NSW NATIONAL PARKS & WILDLIFE SERVICE

Broken Head Nature Reserve

Plan of Management

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This plan of management was adopted by the Minister for Environment on 19 December 2019

Broken Head Nature Reserve is in the traditional Country of the Bundjalung of Byron Bay (Arakwal) people.

This plan of management was prepared by staff of the NSW National Parks and Wildlife Service (NPWS) and replaces the 1998 Byron Coast Group of Nature Reserves Plan of Management in relation to Broken Head Nature Reserve. For additional information or any inquiries about this park or this plan of management, contact the NPWS, Byron Coast Area Office, PO Box 127, Byron Bay 2481 or by telephone on (02) 6620 9300.

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Jingi walla .... (Welcome)

This plan talks about a special part of the Country of the Bundjalung of Byron Bay (Arakwal) people (hereafter called the Arakwal) known as Broken Head Nature Reserve, which is situated on the coast seven kilometres south of the township of Byron Bay.

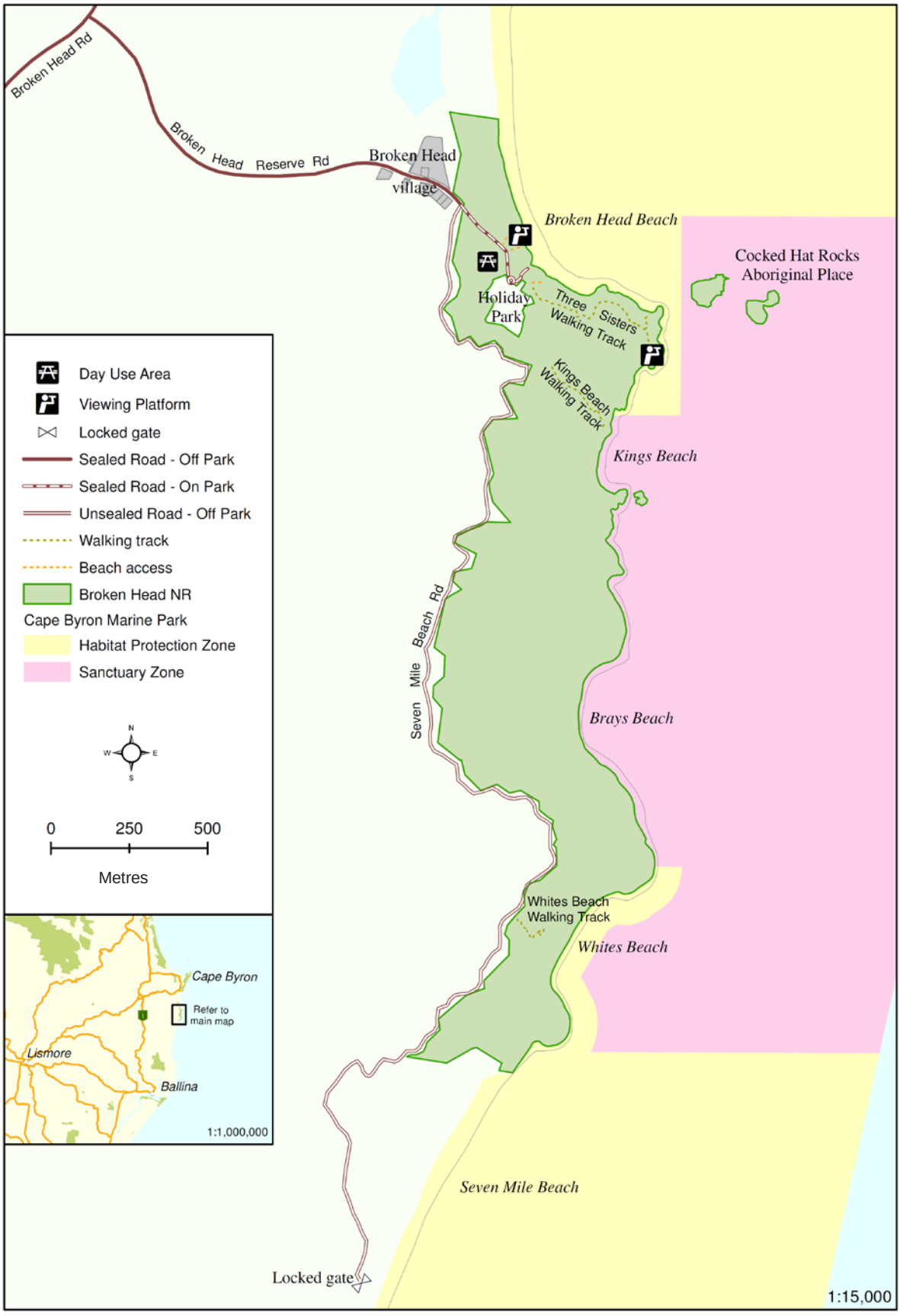
The Reserve is an important part of Country to the Arakwal as a place of spiritual and cultural significance. It is a place where their ancestors lived, used the rich resources of the rainforest and passed this information on to their descendants.

In 2008 the second Indigenous Land Use Agreement (ILUA 2) between the Arakwal and the NSW Government was registered as part of resolving a native title claim. ILUA 2 resulted in significant additions to parks and reserves in the NPWS Byron Coast Area, including the addition of the day use area at Broken Head and the dune system on Broken Head Beach to the Reserve.

A management committee has been established in accordance with ILUA 2 to enable joint management of the Reserve by the Arakwal and the NPWS. Joint management provides a continuing role for the Arakwal in looking after Country.

D. Nicholls

Dulcie Nicholls
Bundjalung of Byron Bay (Arakwal) Elder



Map 1 Broken Head Nature Reserve

1. Broken Head Nature Reserve

1.1 Location, reservation and regional context

Features	Description
Broken Head Nature Reserve	
Location	Broken Head Nature Reserve (referred to as the Reserve in this plan) is situated seven kilometres south of the township of Byron Bay on the far north coast of New South Wales (see Map 1).
Area	The Reserve totals 110 hectares and incorporates an Aboriginal Place on near-shore islands known as the Three Sisters or Cocked Hat Rock (see Section 2.3). The Reserve includes 3.5 kilometres of coastline but does not include the intertidal zone which is below mean high water mark. The Cape Byron Marine Park, which includes the intertidal zone, borders the Reserve and is managed by the NSW Department of Primary Industries.
Reservation date	The original 40-hectare portion of the Reserve was reserved in 1974. Between 1980 and 1988 six additions were made to the Reserve, with the last three occurring between 2005 and 2010.
Previous tenure	Prior to reservation under the *National Parks & Wildlife Act 1974* the Reserve was partly Crown land and partly private land. Large areas of the Reserve were acquired in the 1980s under the NSW Government's Coastal Lands Protection Scheme. The Reserve is named after the locality.
Regional context	
Biogeographic region	The Reserve is located in the South Eastern Queensland Bioregion (biogeographic region). It encompasses near-shore rocky islands, sandy beaches, rocky coves, dunes, grassy headlands, dry sclerophyll forest, woodland and rainforest-clad ridges and gullies. The Reserve complements a suite of significant protected coastal rainforest communities on the NSW far north coast which occur within Cudgen, Wooyung, Marshalls Creek and Brunswick Heads nature reserves.
Surrounding land use	Adjacent and nearby lands support grazing, residential uses and tourism. Much of the surrounding private land has extensive remnant and regrowth vegetation, including rainforest, wet and dry sclerophyll forest, and woodland. The Broken Head Holiday Park forms an in-holding to the Reserve. The Reserve is bounded to the south by Seven Mile Beach and most of its western boundary adjoins Seven Mile Beach Road.
Other authorities	The Reserve is located within the areas of the Arakwal, Jali Local Aboriginal Land Council, North Coast Local Land Services and Byron Shire Council.

1.2 Relationship to Country – Cultural landscape context of the Reserve

The idea of 'Country' to Aboriginal people

To Aboriginal people, the 'landscape' is made up of many features that are interrelated. These include the lands and waters, plants and animals, special places and stories, historical and current uses, and people and their interactions with each other and place. These features are seen as inseparable and make up what is known as 'Country' to Aboriginal people. While these interrelationships are recognised, this plan addresses many of these topics individually so the document is clear and easy to use.

The Country of the Arakwal

The Arakwal and other Bundjalung people have a long and ongoing cultural association with the landscape around Byron Bay, including the Reserve. Research into the Bundjalung lands of south-east Queensland date their occupation to at least 22,000 years ago (Neal & Stock 1986).

The Arakwal lodged a Native Title Determination Application in 1994 (NC95/1 - Byron Bay Bundjalung People) over the land and adjoining waters extending from the Brunswick River to the north, past Julian Rocks to the east, Broken Head to the south and around the hinterland areas of Mullumbimby, Coorabell and Bangalow to the west, including the Reserve.

A series of Indigenous Land Use Agreements (ILUAs) registered under the *Commonwealth Native Title Act 1993* has been made between the NSW Government and the native title claimants within the claim area. These ILUAs acknowledge that the Bundjalung People of Byron Bay are descendants of indigenous people who lived and/or held native title in the Byron Bay area at the time of first contact with European settlers in the 1820s and 1830s, and that they have a strong cultural association with the area. ILUA 1, registered in 2001, provided for the creation of Arakwal National Park in Byron Bay and employment, training and joint management opportunities for the native title claimants.

ILUA 2, registered in 2008, built on ILUA 1 and resulted in significant additions to parks and reserves in the National Parks and Wildlife Service (NPWS) Byron Coast Area (now part of the Tweed Byron Area), including the addition of the day use area at Broken Head and the dune system on Broken Head Beach. A Native Title consent determination, which includes Broken Head Nature Reserve, was granted by the Federal Court in 2019. In accordance with this, a new ILUA (Cavanbah (Byron Bay) Arakwal Indigenous Land Use Agreement) was registered.

In accordance with ILUA 2 and Cavanbah (Byron Bay) Arakwal ILUA, a management committee has been established to enable the joint management of the Reserve by the Arakwal and NPWS (see Section 4.1).

The Reserve is an important part of Country to the Arakwal for a range of reasons, including as a place of spiritual and cultural significance. It is a place where their ancestors lived, utilising the rich resources of the rainforest, and passed this information on to their descendants. The Arakwal recognise the importance of conserving this special place so that current and future generations may learn about its importance, its history and its future.

Photo 1 The headland of Broken Head. The Three Sisters Walking Track can be seen crossing the grassland.

Photo 2 View from Three Sisters Track lookout of the Reserve's back beaches.

2. Legal rules

2.1 Government laws and National Parks and Wildlife policies

The management of nature reserves in New South Wales is in the context of a legislative and policy framework, primarily the *National Parks and Wildlife Act 1974* and Regulation, the *Biodiversity Conservation Act 2016* (OEH 2018) and the policies of the NPWS.

Other legislation and international agreements also apply to management of the area. In particular, the *Environmental Planning and Assessment Act 1979* may require the assessment and mitigation of the environmental impacts of any works proposed in this plan. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* may apply in relation to actions that impact matters of national environmental significance, such as threatened and migratory species listed under that Act.

A plan of management is a statutory document under the National Parks and Wildlife Act. Once the Minister has adopted a plan of management, no operations may be undertaken within the Reserve unless in accordance with the plan. Broken Head Nature Reserve was previously managed under the *Byron Coast Group of Nature Reserves Plan of Management* (NPWS 1998). This plan replaces the 1998 plan in relation to Broken Head Nature Reserve. This plan will also apply to any future additions to the Reserve. Should management strategies or works be proposed for the Reserve that are not consistent with the plan, an amendment to the plan will be required.

2.2 Management principles for nature reserves in NSW

Nature reserves are reserved under the National Parks and Wildlife Act to protect and conserve areas containing outstanding, unique or representative ecosystems, species, communities or natural phenomena.

Under section 30J of the National Parks and Wildlife Act, nature reserves are managed to:

- conserve biodiversity, maintain ecosystem functions, and protect geological and geomorphological features and natural phenomena
- conserve places, objects, features and landscapes of cultural value
- promote public appreciation, enjoyment and understanding of the Reserve's natural and cultural values
- provide for appropriate research and monitoring.

The primary purpose of nature reserves is to conserve nature. Nature reserves differ from national parks in that they do not have the provision of visitor use as a management purpose or principle.

2.3 Cocked Hat Rocks Aboriginal Place

In 1987, the near-shore islands known as the Three Sisters or Cocked Hat Rock were declared an Aboriginal Place under section 84 of the National Parks and Wildlife Act (see Photo 3). The Aboriginal Place was added to the Reserve in 2005. An Aboriginal Place is an area of special significance to Aboriginal culture. Declaration provides recognition of the significance of the area and its heritage values, which relate to traditions, observances, customs, beliefs or history of Aboriginal people. The Cocked Hat Rocks Aboriginal Place is a natural feature that is part of a Dreaming story (see Section 4.2).

Photo 3 Cocked Hat Rocks (Three Sisters) Aboriginal Place.

