ranges Conservation Park valued by the Australian community include the Lennard River Gorge, Bells Gorge, the rugged mountain ranges, the fault lines and twisted topography, spectacular gorges, waterfalls, rock pools and their fringing vegetation. ***The King Leopold Ranges Conservation Park has outstanding heritage value to the nation under criterion (e) for its aesthetic characteristics valued by the Australian community.*** *The aesthetic value of rock art* The stunning painted images of Creation Beings, ancestors, plants and animals in rock shelters in the west Kimberley, including the powerful Wanjina and intriguing Gwion Gwion/Girrigirro figures, are considered amongst the most spectacular examples of 'rock art' in the world (Flood 1990, 70). Highly valued by non-Aboriginal people for their aesthetic values, these images are both powerful and of deep religious significance to Kimberley Aboriginal people. ***Aboriginal rock art paintings in the west Kimberley, particularly in the Wanjina-Wunggurr homeland, the Balanggarra native title claim area and the Devonian reef, are both powerful and of deep religious significance to Kimberley Aboriginal people and have outstanding heritage value to the nation under criterion (e) as they represent a stunning visual record of an ongoing Aboriginal painting tradition in a substantially unmodified landscape.***
(f) The place has outstanding heritage value to the nation because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.	**Design and innovation** *Painted rock images* The painted images found in rock shelters and caves across the Wanjina-Wunggurr homeland, the Balanggarra native title claim area and in the limestone ranges of the Devonian reef provide an exceptional record of painted rock art that is extraordinarily diverse and technically very detailed. ***Considered one of the longest and most complex painted 'rock art' sequences anywhere in the world, (Morwood 2002, 143) the west Kimberley complex of painted images is a creative achievement by Kimberley Aboriginal people that has outstanding heritage value to the nation under criterion (f).*** *Sacred Heart church, Beagle Bay mission* Built in a remote location from locally sourced material, the Sacred Heart church at Beagle Bay mission is a testimony to the ingenuity and resourcefulness of the Pallottine brothers and the Aboriginal residents of the mission who built and decorated it. The use of pearl shell and other media to decorate the interior of the church, particularly the sanctuary, demonstrates a high degree of artistic excellence and technical finesse. The place continues to be highly valued by the Beagle Bay Aboriginal community today because of the considerable Aboriginal involvement in its construction and decoration.

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	The Sacred Heart Church at Beagle Bay mission has outstanding heritage value to the nation under criterion (f) for the high degree of creative and technical achievement in the use of pearl shell and other locally sourced media to decorate the interior, combining western religious and Aboriginal motifs.
	Technical response to environmental constraints *Double log raft* Aboriginal people built strong, light rafts to navigate the treacherous waters of the west Kimberley coast. Rips, whirlpools and overfalls created by the massive twelve metre tides made navigation through the maze of islands and waterways a serious undertaking. While a navigational hazard, these strong tidal currents, provided opportunities for skilled and knowledgeable Aboriginal people to travel long distances to hunt, trade and maintain social and cultural obligations. ***The manufacture of the double log raft from mangrove logs (particularly* Rhizophora stylosa*) is a unique adaptation to the massive tidal variation of the west Kimberley and has outstanding heritage value to the nation under criterion (f) for demonstrating a high degree of technical achievement by Aboriginal people in the course of Australia's cultural history.***
(g) The place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.	**Wealth of the Land and Sea** *European pearling* Memories and stories of pearling along the pearling coast in the Kimberley region have a special iconic association with the Australian community. Today the Australian community continues to be drawn to the region in search of the iconic association with pearling and the attraction of the pearls themselves. This is enlivened by the place's outback location, remoteness of the area and beauty of the coast. A demonstration of this community connection is the high visitation to the area, where a diverse cultural heritage is celebrated in the annual Shinju Matsuri Festival. ***The pearling coast within the West Kimberley place has outstanding (intangible) heritage value to the nation under criterion (g) as a place which has a special association with the Australian community for evoking memories of pearling. These memories are enlivened by the place's remoteness and beauty at the gateway to the Kimberley's outback.***
(h) The place has outstanding heritage value to the nation because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural	**Contact, Change and continuity** *European explorers* *William Dampier (Cygnet) I688 landing place* William Dampier first made observations of Australia and its Indigenous people at Karrakatta Bay and the nearby environment. His accounts of Australia and his other voyages around the world established Dampier as an expert, in his time, on the Pacific and Australia. His travel experiences described in his writing stimulated eighteenth century European exploration of the Pacific and Australia and foreshadowed the later voyages of Cook. ***The William Dampier (Cygnet) 1688 landing place has outstanding heritage value to the nation under criterion (h) for its special association with the life and work of William Dampier.*** *Indigenous resistance: Jandamarra* The late timing of the settlement and the impenetrable nature of the Devonian Reef helped create the man and the legend of Jandamarra - a man brought up in two worlds, whose detailed knowledge of European methods to contain Aboriginal