3. The importance and management of Broken Head Nature Reserve

3.1 Respecting Country – key values associated with the Reserve

The Reserve has many values that are important to the Arakwal and the wider community, including:

'Looking after Country' – Reserve conservation and management

- Management of the Reserve recognises the rights and responsibilities of the Arakwal and their long and ongoing traditional association with the landscape that includes the Reserve.
- The Reserve protects Country and provides for the Arakwal and other Bundjalung people to continue their connection to Country through their cultural aspirations and obligations.
- The Reserve protects cultural and historical heritage values including special places and cultural stories of the Arakwal and other Bundjalung people.
- The Reserve protects a regional wildlife corridor, sensitive coastal dunes, littoral rainforests and headland grasslands supporting a range of native plants and animals, including threatened ecological communities, threatened and migratory species and their habitats.

'Using and knowing about Country' – use of the Reserve, information, research and monitoring

- The Reserve provides the Arakwal with opportunities for cultural use and cultural renewal associated with the sustainable use of wild resources; the transfer of cultural knowledge, customs and stories; and ceremonial and other cultural practices.
- Opportunities for visitors and the wider Byron Bay community to understand and respect the culture and heritage of the Bundjalung people are provided in the Reserve.
- The Reserve provides environmental education opportunities relating to Aboriginal cultural values, non-Aboriginal heritage values, coastal processes, rehabilitation of degraded areas, threatened ecological communities, and threatened and migratory species.
- Three walking tracks in the Reserve provide visitors with passive recreation opportunities including nature study, bushwalking and access to beaches.
- The Reserve provides opportunities for appropriate research and monitoring.

4. Looking after Country

4.1 Joint management

‘Joint management has been an empowering journey for our people, working hand in hand with NPWS our land and culture is improving for the next generation to come.’

Delta Kay, Arakwal Member

As traditional custodians of the land, Aboriginal people have a unique role to care for and manage Country. This role overlaps with the legislative responsibilities of NPWS to manage land for conservation. NPWS works with Aboriginal people to recognise and capitalise on these mutual interests and responsibilities, including recognising that:

- All parks and reserves are part of Aboriginal peoples’ Country and are places where Aboriginal people can care for their Country and access their Country and its resources. Given the history of dispossession in NSW, public lands and parks play an important role in the maintenance of Aboriginal culture and connection to Country. Meaningful engagement with Aboriginal communities on the management and use of parks and reserves is essential to ensure that their needs in relation to their Country are met.
- Aboriginal communities obtain cultural, social and economic benefits through being involved in park management.
- NPWS in partnership with the Aboriginal community are better able to protect and interpret cultural heritage and to apply Aboriginal knowledge to land management and the conservation of cultural and natural values.
- Visitors to parks have an enriched experience through interaction with Aboriginal people and an understanding of Aboriginal cultural values.

The Reserve is jointly managed by the NPWS and the Arakwal through ILUA 2. The ILUA 2 area comprises approximately 245 hectares of Crown land in and around Byron Bay, including the Reserve. ILUA 2 provided for approximately 72 hectares of additions to the national park estate, including the addition of 8.5 hectares to Broken Head Nature Reserve. Additions were also made to Arakwal National Park and Cumbebin Swamp Nature Reserve in Byron Bay. Joint management of the national park estate within the ILUA 2 area is delivered by a management committee established in accordance with ILUA 2. The Byron Coast Area Management Committee carries out its role within the framework of the National Parks and Wildlife Act, ILUA 2 and this plan of management.

Joint management aims to provide Bundjalung people with meaningful involvement in caring for Country on a day-to-day basis through their employment with NPWS and their role on the management committee. In accordance with ILUA 2, three positions were created within the NPWS Byron Coast Area for Aboriginal people to work on Country, including the Reserve.

Desired outcome

- Joint management of the Reserve will be undertaken through the Byron Coast Area Management Committee.

Management response

4.1.1 Issues and proposals relating to the care, control and management of the Reserve will be referred to the Byron Coast Area Management Committee for their consideration and recommendations.

4.2 The story of Country that is now the Reserve

A living ancestry and culture

The Arakwal are part of the Bundjalung Nation and their history in the area pre-dates the arrival of Europeans. Their ancestors, Bobby and Alice, Harry and Clara Bray, and Linda and Jimmy Kay lived and raised families in and around the Byron Bay – Broken Head area. The landscape that includes the Reserve is an important part of this history.

The earliest European record of Aboriginal people in the vicinity of what is now the Reserve was on Seven Mile Beach, south of the Reserve, in 1770. Joseph Banks, on board the *Endeavour*, recorded seeing a group of 20 Aboriginal people on the beach noting that while watching them for an hour no one was seen to look towards the ship and that the group appeared unaffected by 'the neighbourhood of so remarkable an object' (Waters 2003).

Despite the changing natural, socio-economic and political environment brought about since European settlement of the area, the Arakwal have maintained their links with Country that includes the Reserve. It is important to the Arakwal that their cultural traditions and associations are maintained. Maintenance of cultural traditions and associations contributes to identity and wellbeing and shows respect to their ancestors.

The Reserve includes three significant mythological sites associated with ceremony, ritual and spirituality. The Cocked Hat Rocks Aboriginal Place on two near-shore islands encompasses one of these mythological sites which the Arakwal call the Three Sisters (see Photo 3). A story associated with this place relates how a young Aboriginal woman swimming in this area was caught in a strong current and she and her sisters, who attempted to save her, were drowned and transformed into stone (Collins 1990). This story was told as a cautionary tale to children not to swim here as it is a dangerous swimming area with strong currents. Due to their special significance, detailed public information is not available on the two other mythological sites.

A number of sites demonstrating Aboriginal use have been documented in the Reserve (Collins 1990; NPWS Aboriginal Heritage Information Management System 2012), including middens containing the remains of foods such as pipis and molluscs (periwinkles and cartruts), and artefacts such as discarded tools and tool workings. The sites show that in addition to using materials available locally, materials were also imported for tool-making.

The abundant resources of the Reserve and the surrounding area were used extensively by generations of Bundjalung people. The rainforest, woodlands, beaches and the sea provided food and materials for weaving fishing lines, nets and baskets and for ceremonial and other purposes, and timber for canoes, shields, digging sticks and boomerangs. Appendix 1 lists plants known to be of cultural value.

Common animals in the Reserve such as the Australian brush-turkey (*Alectura lathami*), flying-foxes, pigeons, possums, bandicoots, wallabies, snakes and frogs were also important food sources for the Elders, their families and their ancestors. All these animals are

important to the Arakwal for their conservation, totemic, wild resource and other cultural values.

Lawyer cane (*Calamus muelleri*) was particularly plentiful at Broken Head and the Arakwal used it to expertly fashion a wide range of basketry which, in more recent times, was traded or sold to the European population.

Bundjalung of Byron Bay (Arakwal) Elder Harry Bray and his wife Clara lived in a hut at Brays Beach at various times. Broader community acknowledgement of the relationship of the Arakwal with Broken Head is evidenced by the naming of Brays Beach and Brays Hole, in the adjacent marine park, after Harry and Clara Bray. Their grandchildren relate being told by their Elders a story passed down from Harry and Clara that a gully running down to Brays Beach was inhabited by a large carpet snake with huge eyes and that they must avoid this area.

Harry's hunting prowess was remarked upon by George Flick who, with his brother, sometimes accompanied Harry to his Broken Head 'hunting grounds' as a child (Ryan 2001):

> They would follow up the track until something had attracted their attention. They would say 'Shoo my boys keep quiet. Your Uncle Harry can hear a wallaby'….and sure and behold, next thing you would hear would be 'a boomp a boomp' coming up the track…they would throw a boomerang or spear – one hit and they would have him…They could smell a carpet snake within a hundred yards…They never took more than they wanted.

Oral history links the Broken Head area to the infamous massacre of Aboriginal people at Ballina in the 1850s (Collins 1990). People fleeing the massacre ran north up Seven Mile Beach and hid in thick vegetation and in sea caves in what is now the Reserve. Oral tradition relates that they were pursued and killed.

Story of land use

The Broken Head area provoked strong responses from early European travellers in the area, ranging from dread to rapture. As early as 1865 Broken Head was referred to as 'the dreaded three mile scrub' due to its dense and impenetrable vegetation and steep terrain (Waters 2003). This attitude is understandable considering the comparative ease of travel along the long beaches north and south of Broken Head. By the early 1880s, the term 'Three Mile Scrub' was used by Europeans to refer to the Broken Head area (Stubbs 2006).

However, Archibald Meston was greatly impressed with Broken Head when travelling south from Cape Byron in the late 1880s 'along a beach of three miles to a rocky point, where we make a detour and travel two miles through dense scrub of an infinite variety of luxuriant vegetation — a perfect paradise for the botanist' (Waters 2003).

An 1894 article in *The Sydney Morning Herald* about Broken Head describes 'luxuriant vegetation' with 'thousands of hoyas' and 'remarkable-looking Richmond River or Hoop pine' and encourages the visitor to enjoy a ramble among 'graceful bangalow and cabbage-tree palms, tree ferns, immense cycads, figs, and, apparently endless species of tropical plants'. Cycads (*Lepidozamia peroffskyana*) are referred to as 'probably the finest specimens to be found in the colony… [and are]…covered with perfect specimens of ferns, staghorns, eklhorns, todeas, polypodiums, and birdsnest ferns.'

In 1896, a recreation reserve was gazetted over most of the northern area of the current Reserve, stretching south from the current day use area to the ridge north of Brays Beach (see Figure 1). At that time, the coastal fringe east of the recreation reserve formed part of a reserve for 'roadway and other public purposes'.

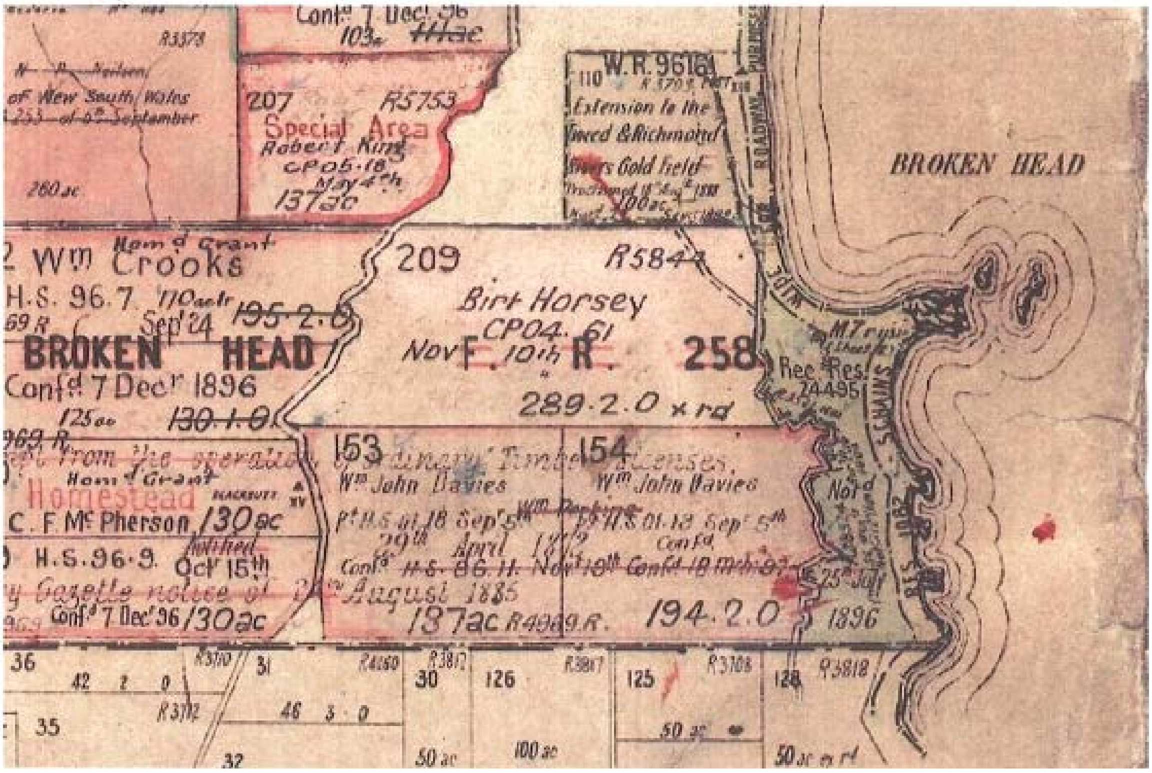


Figure 1 **Parish map from the late 19th century showing the boundaries of the 1896 recreation reserve and the coastal roadway reservation.**

South of the recreation reserve, the land which now forms part of the current Reserve formed the eastern section of a 259 hectare (640 acre) selection by Owen Wareham, a timber merchant (Stubbs 2006). Wareham cleared the land and traded in the hoop pine (*Araucaria cunninghamii*) cut from it (Collins 1990). By the late 1890s, William Flick had purchased 36 hectares of the southern portion of Wareham's selection in the vicinity of Whites Beach and Jews Point and he continued logging this area well into 20th century (Collins 1990).

Newspaper articles from the 1880s noted ships arriving in Sydney carrying timber from Broken Head, including pine logs. Early timber-getters would use bullocks to drag logs to Broken Head Beach and then through the surf from where they were taken aboard waiting ships (Collins 1990; Stubbs 2006). In 1908 a Royal Commission of Inquiry on Forestry was told that shipment of logs from Byron Bay had ceased and timber was being milled locally, mostly for local consumption (Stubbs 2006).

The sands of the beaches around Broken Head also yielded valuable mineral resources. The extent and duration of mining on the beaches and dunes now included in the Reserve is unknown. However, the beach and dunes north of Broken Head which were reserved for 'roadway and other public purposes' would have been mined. Parish maps from 1923 and 1960 also show mining applications for Brays Beach.

Gold was the initial target of miners of the mineral-rich 'black sands'. Newspaper reports from 1870 refer to gold diggings stretching for 13 miles (21 kilometres) from the Richmond River to around Broken Head (Stubbs 2006). Mining on Tallow Beach began soon after. A visitor to Broken Head in 1894 noted parties of gold miners 'scattered about the beach'. However, this type of mining was weather-dependent and in 1909 *The Sydney Morning Herald* reported that sandmining had ceased at Broken Head and Seven Mile Beach with 'no possibility of the beach-mining reviving until the terraces are treated by a heavy storm'. Sandminers who exploited mineral sands early could become rapidly wealthy. Beaches around Broken Head yielded 6.4 kilograms per person per day over a period of nine months

in the late 1800s, however, production averaged out to less than two kilograms per person per day between 1900 and 1929 (Collins 1990). Gold in the beach sands was largely exhausted by the 1930s (Collins 1990).

At the same time as gold was declining the exploitation of beach sand minerals, such as zircon and rutile, became significant. Commercial exploitation began in earnest with a lease to Zircon Rutile Ltd in 1935 (Collins 1990). The lease area at Broken Head yielded 250 tons of zircon in three months in 1936 (Stubbs 2006).

Originally, access to Broken Head from the north was via the beach (see Figure 1), however, in the 1920s a road running north-west from Broken Head, providing a link to the road to Byron Bay, was constructed by the Taylor family, who were local dairy farmers. The new road appears on the 1928 parish map. Some of this road is incorporated in the route of the current Broken Head Reserve Road, however, most of the road which crosses private and Crown land is now closed to the public.

The recreational value of Broken Head was recognised early, with the creation of the recreation reserve in 1896. A 1926 *Brisbane Courier* report noted Broken Head's 'unusually fine picnic ground', its peacefulness and lack of commercialism. However, the focus changed during the Depression (1929–1934) which saw people camping at Broken Head in cheap shelters made from 'cement rendered hessian bags' (Collins 1990). By 1936, things appear to have improved when an article in *The Queenslander* noted that Queensland visitors were spending their summer holidays camping under the campground's shady trees. Camping occurred on land now occupied by the Broken Head Holiday Park. It is also likely that camping occurred within the day use area now included in the Reserve and located adjacent to the Holiday Park.

With the decline of timber resources locally, dairying, horticulture and eventually cattle production became important local industries. It is likely that bananas were grown in the southern part of what is now the Reserve as early as the 1910s (Collins 1990) and from the 1940s on the slope behind the site now occupied by the Broken Head Holiday Park. Mrs M Carter, a former owner of 16 hectares of land around Brays Beach, recalled bananas growing there in the early 1950s and about 80 hectares of bananas growing on adjoining properties stretching to Seven Mile Beach (NPWS 1996). From the late 1950s, the Carter property was used for cattle production. Bananas continued to be grown commercially at Broken Head until the early 1960s (Collins 1990).

In the 1950s, a tick fence was erected on the Broken Head headland to protect cattle by separating tick-infested areas to the north from tick-free areas to the south (Collins 1990). The wooden posts which can be seen near the southern end of the Three Sisters Track are the remains of this fence.

A stone structure and roadway of unknown age and origin was recorded by Collins (1990) at Jews Point (see Photos 4 & 5). Its original purpose is unclear but its construction resembles lime kilns built around Port Macquarie in the mid-1860s (Collins 1990).

Photo 4 (left) Stone structure at Jews Point with distinctive layered rockwork.

Photo 5 (above) Looking down into the stone structure from above.

In the early 1970s, the Parks and Reserves Scientific Committee recommended the dedication of lands at Broken Head as a flora and fauna reserve. In 1974, 40 hectares of land at Broken Head was gazetted as Broken Head Nature Reserve. The Reserve originally extended south from the ridge on the Broken Head headland to the ridge north of Brays Beach.

The Reserve grew steadily in size throughout the 1980s through various land purchases by the NSW Government. By 1988 the Reserve totalled approximately 97 hectares and extended to Seven Mile Beach. Most additions during this period were funded under the Coastal Lands Protection Scheme. This scheme was established by the NSW Government to acquire rural coastal land in need of protection, in response to mounting pressure from tourism, new residential settlement and a lack of adequate local planning on the north coast (Kijas 2007).

In 1983 a property at Brays Beach, known as the Black Stump, was sold to American actor Shirley MacLaine. Ms MacLaine resold the property to the NSW Government the following year, having been made aware of its significance, limited development potential and plans for its inclusion in the Reserve.

Some of the land parcels added to the Reserve over the years included houses. The house on the Black Stump property, where Mrs Carter lived, was removed in late 1997 following heritage assessment and site recording (NPWS 1996). The White's house, located above Whites Beach, was removed in 1980. Another house, located above Brays Beach, was completely destroyed by fire in 1982.

The Three Sisters Walking Track, traversing the Broken Head headland, and the viewing platform overlooking Kings Beach were constructed in 1989 with a bequest to NPWS from the estate of Mr Dudley Cook. Mr Cook was a keen visitor to national parks on the north coast and wished to improve visitor access with his bequest.

The most recent period of reserve expansion began in 2005 with the addition of the Cocked Hat Rocks Aboriginal Place, which comprises two islands located 100 metres offshore from the Broken Head headland. The latest additions to the Reserve were transferred in accordance with ILUA 2 and included the Broken Head day use area and adjacent dunal areas, bringing the total area of the Reserve to 110 hectares.

Desired outcome

- Manage the Reserve to protect its biodiversity values and Aboriginal and non-Aboriginal cultural heritage values.
- Involve the Aboriginal community in efforts to conserve and protect the Reserve's cultural heritage and biodiversity values and incorporate Aboriginal knowledge, insights and values in these efforts.

Management response

4.2.1 Record the location of Aboriginal and non-Aboriginal heritage sites in the Reserve, including occupation sites.

4.2.2 Record Aboriginal and non-Aboriginal stories about the Reserve and its significance.

4.2.3 Undertake an archaeological assessment of the stone structure recorded at Jews Point to determine its significance and any necessary conservation works.

4.3 Native plants and animals

Native plants

The Reserve's native vegetation is highly diverse with 240 species recorded, and includes threatened and rare species. The Reserve supports rainforest, dry sclerophyll forest, woodland, grassland and dunal vegetation. Subtropical rainforest, of the *Cupaniopsis-Acmena* spp. alliance, dominates the Reserve. Due to its proximity to the sea, this alliance is also known as littoral rainforest (Floyd 1990).

There are also smaller areas of subtropical rainforest of the white booyong (*Heritiera trifoliolata*) alliance (also known as *Argyrodendron trifoliolatum*), which is the most structurally complex form of rainforest in New South Wales. This type of subtropical rainforest is more typical of the formerly extensive Big Scrub that occurred further inland on soils derived from volcanic origins. Although it is arguable whether the Reserve's rainforests can be considered part of the Big Scrub, research (Lott & Duggin 1993) indicates that outlying areas, including Broken Head:

> share many species with the remnants on the Big Scrub plateau and were once continuous with them but the additional influences of drier surrounds, mixed soil types and previous sea levels have allowed incorporation of dry rainforest and more coastal species into the vegetation community.

Other research has also noted that the remnant rainforest vegetation in the Midgen Creek area, west of the Reserve, demonstrates a residual link between Broken Head's rainforests and those of the adjoining plateau (Holmes 1987).

The Reserve supports four threatened ecological communities. The *Cupaniopsis-Acmena* spp. alliance is included in the listing of the Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community (EEC) under the Biodiversity Conservation Act (see Photo 6). Littoral rainforest is also included in the Commonwealth Environment Protection and Biodiversity Conservation Act listing of the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia Critically Endangered Ecological Community (CEEC).

The white booyong alliance is included in the Biodiversity Conservation Act listing of the Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions EEC. Lowland rainforest is also included in the Commonwealth Environment Protection and Biodiversity Conservation Act listing of the Lowland Rainforest of Subtropical Australia CEEC.

The Reserve's headland grasslands are included in the Biodiversity Conservation Act listing of the *Themeda* Grassland on Seacliffs and Coastal Headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC (see Photo 7).

Photo 6 Littoral rainforest EEC at Kings Beach.

Photo 7 Themeda Grassland EEC at Snapper Headland.

There are also few small examples of the Coastal Cypress Pine Forest in the North Coast Bioregion EEC in the Reserve. The best example is at a former house site and ranger station where an avenue of coastal cypress (*Callitris columellaris*) was planted along a driveway many years ago. These trees are now mature and coastal cypress is regenerating well. The listing determination does not exclude EECs that result from planting. The community meets the listing criteria and the precautionary approach indicates the community should be managed as an EEC considering its scarcity.

Twelve threatened plants, listed under the Biodiversity Conservation Act, have been recorded in the Reserve, six of which are also listed as endangered or vulnerable under the Environment Protection and Biodiversity Conservation Act. Four rare plants and another species that is close to its southern limit of distribution in NSW have also been recorded (Briggs & Leigh 1996; Floyd 1990; Sheringham & Westaway 1995). Threatened and significant plants recorded, or with potential habitat, in the Reserve are listed in Appendix 2.

Native animals

The Reserve supports a wide range of native animals including threatened and migratory species. The Reserve forms part of a regional coastal corridor which connects to a subregional corridor to the west linking it to the Nightcap Range and beyond via a network of fragmented but significant habitats which provide opportunities for dispersal and movement of wildlife.

Twenty-five threatened animals have been recorded on the Reserve (see Appendix 3). Eight animals known from the Reserve are protected under international migratory bird agreements or, in the case of the two turtle species, an international convention on the conservation of migratory species (see Appendix 3). These agreements and conventions are listed under the Environment Protection and Biodiversity Conservation Act.

The varied habitats of the Reserve support a range of sedentary, nomadic and migratory native animals. The longer growing, flowering and fruiting season on the NSW north coast during autumn-winter provides a reliable and plentiful supply of food for migratory and nomadic birds, flying-foxes and micro-bats at a time of year when food is often in short supply elsewhere. Many of these species move from higher elevation, higher latitude or lower latitude habitats occupied during spring-summer to ‘winter’ on the coastal lowlands (Scotts 2003).

The Reserve is important habitat for birds, particularly for fruit-eating and rainforest-dependent birds. Appendices 4 and 5 list fruit-eating and rainforest-dependent birds known

from the Reserve. These birds are important dispersal agents for rainforest plants, facilitating natural rainforest regrowth in the region and helping to maintain the ecological functioning of nearby Big Scrub rainforest remnants (NPWS 1998). Fruit-eating bats, such as the threatened grey-headed flying-fox (*Pteropus poliocephalus*), also play a key role in seed dispersal.

Rainforest is critical to maintaining migratory pathways for fruit doves and cuckoo-shrikes (Brodie, Green & Graham 2002). Birds arriving from higher elevations in winter, for example from the New England Tableland and nearby areas of the Great Dividing Range, use the food and habitat resources available in the network of Big Scrub remnants and coastal rainforests.

A study of birds in 32 rainforest remnants of the Big Scrub region ranked Broken Head highly for availability of main food plants such as laurels, myrtles and figs, however, the diversity of birds was lower than expected. This lower diversity may be due to vegetation damage caused by factors associated with its proximity to the sea, including salt spray and severe storm events (Holmes 1987).

Migratory birds visiting the Reserve include the rose-crowned fruit-dove (*Ptilinopus regina*), brush cuckoo (*Cacomantis variolosus*), white-throated needletail (*Hirundapus caudacutus*), black-faced monarch (*Monarcha melanopsis*), spectacled monarch (*Symposiarchrus trivirgatus*) and rufous fantail (*Rhipidura rufifrons*). Birds visiting the Reserve in cooler months from higher altitudes or from further south include the golden whistler (*Pachycephala pectoralis*), regent bowerbird (*Sericulus chrysocephalus*) and brown gerygone (*Gerygone mouki*). Other visitors to the Reserve occur in the region year-round but are locally nomadic, such as the wompoo fruit-dove (*Ptilinopus magnificus*) and Australasian figbird (*Sphecotheres vieilloti*). In spring and summer nectar-eating birds such as little wattlebird (*Anthochaera chrysoptera*) and noisy friarbird (*Philemon corniculatus*) arrive to exploit local flowering.

Common animals of the Reserve include the fawn-footed melomys (*Melomys cervinipes*), mountain brushtail possum (*Trichosurus caninus*), brown tree snake (*Boiga irregularis*), eastern snake-eyed skink (*Cryptoblepharus virgatus*), eastern water dragon (*Intellagama lesuerii*), lace monitor (*Varanus varius*), tusked frog (*Adelotus brevis*), brown thornbill (*Acanthiza pusilla*), white-bellied sea-eagle (*Haliaeetus leucogaster*), varied triller (*Lalage leucomela*), emerald dove (*Chalcophaps indica*), white-headed pigeon (*Columba leucomela*), spangled drongo (*Dicrurus bracteatus*), Australian brush-turkey (*Alectura lathami*), Lewin's honeyeater (*Meliphaga lewinii*), white-cheeked honeyeater (*Phylidonyris niger*), olive-backed oriole (*Oriolus sagittatus*), eastern yellow robin (*Eopsaltria australis*), Australian king-parrot (*Alisterus scapularis*), green catbird (*Ailuroedus crassirostris*), silver gull (*Chroicocephalus novaehollandiae*) and crested tern (*Thalasseus bergii*).