CRITERION	VALUES
history.	resistance and his capacity to pass those skills on to his Bunuba countrymen and women, severely threatened the colonising project. While Jandamarra did not act alone, his abilities to disappear and avoid capture, and to appear to even cheat death itself, made him a much feared adversary to Europeans and a powerful leader amongst his own people. ***The limestone ranges of the Devonian Reef, known to the Bunuba as* Barlil*, has outstanding value to the nation under criterion (h) for its association with Jandamarra, whose campaign of resistance was unprecedented in Australian history, as was the ferocity of the police and settler response. Jandamarra's death in 1897 ended the last large-scale organised violent resistance by Aboriginal people in Australia's cultural history.***
(i) The place has outstanding heritage value to the nation because of the place's importance as part of Indigenous tradition.	**Wanjina–Wunggurr Tradition** The Wanjina-Wunggurr tradition, with features including the painted images of Wanjina and Gwion Gwion in rock shelters across the west Kimberley, provides testimony of a complex association of socio-religious beliefs that continues to be central to the laws and customs of the Wanjina-Wunggurr people. Together, the Wanjina and the Wunggurr Snake are believed to be the manifestations of a life force, also called Wunggurr, which permeates the Wanjina-Wunggurr cosmos and is imbued in all living forms. The creative association of the Wanjina and the Wunggurr Snake is represented in the religious narratives and manifested in the painted images on rock, and as other features in the land, sea and sky including natural rock formations and man-made stone arrangements. Members of the Wanjina-Wunggurr society trace their descent to the Wanjina ancestral beings. Wanjina 'rock art' sites serve as geographical focal points for a system of territorial and social organisation that links small groups of people (the clans of anthropological discourse) to named local countries (clan estates) (Blundell et al. 2009) and into a system of exchange called the *wurnan* that extends throughout the Kimberley. The exchange of items between local group members is viewed as the passage of items in space from Wanjina to Wanjina. In order to sustain the ongoing cycle of life, members of the Wanjina-Wunggurr community continue to engage in a range of ritual practices established in *Lalai* (The Dreaming). While Wanjina-Wunggurr people believe that the Wanjina 'put' themselves onto rock surfaces as paintings, they also believe that as the human descendents of these Wanjina, it is their duty to maintain the 'brightness' or 'freshness' of the paintings by re-touching them with charcoal and pigments (Mowaljarlai and Malnic 1993; Redmond 2001; Blundell and Woolagoodja 2005; Blundell et al. 2009). By keeping the paintings 'fresh' the world will remain fertile – the annual rains arrive, plants and animals will reproduce, and child spirits will remain available in whirlpools and waterholes throughout the Wanjina-Wunggurr homeland. There is no other Indigenous society in northern or central Australia, indeed anywhere in Australia, where a single class of Creator Being, the Wanjina, depicted as a distinct rock art figure, has such a significant and multifaceted role or set of associated meanings and practices (Blundell et al. 2009). ***The Wanjina-Wunggurr homeland, where the painted images on rock and other features in the land, sea and sky, including natural rock formations and man-made stone arrangements, are manifestations of the Wanjina and the Wunggurr Snake, are of outstanding heritage value to the nation under criterion (i) because of their importance as part of Indigenous tradition.***

For a description of any references quoted above, and more information on each of the places please search the Australian Heritage Database at http://www.environment.gov.au/cgi-bin/ahdb/search.pl using the name of the place.

Appendix B: EPBC Act Schedules 5A and 5B: National Heritage Management Plans and Principles

Schedule 5A Management plans for National Heritage places

Schedule 5A—Management plans for National Heritage places

(regulation 10.01C)

A management plan must:

(a) establish objectives for the identification, protection, conservation, presentation and transmission of the National Heritage values of the place; and

(b) provide a management framework that includes reference to any statutory requirements and agency mechanisms for the protection of the National Heritage values of the place; and

(c) provide a comprehensive description of the place, including information about its location, physical features, condition, historical context and current uses; and

(d) provide a description of the National Heritage values and any other heritage values of the place; and

(e) describe the condition of the National Heritage values of the place; and

(f) describe the method used to assess the National Heritage values of the place; and

(g) describe the current management requirements and goals, including proposals for change and any potential pressures on the National Heritage values of the place; and

(h) have policies to manage the National Heritage values of a place, and include, in those policies, guidance in relation to the following:

(i) the management and conservation processes to be used;

(ii) the access and security arrangements, including access to the area for indigenous people to maintain cultural traditions;

(iii) the stakeholder and community consultation and liaison arrangements;

(iv) the policies and protocols to ensure that indigenous people participate in the management process;

(v) the protocols for the management of sensitive information;

(vi) the planning and management of works, development, adaptive reuse and property divestment proposals;

(vii) how unforeseen discoveries or disturbance of heritage are to be managed;

(viii) how, and under what circumstances, heritage advice is to be obtained;

(ix) how the condition of National Heritage values is to be monitored and reported;

(x) how records of intervention and maintenance of a heritage places register are kept;

(xi) the research, training and resources needed to improve management;

(xii) how heritage values are to be interpreted and promoted; and

(i) include an implementation plan; and

(j) show how the implementation of policies will be monitored; and
(k) show how the management plan will be reviewed.

Schedule 5B—National Heritage management principles

(regulation 10.01E)

1 The objective in managing National Heritage places is to identify, protect, conserve, present and transmit, to all generations, their National Heritage values.

2 The management of National Heritage places should use the best available knowledge, skills and standards for those places, and include ongoing technical and community input to decisions and actions that may have a significant impact on their National Heritage values.

3 The management of National Heritage places should respect all heritage values of the place and seek to integrate, where appropriate, any Commonwealth, State, Territory and local government responsibilities for those places.

4 The management of National Heritage places should ensure that their use and presentation is consistent with the conservation of their National Heritage values.

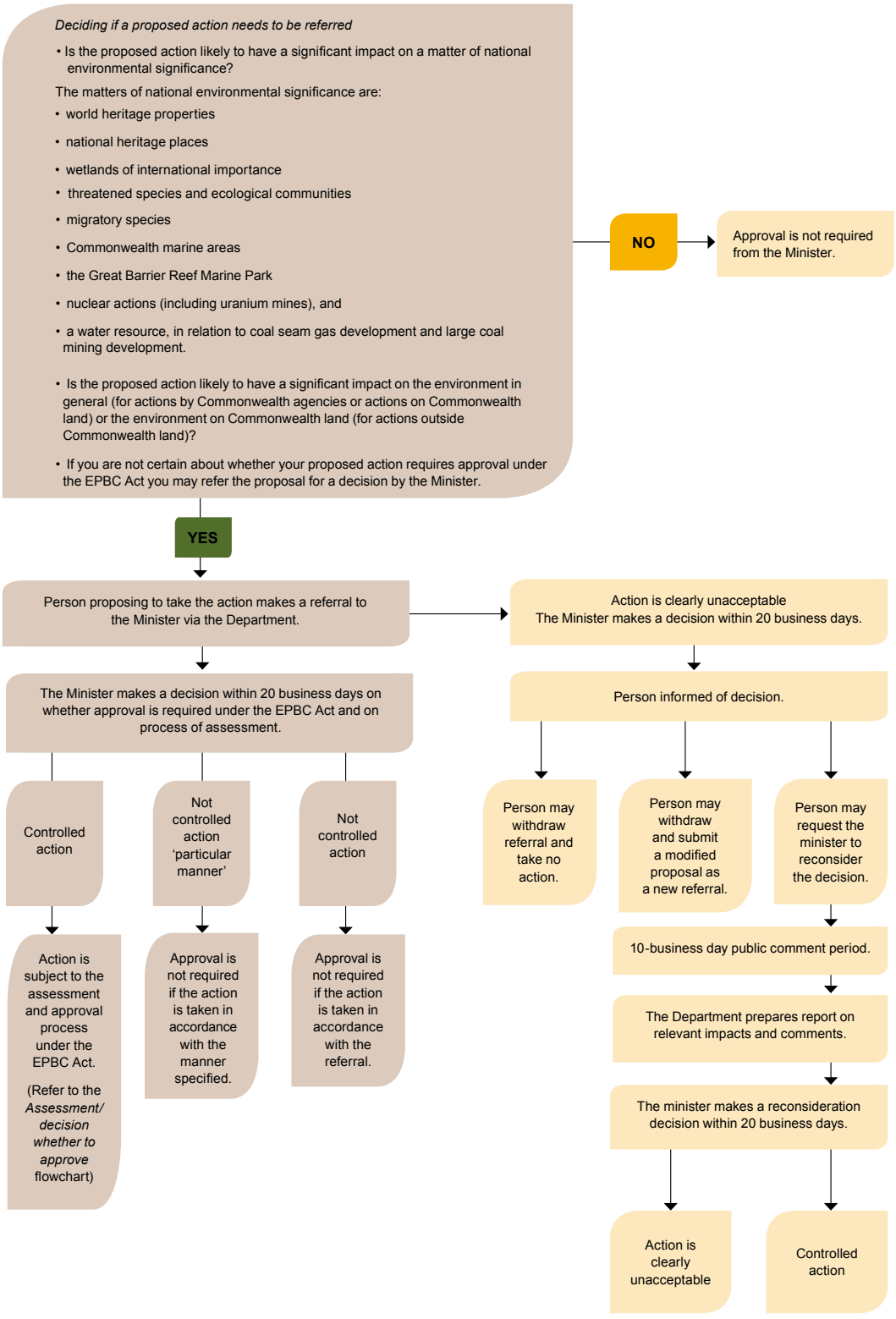
5 The management of National Heritage places should make timely and appropriate provision for community involvement, especially by people who:
   (a) have a particular interest in, or association with, the place; and
   (b) may be affected by the management of the place.