Photo 8 Threatened sooty oystercatchers forage on a rock platform.

The Reserve's islands, beaches and rocky shoreline are significant habitats for seabirds and shorebirds. Currently, the Reserve is declared to mean high water mark, however, inclusion of the intertidal zone to mean low water mark would provide additional protection for the habitat of migratory and threatened shorebirds, such as the pied oystercatcher (*Haematopus longirostris*) and sooty oystercatcher (*H. fuliginosus) (see Photo 8).*

The Cocked Hat Rocks are important roosting, breeding and nesting sites for shore and seabirds, including migratory and threatened species. Species frequently recorded using Cocked Hat Rocks are silver gull, crested tern, cormorants (*Phalacrocorax* spp.), eastern reef egret (*Egretta sacra*) and the threatened sooty oystercatcher.

Recent research (Crowther, Sumner & Dickman 2003) has recorded the subtropical antechinus (*Antechinus subtropicus*) in the Reserve. This is a newly described species and was formerly thought to be the brown antechinus (*Antechinus stuartii*). In view of this recent work, it is unknown if all previous records of the brown antechinus from the Reserve are *A. subtropicus*, or if both species occur.

The Reserve's invertebrate fauna is poorly documented; however, the Reserve is known to support endemic rainforest butterflies and a number of subtropical butterfly species at or near their southern limit. The Diggle's blue (*Hypochrysops digglesii*) breeds at the edge of the Reserve's rainforest, where its larvae feed on mistletoes in the adjacent woodlands. This is the only population known from reserved public lands in New South Wales and it is considered at risk from adjacent development (Sands & New 2002; Sands 1993). The endemic cephenes blue (*Pseudodipsas cephenes*) is scarce at the southern end of its range in northern New South Wales (Braby 2000) and is rainforest-dependent. Populations in the Reserve and in Iluka Nature Reserve (its southern limit of distribution) are considered relatively secure, however, there is concern for the species in New South Wales as there are few areas of known habitat (Braby 2000; Sands & New 2002).

The Broken Head area is also a stronghold for the endemic rainforest butterflies, the regent skipper (*Euschemon rafflesia rafflesia*) and the Richmond birdwing (*Ornithoptera richmondia*). The Richmond birdwing (see Photo 9) is listed as vulnerable in Queensland under the Queensland *Nature Conservation Act 1992.* Each species is dependent on a particular plant species in the Reserve for larval food. The regent skipper larva feeds exclusively on the rainforest shrub, veiny wilkiea (*Wilkiea huegeliana*). The Richmond birdwing feeds exclusively on the rainforest vine, *Pararistolochia praevenosa*.

Photo 9 Male Richmond birdwing butterfly.

Threats to native plants and animals

Major threats to the Reserve's native animals and plants are pest plants and, to a lesser degree, pest animals (see Section 4.4) and climate change (see Section 4.7). Other threats to native species in the Reserve are pathogens, such as the fungus myrtle rust (see Section 4.4) and inappropriate fire regimes (see Section 4.6).

Comparison of previous and current aerial photographs of the Reserve and anecdotal evidence indicates that adjacent native vegetation is expanding into the *Themeda* Grassland EEC. Canopy trees in the best example of the Coastal Cypress EEC in the Reserve, at the former ranger station, support a very dense occurrence of the vine native hoya (*Hoya australis*) which may result in their collapse. Interactions between the *Themeda* Grassland EEC and adjacent vegetation communities and between the Coastal Cypress EEC and native hoya require investigation to determine if any action is required to maintain the EECs.

Strategies for the recovery of threatened species, populations and ecological communities have been set out in the *Biodiversity Conservation Program.* These actions are currently prioritised and implemented through the Saving our Species program which aims to

maximise the number of threatened species that can be secured in the wild in New South Wales for 100 years (OEH 2013b). Individual recovery plans may also be prepared for threatened species to consider management needs in more detail. National recovery plans, satisfying the requirements of the Environment Protection and Biodiversity Conservation Act and Biodiversity Conservation Act, have been prepared for the Olongburra frog (*Litoria olongburensis*) and for the two species of marine turtle recorded on the Reserve. State recovery plans under the Biodiversity Conservation Act have been prepared for the koala (*Phascolarctos cinereus*), rusty rose walnut (*Endiandra hayesii*) and spiny gardenia (*Randia moorei*). A draft national recovery plan has been prepared for the grey-headed flying-fox and a plan is also being prepared for the long-nosed potoroo (*Potorous tridactylus*).

The *Northern Rivers Regional Rainforest Biodiversity Management Plan* (DECCW 2010a) meets the requirements of state recovery planning for the following threatened species and ecological communities which occur in the Reserve: Byron Bay diuris (*Diuris* sp. aff. *chrysantha*), pink nodding orchid (*Geodorum densiflorum*) and the *Themeda* Grassland EEC.

The *Border Ranges Rainforest Biodiversity Management Plan* (DECCW 2010b) meets the requirements of state recovery planning for the following threatened species and ecological communities which occur in the Reserve: ball nut (*Floydia praealta*), rainforest senna (*Senna acclinis*), rusty plum (*Niemeyera whitei*), rusty rose walnut, scented acronychia (*Acronychia littoralis*), spiny gardenia, stinking cryptocarya (*Cryptocarya foetida*), white lace flower (*Archidendron hendersonii*) and the Littoral Rainforest and Lowland Rainforest EECs. Both biodiversity management plans encourage a range of recovery actions for the listed species including the control of weeds, pest animals and pathogens (see Section 4.4) and the application of appropriate fire regimes (see Section 4.6).

Desired outcome

- Conserve native plants and animals and minimise impacts from introduced species, including pathogens, inappropriate fire regimes and climate change (see Sections 4.4, 4.6 and 4.7).

Management response

4.3.1 Implement actions in the *Biodiversity Conservation Program* and recovery plans for threatened species and ecological communities in the Reserve.

4.3.2 Pursue inclusion of the intertidal zone to mean low water mark in the Reserve to protect the habitat of migratory and threatened shorebirds.

4.3.3 Encourage flora and fauna surveys of the Reserve to expand information available on the Reserve's flora and fauna, including threatened and migratory species and threatened ecological communities.

4.3.4 Map the current extent of the *Themeda* Grassland EEC on the Broken Head headland and monitor changes.

4.3.5 Consult NPWS threatened species and regeneration specialists about management of native hoya vine in the Coastal Cypress EEC at the former ranger station site and implement any recommended management strategies.

4.4 Pests

Pest species are plants and animals that have negative environmental, economic and social impacts and are most commonly introduced species. Pests can have impacts across the

range of reserve values, including impacts on biodiversity, cultural heritage, catchment and scenic values.

NPWS prepares pest management strategies which identify pest species across the region's parks and priorities for control, including actions listed in the *Biodiversity Conservation Program*, threat abatement plans, and other strategies such as the *NSW Biodiversity Priorities for Widespread Weeds* (NSW DPI & OEH 2011) and the *NSW Biosecurity Strategy 2013–2021* (DPI 2013).

The NPWS pest management strategy (OEH 2012a) identifies pest species and priority programs for this park. The overriding objective of the pest management strategy is to minimise adverse impacts of introduced species on biodiversity and other park and community values while complying with legislative responsibilities. The strategy also identifies where other site- or pest-specific plans or strategies need to be developed to provide a more detailed approach.

The regional pest management strategy identifies the cane toad (*Bufo marinus*) and myrtle rust (*Uredo rangelii*) as significant pest animals and pathogens occurring in the Reserve. Four pest animals and insects are known to occur in adjoining areas: the fox (*Vulpes vulpes*), feral pig (*Sus scrofa*), cat (*Felis catus*) and pandanus planthopper (*Jamella australiae*). Eradication of pandanus planthopper and containment of myrtle rust are critical priorities for the Reserve due to their potential to significantly impact on reserve values.

A plan has been prepared to guide the management and control of cane toads on parks and reserves in New South Wales (OEH 2011a). The plan does not identify the Reserve as a priority for cane toad control.

Myrtle rust, a plant disease caused by an exotic fungus, is known to affect plants in the Myrtaceae family and was first detected on the NSW central coast in 2010. It is now widespread and has been recorded in bushland and gardens in and around Broken Head. Myrtle rust infects young actively-growing shoots, leaves, flower buds and fruits and its spores are spread by wind, water, animal dispersal and human activity. A plan outlining how myrtle rust will be managed in national parks and reserves has been developed and incorporates strategies to limit its spread and to minimise impacts to threatened species and ecological communities (OEH 2011b). The threatened red lilly pilly (*Syzygium hodgkinsoniae*) and many non-threatened plants in the Myrtaceae family which occur in the Reserve in the littoral and lowland rainforest EECs are potentially at risk. To date, myrtle rust has only been confirmed in the Reserve on recently planted broad-leaved paperbarks (*Melaleuca quinquenervia*) in the day use area (B Smeuninx 2012, pers. comm.)

In 2005, pandanus plants (*Pandanus tectorius*) in the Reserve were surveyed for the pest insect, pandanus planthopper and none were detected. Infestation with planthopper can lead to the death of pandanus plants. The regional pest management strategy recommends regular surveys of high risk areas, such as the Reserve, and provides a range of treatment options if the insect is detected. This strategy also identifies lethal yellowing of pandanus, caused by a bacterial pathogen, as an emerging threat and ranks it as a critical regional pest management priority. Surveys for planthopper will also look for signs of this emerging disease.

More open parts of the Reserve, particularly the day use area, are potential habitat for the pest bird, the common (Indian) myna (*Sturnus tristis*), which is establishing in Suffolk Park, an urban area 1.5 kilometres north of the Reserve. An action plan (DECC 2009) has been developed targeting this emerging pest. The Reserve will be monitored and if the species is detected action will be taken in accordance with the action plan.

The regional pest management strategy identifies the containment or eradication of bitou bush (*Chrysanthemoides monilifera*) as a critical priority for the Reserve because of its

significant impact on threatened species and ecological communities. The Reserve was identified as NSW's third highest priority area in the bitou bush threat abatement plan (DEC 2006). Control programs have reduced bitou bush cover in the Reserve by over 90 per cent. Before and after photographs show the visual impact of bitou bush removal at Whites Beach (see Photos 10 & 11). All bitou bush infestations have undergone initial and follow-up treatment. Only small infestations remain on inaccessible cliff faces. Ongoing monitoring and treatment is required to maintain the current low infestation level.

The regional pest management strategy identifies winter senna (*Senna pendula* var. *glabrata*) as a significant weed species with widespread distribution in the Reserve, however, most weeds in the Reserve occur as isolated or scattered infestations. The long, narrow shape of the Reserve results in a high boundary to area ratio making it highly susceptible to weed infestation, particularly along the western boundary with Seven Mile Beach Road. Major storms can also cause significant canopy damage and open up areas within the core of the Reserve to weed infestation. A detailed weed management strategy has been prepared for the Reserve (OEH 2012b) which builds on earlier weed management strategies by Bower (Bower Bush Works 2006) and Joseph (1995). The current strategy provides the framework for weed control programs in the Reserve. Appendix 6 lists the Reserve's priority weeds and their current distribution.

Cooperating with Reserve neighbours on strategies to control weeds on the Reserve's borders increases the effectiveness of weed control undertaken on the Reserve. Byron Shire Council and NPWS have cooperated on the aerial control of bitou bush on Crown land managed by the Council which abuts the southern boundary of the Reserve. Between 1997 and 1999, the Broken Head Protection Association, a local community conservation group, with the support of NPWS obtained funding from the Australian Government's Coastcare program to undertake vegetation restoration and soil erosion control works on Brays Beach, in its catchment and around the former ranger station site. The project was very successful in restoring areas of the Reserve degraded by past land use. Volunteers participating in the project were trained in weed control techniques by qualified bush regenerators.

Pest species with the potential to threaten the survival or evolutionary development of species, populations or ecological communities listed under the Biodiversity Conservation Act may be declared key threatening processes under the Biodiversity Conservation Act and/or the Environment Protection and Biodiversity Conservation Act. Table 1 lists the pests declared as key threatening processes relevant to Reserve.

The Biodiversity Conservation Act provides for threat abatement plans to be prepared for key threatening processes. A threat abatement plan has been prepared for predation by the red fox (OEH 2011c) and invasion of native plant communities by bitou bush (DEC 2006). A plan is also being developed for predation by feral cats. Threat abatement strategies are also listed in the *Biodiversity Conservation Program*.

Table 1 Pests known from the Reserve or adjacent lands declared as key threatening processes under the Biodiversity Conservation Act or the Environment Protection and Biodiversity Conservation Act

Key threatening process	BC Act	EPBC Act
Competition from feral honeybees	X	
Invasion and establishment of the cane toad	X	X
Invasion of native plant communities by *Chrysanthemoides monilifera*	X	
Invasion of native plant communities by exotic perennial grasses	X	
Invasion and establishment of exotic vines and scramblers	X	

Key threatening process	BC Act	EPBC Act
Invasion, establishment and spread of *Lantana camara*	X	
Introduction and establishment of exotic rust fungi of the Order Pucciniales pathogenic on plants of the family Myrtaceae	X	
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	X	X
Predation by feral cats	X	X
Predation by the European red fox	X	X

Photo 10 Whites Beach (2008) prior to treatment of bitou bush which appear as bright green shrubs in the background.