6 Indigenous people are the primary source of information on the value of their heritage and the active participation of indigenous people in identification, assessment and management is integral to the effective protection of indigenous heritage values.

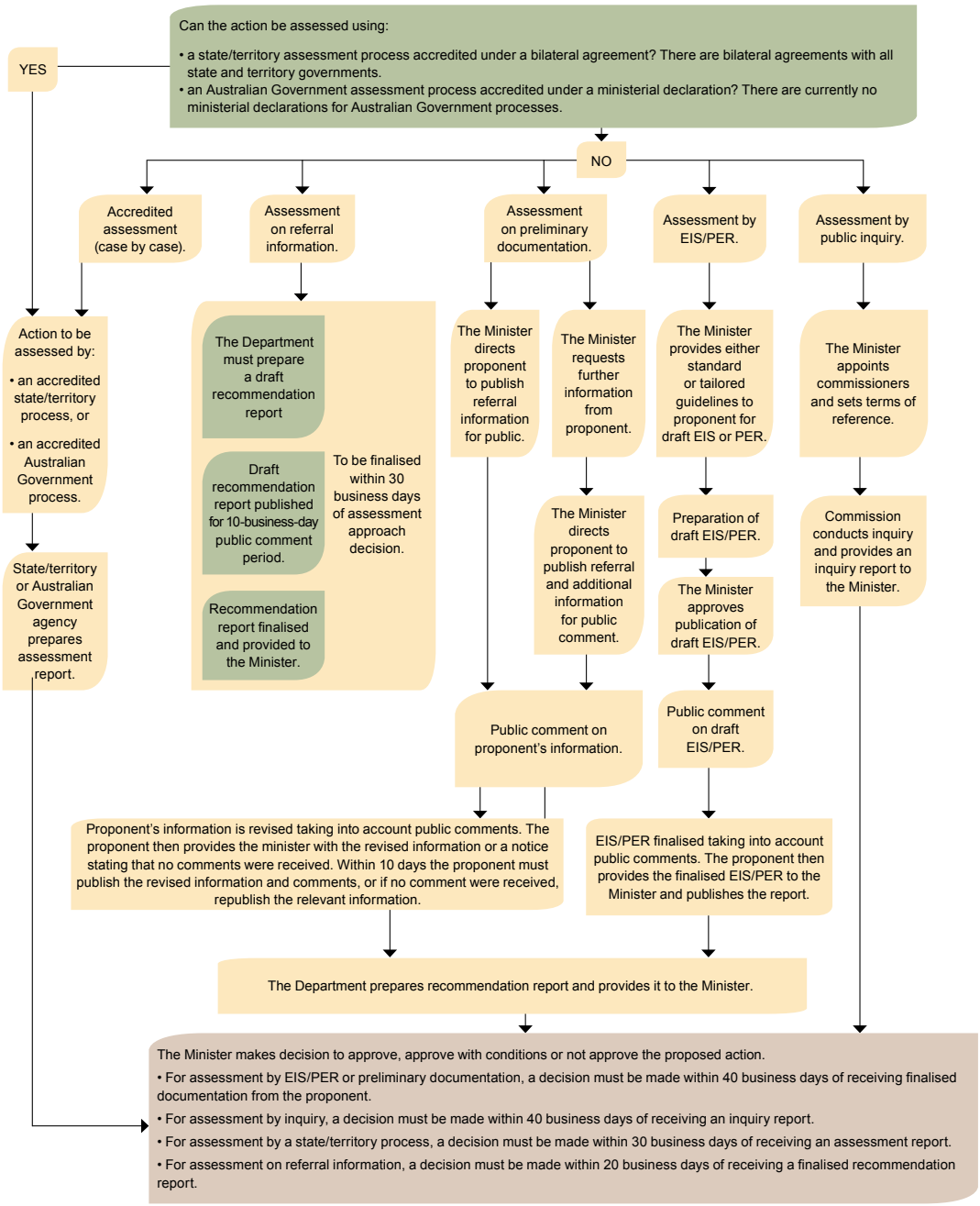
7 The management of National Heritage places should provide for regular monitoring, review and reporting on the conservation of National Heritage values.

Appendix C: Flow charts of the EPBC Act assessment processes

EPBC Act environment assessment process—referral



EPBC Act environment assessment process—assessment/decision whether to approve



Appendix D: CV Act Miscellaneous Plan 1992