Photo 11 Whites Beach (2012) following bitou bush treatment.

Desired outcome

- Manage pest plants and animals, including introduced pathogens, to minimise impacts on native plants and animals in accordance with the pest management strategy and other relevant strategies and plans, such as the Broken Head Nature Reserve Weed Management Strategy.

Management response

4.4.1 Implement priority pest management actions from the pest management strategies.

4.4.2 Implement the Reserve Weed Management Strategy, incorporating monitoring.

44.3 Seek the cooperation of neighbours, where appropriate, in implementing weed and pest management programs.

4.4.4 Monitor the Broken Head day use area for invasion by the pest species, common (Indian) myna, and implement a control program if required.

4.5 Repairing the Reserve

Geology and soils

The Reserve's coastline is relatively young with steep headlands, small coves and beaches (NPWS 1998). The Reserve's western boundary is dominated by a north-south ridge which reaches 90 metres at its highest point above Brays Beach. Intermittent creeks flow east from this ridgeline via the Reserve's beaches to the sea. The Reserve's soils are predominantly derived from 400 million-year-old metamorphosed sediments of the Neranleigh-Fernvale Group, which comprise shale, siltstones, sandstones, phyllite, slate, quartzite and greywacke. These rocks weather to produce texture-contrast soils which are shallow, stony, of low fertility and are highly erodible if exposed (Murray & Baverstock 1991; NPWS 1998; Morand 1994).

The majority of soils in the Reserve are described as belonging to the Billinudgel soil landscape (Morand 1994). Features of these soils include aluminium toxicity potential, very strongly acid, low water-holding capacity and hardsetting. Morand (1994) also highlights the slumping of the steep seaward slope on Broken Head Beach due to undercutting caused by severe storms as a feature of this soil landscape.

The dunes and the beach north of Broken Head and the beaches further south in the Reserve belong to the Angels Beach soil landscape. These sands were deposited since stabilisation of present sea levels following the last ice age, about 6500 years ago, and are highly erodible and permeable, with very low fertility, variable pH (depending on seawater saturation and amount of shell fragments) and very low water-holding capacity. Soils of the back-barrier dunal areas, such as low-lying areas west of the access road to the day use area and north of the entrance to the Reserve, are generally humus podzols and peaty podzols in association with acid peats in wetter areas. They share the same features as the beach and dunal sands however 'coffee rock' may be present (Morand 1994).

Repair priorities

The Reserve's natural systems are still in the process of recovering from their land use history which included logging, sandmining, banana production and grazing. Control of pest plants is required to assist recovery from these impacts (see Section 4.4).

Biodiversity impacts associated with Seven Mile Beach Road, which is maintained by Byron Shire Council and is located on the Reserve's western boundary, include stormwater runoff, sedimentation, wildlife road deaths, the coating of vegetation with dust from the unsealed road and impacts associated with road maintenance.

Byron Shire Council mapping indicates that potential acid sulfate soils are likely to occur one metre below the surface in a small area around the Reserve's northern boundary. In their natural state, these soils are submerged and often alkaline and are therefore called potential acid sulfate soils but when exposed or drained they become oxidised producing sulfuric acid and are then called actual acid sulfate soils. Acid sulfate soils should not be disturbed, however, it may be necessary to remediate acid sulfate soils that have been exposed or disturbed by past activities, such as drainage. Any proposed disturbance to acid sulfate soils would require environmental assessment including preparation of an acid sulfate soils management plan.

A field investigation has been undertaken of a rusty-coloured sludge which is observed at times in the water in the drain between the Broken Head Holiday Park and the day use area and in a creek which connects to the drain. The investigation found that this material is probably an iron deposit often termed ochre (D Morand 2012, pers. comm.). It is not

associated with acid sulfate soils but is formed by a process involving soil bacteria and iron within the soil.

The southern end of Broken Head Beach is significantly affected by coastal erosion. Byron Shire Council's coastal erosion mapping (Byron Shire Council 2010) indicates that dunal areas of the Reserve north of Broken Head headland are under immediate threat of coastal erosion. Low-lying areas of the Reserve such as the day use area, roads and carparks may come under threat from coastal erosion within 100 years.

Desired outcome

- The extent of acid sulfate soils and any associated hazards in the Reserve are identified and managed to minimise impacts on the environment and infrastructure.
- Natural coastal processes in the Reserve, including shoreline fluctuation and dune erosion, are allowed to continue unimpeded.
- Impacts associated with the maintenance and operation of Seven Mile Beach Road are minimised.

Management response

4.5.1 Encourage research into the location of acid sulfate soils in the Reserve and the identification of any amelioration measures required.

4.5.2 Contact Byron Shire Council and request consultation prior to maintenance works on Seven Mile Beach Road to permit consideration of methods to reduce the impact of works on the Reserve's biodiversity values.

4.6 Fire

The primary objectives of NPWS fire management are to protect life, property, community assets and cultural heritage from the adverse impacts of fire, while also managing fire regimes in parks to maintain and enhance biodiversity. NPWS also assists in developing fire management practices that contribute to conserving biodiversity and cultural heritage across the landscape, and implements cooperative and coordinated fire management arrangements with other fire authorities, neighbours and the community (OEH 2013a).

Fire is a natural feature of many environments and is essential for the survival of some plant communities. However, inappropriate fire regimes can lead to loss of particular plant and animal species and communities, and high frequency fires have been listed as a key threatening process under the Biodiversity Conservation Act. The Reserve's extensive rainforests and small areas of cypress forest are fire-sensitive, however, some of the Reserve's vegetation communities, such as dry and wet sclerophyll forests and woodlands, are adapted to fires at specific intensities and intervals. The fire ecology of the *Themeda* Grassland EEC has yet to be determined.

Built assets on the Reserve that are vulnerable to fire are visitor facilities in and around the Broken Head day use area, signage, walking tracks and viewing platforms on the Three Sisters Walking Track and on a beach access at the day use area.

The Broken Head Holiday Park is an in-holding in the Reserve. Several private properties lie to the west of Seven Mile Beach Road and border the new reserve additions north of Broken Head Reserve Road. These properties contain an assortment of built assets, including private dwellings and tourist accommodation surrounded by grasslands, landscaping and various forest types.

Two fires have been recorded within and adjoining the Reserve. A fire in 1987 burnt about 1 hectare of headland brush box forest, rainforest and native grassland above Kings Beach. In 1991, 22 hectares of headland brush box forest and rainforest was burnt in a fire which entered the Reserve from private property west of Seven Mile Beach Road and burned downhill to Whites Beach.

A fire management strategy which defines the fire management approach for the Reserve was prepared and adopted in 2006 (NPWS 2006). Currently, the Reserve has a Type 1 fire management strategy which outlines the Reserve's recent fire history, key assets within and adjoining the Reserve, including sites of natural and cultural heritage value, fire management zones and fire control advantages such as management trails. It also contains fire regime guidelines for conservation of the Reserve's vegetation communities. The fire management strategy designates the Reserve as a Land Management Zone. The primary fire management objectives for the Land Management Zone are to conserve biodiversity and to protect culturally significant sites. The fire management strategy will be updated to incorporate consideration of the recent additions to the Reserve as a result of ILUA 2 located north of the Broken Head Holiday Park. This may result in the adoption of a Type 2 Fire Management Strategy which is presented in a map format.

NPWS maintains cooperative arrangements with surrounding landowners and the Rural Fire Service and is actively involved with the Northern Rivers Bush Fire Management Committee. Cooperative arrangements include fire planning, fuel management and information sharing.

Desired outcome

- Negative impacts of fire on life, property and the environment are minimised.
- The potential for spread of bushfires on, from, or into the park is minimised.
- Fire regimes are appropriate for conservation of native plant and animal communities.

Management response

4.6.1 Update the Reserve fire management strategy to incorporate new additions and information and implement the strategy.

4.7 Climate change

Climate change has been listed as a key threatening process under the Biodiversity Conservation Act. Projections of future changes in climate for New South Wales include higher temperatures, increasing sea levels and water temperatures, more intense but possibly reduced annual average rainfall, increased temperature extremes and higher evaporation. These changes are likely to lead to greater intensity and frequency of fires, more severe droughts and increased regional flooding.

For the Reserve, the likely impacts of climate change based on regional scenarios (DECCW 2010c) are:

- An increase in sea level which coupled with storms will cause coastline recession of 20–40 metres by 2050.
- Salt water intruding into water tables is likely to raise the saltwater table on the coastal sand plain and push the freshwater sitting above it towards the surface. In lower areas, salt water is likely to approach or reach the surface. These physical changes in water tables will change the vegetation in affected areas to plants able to cope with these new conditions.

- More intense rainfall is likely to result in increased flooding. Events such as the flooding of the Broken Head day use area in December 2010 (A Robinson 2012, pers. comm.) and localised flooding at Kings Beach are likely to become more common.
- Acid sulfate soil problems are likely to increase in the short term but improve in the longer term with inundation of these low-lying soils (see Section 4.5).

Climate change may significantly affect biodiversity by changing population size and distribution of species, modifying species composition, and altering the geographical extent of habitats and ecosystems. Species most at risk are those unable to migrate or adapt, particularly those with small population sizes or with slow growth rates. The potential impact of climate change is difficult to assess since it depends on the compounding effects of other pressures, particularly barriers to migration and pressure from weeds and feral animals. Programs to reduce pressures arising from such threats will help reduce the severity of the effects of climate change (see Sections 4.4 and 4.6).

The Department has mapped climate change corridors along climatic gradients for native animals occupying coastal, dry and moist habitats (DECC 2007a). These corridors are predicted to be important for wildlife adapting to the threatening processes of climate change. Corridors for fauna occupying moist and coastal habitats overlap in the Reserve. The corridor for fauna of moist habitats runs north from Broken Head to Cumbebin Swamp and then west along the escarpment to the Nightcap Range. The coastal corridor parallels the coast north of the Reserve connecting it to Arakwal National Park and Cape Byron State Conservation Area. The corridor south of the Reserve incorporates the fragmented woodlands and forest of Broken Head, the extensive Newrybar Swamp and the extensive heath and wetland communities of the sandplain north of Lennox Head.

Desired outcome

- The effects of climate change on natural systems are reduced (see Sections 4.4 and 4.6).
- Visitor facilities are designed taking into account the likely impacts of climate change (see Section 4.5).

5. Using and knowing about Country

5.1 Keeping connected with Country - cultural renewal

Aboriginal people have adapted and sustained their cultural identity despite the impacts brought about by European settlement. The links Aboriginal people maintain with Country continue to be expressed through stories, descent, occupation and use. Aboriginal people maintain their cultural identity and links with Country through cultural learning passed on by Elders to the following generations.

NPWS recognises that the Arakwal and other Bundjalung people may want to undertake cultural activities in the Reserve and that these activities are important to transfer knowledge and to maintain, renew or repair cultural associations with Country. Cultural activities may include the use of wild resources.

ILUA 2 provides for access to the Reserve by Arakwal for cultural purposes including conduct of ceremonies; gathering material for medicine, ceremonies and food; and for the utilisation of wild resources. ILUA 2 also provides for studies into any danger to threatened species from the exercise of rights to use wild resources or to gather traditional foods in the Reserve.

Desired outcome

- The Aboriginal community has access to the Reserve for cultural activities while ensuring that the Reserve's biodiversity values are protected.

Management response

5.1.1 Conduct studies into threats to reserve values, including threatened species, from the exercise of rights to use wild resources, and manage activities accordingly.

5.2 Managing use of the Reserve

NPWS parks and reserves provide a range of opportunities for recreation and tourism including opportunities for relaxation and renewal as well as appropriate active pursuits. Visitor opportunities provided in the natural and undeveloped settings afforded by the parks system are mostly those at the low-key end of the spectrum. NPWS aims to ensure that visitors enjoy, experience and appreciate the parks while park values are conserved and protected.

The Reserve is located within the Northern Rivers Region. The population in the region is currently 288,368 and is projected to grow to 308,637 by June 2016. Almost half of the Australian visitors that overnight in the region are from Queensland and this trend is growing (Tourism NSW 2012). The position of the Reserve close to the growth hub of south-east Queensland means that potential reserve visitation demand is high. Visitation to the Reserve is highest in summer.

Reserve visitation needs to be carefully managed as visitors can negatively impact natural and cultural values. The nature and severity of potential visitor impacts depend on the type, frequency and interaction of activities, visitor numbers and behaviour, site capacity and durability and the sensitivity of the site's natural and cultural values.

Visitors directly impact the Reserve by destroying vegetation and dumping rubbish and indirectly impact by their domestic pets predating and disturbing native animals and their habitats.

Most visitor activity is concentrated on the Reserve's beaches, rocky coastline and the Broken Head day use area. Main activities undertaken are beach activities, picnicking, bushwalking and nature appreciation. Other nearby areas of NPWS estate provide a diverse range of recreation opportunities, information and visitor facilities, in particular, Cape Byron State Conservation Area at Byron Bay.

Vehicle access and picnicking

Broken Head Reserve Road is the major visitor access route to the Reserve and terminates at the Broken Head day use area (see Photos 12 & 13), which is promoted as the main visitor hub in the Reserve. Broken Head day use area provides a range of visitor facilities including toilets, showers and barbecues, and parking for 86 vehicles. Three beach access tracks provide access from the carpark to Broken Head Beach, one of which also includes a viewing platform. The day use area was added to the Reserve in 2009 in accordance with ILUA 2. A major upgrade of the day use area was completed in 2010 which improved visitor facilities and protected important dunal areas. Entry fees were introduced at the day use area in 2012 with revenue directed back to management of the Reserve.

Photo 12 and Photo 13 Broken Head day use area.

Seven Mile Beach Road commences at the entrance to the day use area, runs south along the dominant north-south ridge on the western boundary of the Reserve, and terminates approximately 800 metres south of the Reserve on Seven Mile Beach. Seven Mile Beach Road is a public road owned and maintained by Byron Shire Council. The road is narrow, winding and unpaved. Speeding and low visibility on bends impacts road safety. There are also problems with illegal parking on road sides, particularly during peak visitor periods. Byron Shire Council has addressed this issue by installing 'No Stopping' signs on the roadside and operating compliance patrols in peak periods. Due to these safety considerations, the use of Seven Mile Beach Road for vehicle access to the Reserve will not be promoted.

A small, unpaved carpark for approximately 25 vehicles is located at the entrance to the Kings Beach Walking Track approximately 800 metres south along Seven Mile Beach Road from the day use area. Car parking at the track head to Whites Beach occurs informally on the road reserve along Seven Mile Beach Road.

The Broken Head day use area will continue to be promoted as the Reserve's visitor access hub in an effort to reduce traffic on Seven Mile Beach Road, to improve road safety and to ameliorate parking issues associated with access to Kings and Whites beaches.

Bushwalking

Bushwalking allows visitors to be in close contact with the environment and can increase understanding and enjoyment of parks and the environment generally. The Reserve provides a range of bushwalking opportunities with varying degrees of social interaction, physical challenge and self-reliance in a largely natural, coastal setting featuring sandy beaches and rocky coves fringed by rainforest and headland grasslands. Bushwalking opportunities provided in the Reserve are shown on Maps 1 and 2 and detailed in Table 2. A small proportion of visitors who are experienced and equipped for self-reliant bushwalking also utilise more remote areas of the Reserve.

The Three Sisters Walking Track, which traverses the Broken Head headland, is the most popular walking track in the Reserve (see Photo 1, 14 & 15). It is accessed from the day use area, has moderate grades and offers a spectacular coastal panorama stretching from Cape Byron in the north, across the Reserve's beaches, rocky coves and headlands. A coastal viewing platform is located at the end of the Three Sisters Walking Track (see Photos 2 & 14).

The current extension (A) to the Three Sisters Walking Track descends from the viewing platform to a rocky cove and rock platform which are subject to tidal influences and swell (see Map 2). A risk assessment is required to determine options for management of this section of the track. This may include provision of additional environmental and/or safety measures or possible closure.

A proposal to construct a new walking track to link the Three Sisters Walking Track to the Kings Beach Walking Track, incorporating the ridge-top route of a tick fence constructed in the 1950s, is currently under consideration (see Map 2). This would allow visitors to enjoy a longer walk of approximately 1.3 kilometres (2.6 kilometres return) from the Broken Head day use area to Kings Beach without having to use Seven Mile Beach Road or cross rocky, tidal sections of the coastline. The existing Kings Beach Walking Track will remain open to the public independent of whether the proposed walking track is constructed. Environmental impact assessment of the project will be undertaken.

Table 2 Bushwalking in Broken Head Nature Reserve

Walking Track Name	Location	Setting	Distance (metres)	Maintenance Standard*
Three Sisters	Broken Head day use area to the Three Sisters viewing platform.	Coast, rainforest, headland grassland	578	Walking Track (Class 3)
Three Sisters extension A	Three Sisters viewing platform, at the end of the above walking track, to the rocky cove below.	Coast	34	Walking Track (Class 3)
Three Sisters extension B	Three Sisters Walking Track to the beach adjacent to Cocked Hat Rocks (Three Sisters).	Coast	55	Walking Track (Class 3)
Kings Beach	Kings Beach carpark, on Seven Mile Beach Road, to Kings Beach.	Rainforest	306	Walking Track (Class 3)
Proposed Three Sisters to Kings	Proposed link between the Three Sisters Walking Track and the Kings Beach Walking Track via a ridgeline route.	Coast, rainforest	370	Walking Track (Class 3)

Walking Track Name	Location	Setting	Distance (metres)	Maintenance Standard*
Beach Link				
Whites Beach	Seven Mile Beach Road to Whites Beach.	Rainforest	182	Walking Track (Class 3)

* The Australian Standard for walking tracks (AS2156.1-2001) has been used as the basis for this track classification system. Refer to this standard for the complete details for each class of track. The names given to each class of track have been applied for ease of use and comprehension and are not derived from the standard.

Photo 14 (above) Three Sisters Walking Track and viewing platform on Broken Head headland.

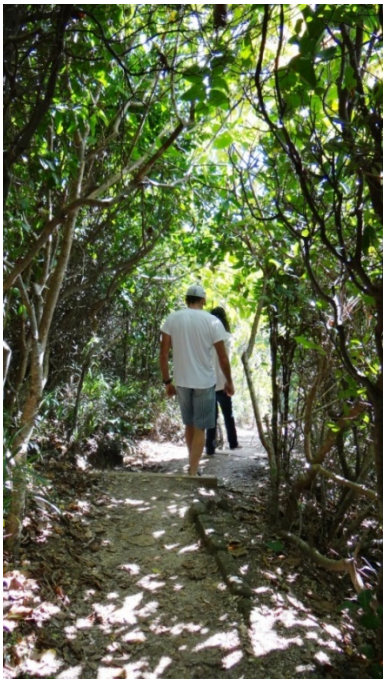
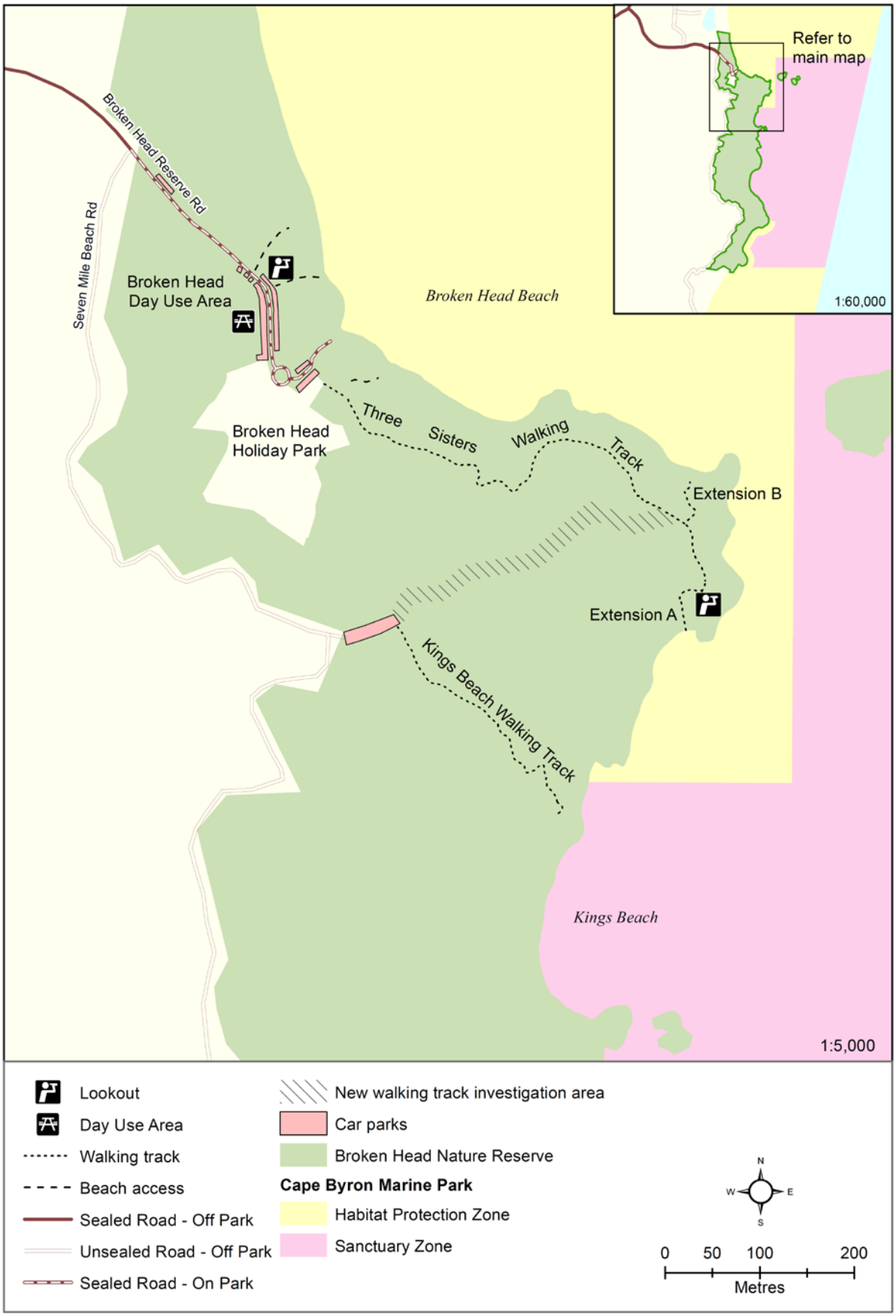


Photo 15 (right) Littoral rainforest on Three Sisters Walking Track.



Map 2 Proposed walking track investigation area

The Kings Beach Car Park sits at the existing Kings Beach track head. Its location off the narrow and winding Seven Mile Beach Road has raised a number of safety concerns. Visitors to Kings Beach also regularly park on the Seven Mile Beach Road roadside causing a traffic hazard. Pedestrians are known to short cut through the Reserve putting themselves at risk by crossing unsafe areas of rocky headland subject to tides and wave action. The track head in the Broken Head day use area will be promoted as the preferred access for Kings Beach to reduce traffic impacts and promote safe access. The proposed construction of the new walking track to link the Three Sisters Walking Track to the Kings Beach Walking Track will also promote safe access.

At Kings Beach Car Park, further investigation will be undertaken into:

- managing illegal camping, rubbish dumping and damage to vegetation
- salt-related dieback of rainforest caused by the car park
- weed invasion on the edges of the car park
- the potential introduction of pathogens on vehicles.

Horse riding

Horse riding is a popular recreational activity that has cultural associations for many Australians. The NPWS *Strategic Directions for Horse Riding in NSW National Parks* (OEH 2012c) provides a process for providing riding opportunities in eight priority regions in New South Wales.

Horse riding opportunities are being implemented in selected national parks across NSW in accordance with the NPWS *Horse Riding Policy*. However, horse riding is not an appropriate activity in nature reserves due to the specific conservation requirements of this category of reserve (see Section 2.2). As such, horse riding is not permitted within the Reserve due to its significant natural and cultural heritage values and the lack of suitable trails.

Though NPWS policy may permit horse riding on park roads in nature reserves, horse riding is not permitted on the section of Broken Head Reserve Road within the Reserve due to road safety considerations including the narrowness of the road and the likelihood of conflict with other road users, particularly in peak visitation periods. Moreover, this section of Broken Head Reserve Road is relatively short and only leads to areas where horse riding is not allowed (e.g. a day use area within the Reserve, Broken Head Holiday Park and adjacent Council-managed beach).

Cycling

There is currently minimal cycling in the Reserve. In accordance with NPWS policy and the *Sustainable Mountain Biking Strategy* (OEH 2011d) cycling is permitted on Broken Head Reserve Road within the Reserve but is not permitted on walking tracks within the Reserve. Mountain bike single-tracks will continue to be prohibited in nature reserves as they are inconsistent with their management principles (OEH 2011d).

Camping

Camping is not permitted in the Reserve. Clearing of rainforest or other high conservation value vegetation would be required to create a campground or the existing day use area would have to be reduced in size. Camping is already available at a number of local campgrounds including at the Broken Head Holiday Park adjacent to the day use area.

Commercial activities and large-scale organised activities

Commercial activities and large-scale organised activities require consent or licensing under the National Parks and Wildlife Act or Regulation. All approved activities must be consistent with the management principles of nature reserves and be compatible with the natural and cultural heritage values of the Reserve.

Group activities can provide opportunities for people who would otherwise not be able to experience the Reserve and can promote environmental understanding and support for conservation. Large groups can, however, have an environmental impact and can restrict opportunities for independent visitors.

Applications for activities will be assessed in accordance with relevant NPWS policies and procedures. Applications for commercial activities and large-scale organised activities will only be considered for the Broken Head day use area, as it is highly modified and has appropriate facilities, and for access to Broken Head Beach. Generally, only weddings and events will be considered. However, tour operations in the Broken Head day use area and on walking tracks emanating from the day use will also be considered. Commercial recreational activities, such as fitness training, kayak tours, surf schools and equipment hire will not be permitted.

A licence has been issued for a mobile vendor to sell refreshments at the Broken Head day use area. Mobile refreshment vendors will only be licensed to operate in the Broken Head day use area.

Cultural activities undertaken in accordance with ILUA 2 are not restricted to the day use area (see Section 5.1).

Easements

The following infrastructure within the Reserve (see Map 3) is covered by a formal easement agreement which incorporates a process for obtaining consent from NPWS for works, including maintenance:

- Broken Head Reserve Road for public access
- rising main and water supply pipelines in the road reserve for Broken Head Reserve Road and in part of the day use area
- drainage and sewer pipelines in the Broken Head day use area and the road reserve for Broken Head Reserve Road
- sewer pump station in the Broken Head day use area.

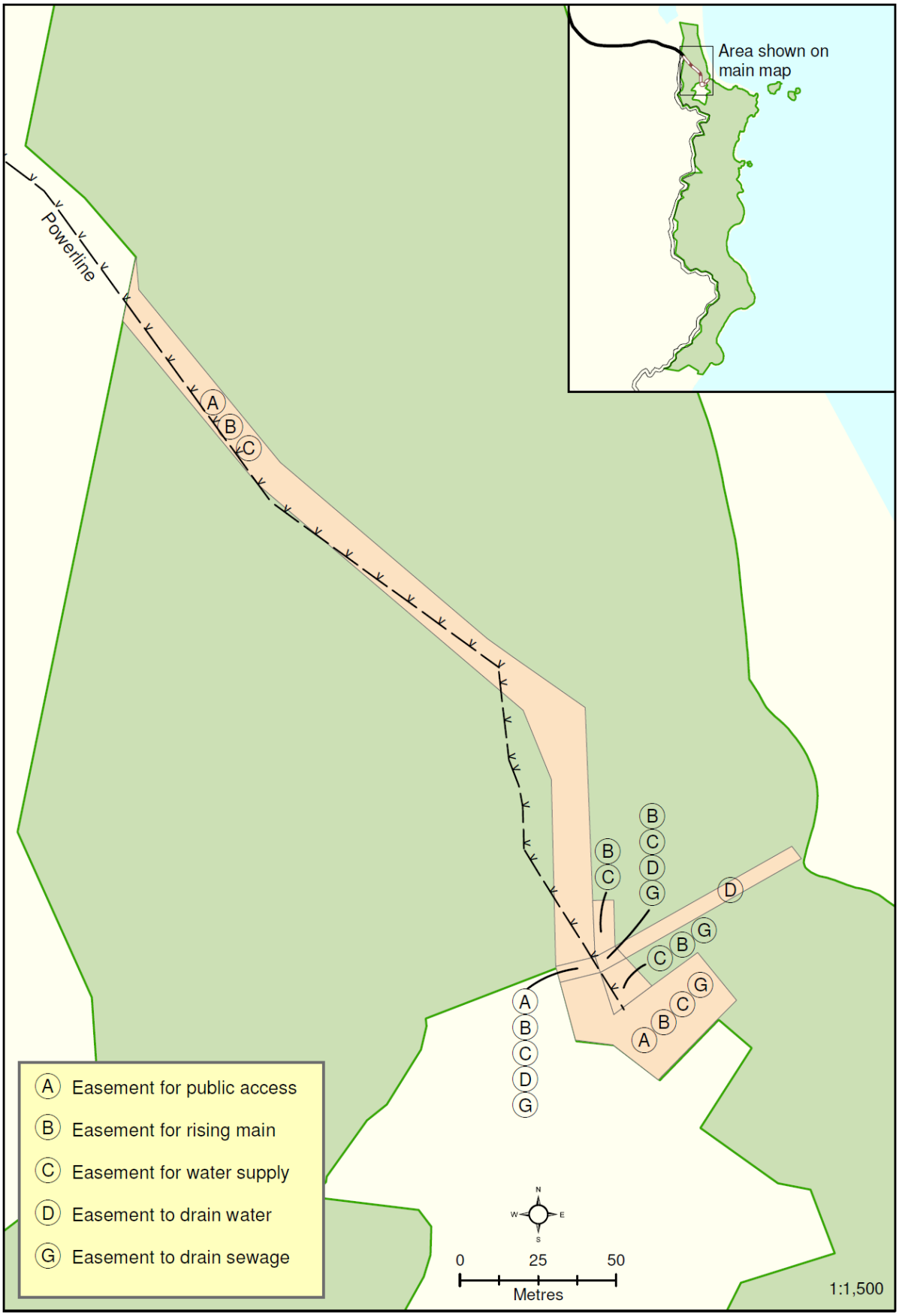
The rising main, water supply infrastructure and sewer pump station are the responsibility of Byron Shire Council. The road is maintained by NPWS. The drainage and sewer pipelines from the Broken Head Holiday Park are the responsibility of the owners of the Holiday Park.

Transmission lines

Essential Energy operates a powerline adjacent to Broken Head Reserve Road within the Reserve (see Map 3). The section of the powerline running through the day use area was relocated underground by NPWS as part of the 2010 day use area upgrade. The remaining above ground section of the powerline traverses a threatened rainforest community adjacent to the road.

This power line is not covered by a formal easement. In accordance with the *Electricity Supply Act 1995* a network operator can operate and use existing powerlines whether or not there is a formal easement in place.

Powerline maintenance has the potential to cause significant environmental and visual impacts. No access or maintenance agreement currently exists with Essential Energy, but the company must comply with the National Parks and Wildlife Act and Regulation when carrying out any maintenance or replacement work and will require NPWS consent for certain works.



Map 3 Broken Head day use area utilities

Cocked Hat Rocks

The Cocked Hat Rocks are important roosting, breeding and nesting sites for shore and seabirds. Visitor access has the potential to damage nests, eggs and nestlings and to disturb bird breeding, nesting and the fledging of young. To protect these important biodiversity values, recreational and commercial use of the Cocked Hat Rocks will not be permitted.

Cape Byron Marine Park

Areas below mean high water mark form part of the Cape Byron Marine Park which is managed by the Marine Parks Authority. The NPWS and the Marine Parks Authority aim to ensure that management of the Reserve and the marine park are complementary. The zoning plan for the marine park came into effect on 1 May 2006 and designates waters from Kings Beach to north of Snapper Rock as Sanctuary Zone with the remainder of waters adjoining the Reserve designated Habitat Protection Zone.

Desired outcome

Visitor use is appropriate and ecologically sustainable.

- Birds using Cocked Hat Rocks are protected and their breeding activities are not disturbed by reserve visitors.
- Infrastructure within easements is managed in accordance with the terms of the easement agreement.
- Visitor facilities and activities are planned and managed to provide a satisfying visitor experience and minimise impacts.
- Transmission lines are managed to minimise impacts on reserve values.

Management response

5.2.1 Undertake feasibility and environmental impact assessments for the development of a walking track linking the Three Sisters Walking Track and the Kings Beach Walking Track.

5.2.2 Undertake a risk assessment of the existing southern extension (A) of the Three Sisters Walking Track from the viewing platform to determine appropriate action, which may include improved environmental or safety works, or track closure.

5.2.3 Erect signage at the Broken Head day use area and on the Three Sister Walking Track identifying the location of the Cocked Hat Rocks and advising that recreational use is not permitted.

5.2.4 Camping and horse riding are not permitted in the Reserve.

5.2.5 Cycling is only permitted in the Reserve on Broken Head Reserve Road.

5.2.6 Applications for activities will only be considered for the Broken Head day use area and for access to Broken Head Beach for weddings and events.

5.2.7 Tour operations in the Broken Head day use area and on walking tracks emanating from the day use area will be considered.

5.2.8 Commercial recreational activities, such as fitness training, kayak tours, surf schools and equipment hire are not permitted in the Reserve.

5.2.9 Mobile refreshment vendors will only be licensed to operate in the Broken Head day use area.

5.2.10 Monitor approved activities with respect to cumulative impacts, safety requirements, quality of information being given and compliance with licence or consent conditions and institute controls and/or change consent conditions if necessary.

5.2.11 Formalise an agreement with Essential Energy for the maintenance of the powerline in the Reserve.

5.3 Talking about Country – providing information

Providing information assists the protection of natural and cultural heritage, promotes support for conservation, and increases the enjoyment and satisfaction of visitors. Information about the Reserve's cultural and biodiversity values is provided through signage on the Three Sisters Walking Track which is the Reserve's most popular walking track. Signage at all track entrances has also been upgraded recently (see Photo 16). Broken Head day use area also provides opportunities for Discovery program activities.

Photo 16 Directional signage (2012) at the entrance to Kings Beach Walking Track.

The nearby Cape Byron State Conservation Area provides additional and complementary information on cultural and biodiversity values of the parks and reserves of the Byron Coast. The Cape Byron headland is also a good vantage point from which to view the Reserve's broader landscape setting.

Desired outcome

- There is widespread community understanding and appreciation of the Reserve's natural and cultural values.

Management response

5.3.1 Consult and involve the Arakwal in the development and delivery of information programs on the Reserve's Aboriginal cultural and biodiversity values.

5.3.2 Provide additional directional signposting within the Reserve as facilities are provided.

5.4 Understanding Country – research and monitoring

The Arakwal have a broad knowledge of Country as told by the Elders through oral history. The NPWS respects this intellectual property and wishes to add to this body of knowledge. Research is an important part of 'Looking after Country' (see Section 4) and 'Knowing about Country' as it ensures reserve values are clearly identified and managed as well as possible.

Research and monitoring assists in assessing the success of reserve management programs and may trigger specific management actions. In particular, monitoring of plant and animal communities, species and habitats is important to identify changes in their distribution and abundance due to human impacts and the impacts of introduced species, management activities, climate change and responses to natural phenomenon (see Photos 17 & 18).

Photo 17 Broken Head beachfront 1939. The headland is dominated by grassland at this time (Source: State Library).

Photo 18 Broken Head beachfront today. Rainforest has largely replaced the headland grassland visible in the 1939 photo. Monitoring helps us to understand how plant communities change over time.

Research and monitoring will be encouraged which assists management of the Reserve, such as into Aboriginal and non-Aboriginal cultural heritage, threatened and migratory species and threatened ecological communities, pest species, acid sulfate soils and fire and their impacts on native plants and animals (see Sections 4.2, 4.3, 4.4, 4.5 & 4.6).

Desired outcome

- Research and monitoring is undertaken on topics which assist management.
- Research and monitoring has minimal impact on the Reserve's natural and cultural values and is subject to NPWS licensing/consent requirements.

Management response

5.4.1 Permit research and monitoring, subject to NPWS licensing/consent requirements, that enhances management and has minimal impact on the Reserve's natural and cultural values.

6. Plan implementation

This plan of management establishes a scheme of operations for Broken Head Nature Reserve. Activities identified in the plan are listed in the table below. Relative priorities are allocated against each activity as follows:

- **High** priority activities are those imperative to achievement of the objectives and desired outcomes. They must be undertaken in the near future to avoid significant deterioration in natural, cultural or management resources.
- **Medium** priority activities are those that are necessary to achieve the objectives and desired outcomes but are not urgent.
- **Low** priority activities are desirable to achieve management objectives and desired outcomes but can wait until resources become available.
- **Ongoing** activities are undertaken on an annual basis or are statements of management intent that will direct the management response if an issue arises.

This plan of management does not have a specific term and will stay in force until amended or replaced in accordance with the National Parks and Wildlife Act.

Table 3 List of management responses

Section number	Management response	Priority
4.1	**Joint Management**	
4.1.1	Issues and proposals relating to the care, control and management of the Reserve will be referred to the Byron Coast Area Management Committee for their consideration and recommendations.	High
4.2	**The Story of Country that is now the Reserve**	
4.2.1	Record the location of Aboriginal and non-Aboriginal heritage sites in the Reserve, including occupation sites.	Medium
4.2.2	Record Aboriginal and non-Aboriginal stories about the Reserve and its significance.	Medium
4.2.3	Undertake an archaeological assessment of the stone structure recorded at Jews Point to determine its significance and to ascertain the requirement for any conservation works.	High
4.3	**Native plants and animals**	
4.3.1	Implement relevant actions in the *Biodiversity Conservation Program* and recovery plans for threatened species and ecological communities in the Reserve.	Medium
4.3.2	Pursue inclusion of the intertidal zone to mean low water mark in the Reserve to protect the habitat of migratory and threatened shorebirds.	Low
4.3.3	Encourage flora and fauna surveys of the Reserve to expand information available on the Reserve's flora and fauna, including threatened and migratory species and ecological communities.	Ongoing
4.3.4	Map the current extent of the *Themeda* Grassland EEC on the Broken Head headland and monitor changes.	High
4.3.5	Consult NPWS threatened species and regeneration specialists about management of native hoya vine in the Coastal Cypress EEC at the former ranger station site and implement any recommended management strategies.	High

Section number	Management response	Priority
4.4	**Pests**	
4.4.1	Implement priority pest management actions from the pest management strategies.	High
4.4.2	Implement the Reserve Weed Management Strategy, incorporating monitoring.	High
4.4.3	Seek the cooperation of neighbours, where appropriate, in implementing weed and pest management programs.	Medium
4.4.4	Monitor the Broken Head day use area for invasion by the pest species common (Indian) myna and implement a control program if required.	Low
4.5	**Repairing the Reserve**	
4.5.1	Encourage research into the location of acid sulfate soils in the Reserve and the identification of any amelioration measures required.	Low
4.5.2	Contact Byron Shire Council and request consultation prior to maintenance works on Seven Mile Beach Road to permit consideration of methods to reduce the impact of works on the Reserve's biodiversity values.	High
4.6	**Fire**	
4.6.1	Update the Reserve fire management strategy incorporating new additions and information and implement the strategy.	High
5.1	Keeping connected to Country – cultural renewal	
5.1.1	Conduct studies into threats to reserve values, including threatened species, from the exercise of rights to use wild resources, and manage activities accordingly.	High
5.2	**Managing use of the Reserve**	
5.2.1	Undertake feasibility and environmental impact assessments for the development of a walking track linking the Three Sisters Walking Track and the Kings Beach Walking Track.	High
5.2.2	Undertake a risk assessment of the existing southern extension (A) of the Three Sisters Walking Track from the viewing platform to determine appropriate action which may include improved environmental or safety works, or track closure.	High
5.2.3	Erect signage at the Broken Head day use area and on the Three Sister Walking Track identifying the location of the Cocked Hat Rocks and advising that recreational use is not permitted.	Medium
5.2.4	Camping and horse riding are not permitted in the Reserve.	Ongoing
5.2.5	Cycling is only permitted in the Reserve on Broken Head Reserve Road.	Ongoing
5.2.6	Applications for activities will only be considered for the Broken Head day use area and for access to Broken Head Beach for weddings and events.	Ongoing
5.2.7	Tour operations in the Broken Head day use area and on walking tracks emanating from the day use area will be considered.	Ongoing
5.2.8	Commercial recreational activities, such as fitness training, kayak tours, surf schools and equipment hire are not permitted in the Reserve.	Ongoing
5.2.9	Mobile refreshment vendors will only be licensed to operate within the Broken Head day use area.	Ongoing

Section number	Management response	Priority
5.2.10	Monitor commercial and non-commercial activities with respect to cumulative impacts, safety requirements, quality of information being given and compliance with licence or consent conditions. Institute controls and/or change consent conditions if necessary.	Ongoing
5.2.11	Formalise an agreement with Essential Energy for the maintenance of the powerline in the Reserve.	High
5.3	**Talking about Country – providing information**	
5.3.1	Consult and involve the Arakwal in the development and delivery of information programs on the Reserve's Aboriginal cultural and biodiversity values.	Medium
5.3.2	Provide additional directional signposting within the Reserve as facilities are provided.	Medium
5.4	**Understanding Country – research and monitoring**	
5.4.1	Permit research and monitoring, subject to NPWS licensing/consent requirements, that enhances management and has minimal impact on the Reserve's natural and cultural values.	Ongoing

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Appendix 1 Plants important to the Arakwal for wild resource use

Common name	Scientific name	Use
Bangalow palm	*Archontophoenix cunninghamiana*	Sled, etc.
Black apple	*Planchonella australis*	Edible fruit, dye
Blue lilly pilly	*Syzygium oleosum*	Edible fruit
Brown kurrajong	*Commersonia bartramia*	Fibre for weaving nets and bags
Coast morning glory	*Ipomoea brasiliensis*	Skipping rope
Cunjevoi	*Alocasia brisbanensis*	Medicine
Honeysuckle	*Banksia integrifolia*	Nectar, seedpods for combs and firewood
Hoop pine	*Araucaria cunninghamii*	Ritual, resin used as cement and dye
Lawyer cane	*Calamus muelleri*	Canes for weaving
Long yam	*Dioscorea transversa*	Edible tuber
Midjem	*Austromyrtus dulcis*	Edible fruit
Mushrooms	*Agaricus sp.*	Edible
Native grapes	*Cayratia spp., Tetrastigma nitens*	Edible fruit
Native tamarind	*Diploglottis cunninghamii*	Edible fruit
Native wisteria	*Callerya megasperma*	Vines used as hoops for climbing trees
Pandanus	*Pandanus tectorius*	Food
Pigface	*Carpobrotus glaucescens*	Food
Raspberries	*Rubus spp.*	Edible fruit
Sandpaper fig	*Ficus coronata*	Leaves for sandpaper
Shining burrawang	*Lepidozamia peroffskyana*	Food
Strangler fig	*Ficus watkinsiana*	Edible fruit
Supplejack	*Flagellaria indica*	Canes for weaving
Water vine	*Cissus spp.*	Edible fruit, water in stems, vine for climbing
White booyong	*Heritiera trifoliolata*	Communication

Source: Low 2003a; Low 2003b.

Appendix 2 Threatened and significant flora

Common name	Scientific name	BC Act status	Known to occur or with potential habitat
Threatened flora			
Ball nut*	*Floydia praealta*	Vulnerable	Known
Byron Bay diuris	*Diuris sp. aff. chrysantha*	Endangered	Known
Pink nodding orchid	*Geodorum densiflorum*	Endangered	Known
Queensland xylosma	*Xylosma terra-reginae*	Endangered	Known
Rainforest senna	*Senna acclinis*	Endangered	Known
Red lilly pilly*	*Syzygium hodgkinsoniae*	Vulnerable	Known
Rusty plum	*Niemeyera whitei*	Vulnerable	Known
Rusty rose walnut*	*Endiandra hayesii*	Vulnerable	Known
Scented acronychia#	*Acronychia littoralis*	Endangered	Known
Spiny gardenia#	*Randia moorei*	Endangered	Known
Stinking cryptocarya*	*Cryptocarya foetida*	Vulnerable	Known
White lace flower	*Archidendron hendersonii*	Vulnerable	Known
Durobby*	*Syzygium moorei*	Vulnerable	Potential
Green-leaved rose walnut	*Endiandra muelleri subsp. bracteata*	Endangered	Potential
Rare flora^			
A green midge orchid	*Acianthella amplexicaulis*		Known
Rusty vine	*Thozetia racemosa*		Known
Toothed-leaved palm lily	*Cordyline congesta*		Known
Veiny lace flower	*Archidendron muellerianum*		Known
Approaching southern distributional limit			
Southern tapeinosperma	*Tapeinosperma pseudojambosa*		Known

Source: Atlas of NSW Wildlife; Kooyman & Rossetto (2006); NPWS YETI 2009 database, Sheringham & Westaway (1995).

Key: # Species listed as endangered under the EPBC Act.

* Species listed as vulnerable under the EPBC Act.

^ Denotes species listed as a Rare or Threatened Australian Plant (ROTAP) according to Briggs and Leigh (1996)

Appendix 3 Threatened and significant fauna

Common name	Scientific name	BC Act, BONN CAMBA, JAMBA, ROKAMBA	Known/likely to occur or with potential habitat
Amphibians			
Olongburra frog *	*Litoria olongburensis*	Vulnerable	Known
Birds			
Common tern	*Sterna hirundo*	CJR	Known
Eastern reef egret	*Egretta sacra*	CAMBA	Known
Little eagle	*Hieraaetus morphnoides*	Vulnerable	Known
Marbled frogmouth	*Podargus ocellatus*	Vulnerable	Known
Eastern osprey	*Pandion* cristatus	Vulnerable	Known
Australian pied oystercatcher	*Haematopus longirostris*	Vulnerable	Known
Rainbow bee-eater	*Merops ornatus*	JAMBA	Known
Rose-crowned fruit-dove	*Ptilinopus regina*	Vulnerable	Known
Sooty oystercatcher	*Haematopus fuliginosus*	Vulnerable	Known
Wandering tattler	*Tringa incana*	JAMBA	Known
White-bellied sea-eagle	*Haliaeetus leucogaster*	CAMBA	Known
White-eared monarch	*Carternornis leucotis*	Vulnerable	Known
White-throated needletail	*Hirundapus caudacutus*	CJR	Known
Wompoo fruit-dove	*Ptilinopus magnificus*	Vulnerable	Known
Pale-vented bush-hen	*Amaurornis moluccana*	Vulnerable	Likely
Little tern	*Sterna albifrons*	Endangered Bonn, CJR	Likely
Square-tailed kite	*Lophoictinia isura*	Vulnerable	Likely
Superb fruit-dove	*Ptilinopus superbus*	Vulnerable	Likely
Mammals			
Common blossom-bat	*Syconycteris australis*	Vulnerable	Known
Common planigale	*Planigale maculata*	Vulnerable	Known
Eastern bentwing-bat	*Miniopterus schreibersii oceanensis*	Vulnerable	Known
Eastern long-eared bat	*Nyctophilus bifax*	Vulnerable	Known
Grey-headed flying-fox *	*Pteropus poliocephalus*	Vulnerable	Known
Koala*	*Phascolarctos cinereus*	Vulnerable	Known
Little bentwing-bat	*Miniopterus australis*	Vulnerable	Known
Long-nosed potoroo	*Potorous tridactylus*	Vulnerable	Known

Common name	Scientific name	BC Act, BONN CAMBA, JAMBA, ROKAMBA	Known/likely to occur or with potential habitat
Greater broad-nosed bat	*Scoteanax rueppellii*	Vulnerable	Potential habitat
Yellow-bellied sheathtail-bat	*Saccolaimus flaviventris*	Vulnerable	Potential habitat
Reptiles			
Green turtle *	*Chelonia mydas*	Vulnerable BONN	Known
Loggerhead turtle #	*Caretta caretta*	Endangered BONN	Known
Invertebrates			
Mitchell's rainforest snail +	*Thersites mitchellae*	Endangered	Likely

Source: Atlas of NSW Wildlife (available at http://www.bionet.nsw.gov.au/); D Milledge 2011, pers. comm.

Key to conservation status:

+ Species listed as critically endangered under the EPBC Act.

Species listed as endangered under the EPBC Act.

* Species listed as vulnerable under the EPBC Act.

Key to international migratory species agreements under the EPBC Act:

BONN Bonn Convention on the Conservation of Migratory Species of Wild Animals;

CAMBA China - Australia Migratory Bird Agreement;

JAMBA Japan - Australia Migratory Bird Agreement;

ROKAMBA Republic of Korea - Australia Migratory Bird Agreement

CJR Refers to the above three migratory bird agreements

Appendix 4 Fruit-eating birds

Common name	Scientific name
Australasian figbird	*Sphecotheres vieilloti*
Australian king-parrot	*Alisterus scapularis*
Black-faced cuckoo-shrike	*Coracina novaehollandiae*
Brown cuckoo-dove	*Macropygia amboinensis*
Cicadabird	*Coracina tenuirostris*
Crimson rosella	*Platycercus elegans*
Eastern koel	*Eudynamys orientalis*
Green catbird	*Ailuroedus crassirostris*
Lewin's honeyeater	*Meliphaga lewinii*
Mistletoebird	*Dicaeum hirundinaceum*
Olive-backed oriole	*Oriolus sagittatus*
Pied currawong	*Strepera graculina*
Rainbow lorikeet	*Trichoglossus haematodus*
Regent bowerbird	*Sericulus chrysocephalus*
Rose-crowned fruit-dove	*Ptilinopus regina*
Scaly-breasted lorikeet	*Trichoglossus chlorolepidotus*
Silvereye	*Zosterops lateralis*
Torresian crow	*Corvus orru*
Varied triller	*Lalage leucomela*
White-headed pigeon	*Columba leucomela*
Wompoo fruit-dove	*Ptilinopus magnificus*

Source: Atlas of NSW Wildlife; Holmes (1987).

Appendix 5 Rainforest-dependent birds

Common name	Scientific name
Australian brush-turkey	*Alectura lathami*
Black-faced monarch	*Monarcha melanopsis*
Brown gerygone	*Gerygone mouki*
Grey goshawk	*Accipiter novaehollandiae*
Green catbird	*Ailuroedus crassirostris*
Large-billed scrubwren	*Sericornis magnirostra*
Lewin's honeyeater	*Meliphaga lewinii*
Marbled frogmouth	*Podargus ocellatus*
Noisy pitta	*Pitta versicolor*
Pale-yellow robin	*Tregellasia capito*
Rose-crowned fruit-dove	*Ptilinopus regina*
Rufous fantail	*Rhidipura rufifrons*
Spangled drongo	*Dicrurus bracteatus*
Spectacled monarch	*Symposiachrus trivirgatus*
White-eared monarch	*Carterornis leucotis*
White-headed pigeon	*Columba leucomela*
Wompoo fruit-dove	*Ptilinopus magnificus*

Source: Atlas of NSW Wildlife; Lott & Duggin (1993).

Appendix 6 Weeds

Common name	Scientific name	Distribution
Bitou bush [A B]	*Chrysanthemoides monilifera*	Isolated occurrences
Blackberry nightshade	*Solanum nigrum*	Isolated occurrences
Broadleaf paspalum	*Paspalum mandiocanum*	Mainly isolated occurrences but scattered in a few zones
Camphor laurel	*Cinnamomum camphora*	Isolated occurrence in one zone
Cherry guava	*Psidium cattleianum*	Isolated occurrence in one zone
Climbing nightshade	*Solanum seaforthianum*	Isolated occurrences
Coastal morning glory	*Ipomoea cairica*	Isolated to scattered occurrences
Common sowthistle	*Sonchus oleraceus*	Isolated occurrence in one zone
Corky passion vine	*Passiflora suberosa*	Isolated in one zone, scattered in one zone
Crofton weed	*Ageratina adenophora*	Scattered occurrences in most zone
Crowsfoot grass	*Eleusine indica*	Isolated occurrences
Fishbone fern	*Nephrolepsis cordifolia*	Isolated occurrences
Giant Parramatta grass	*Sporobolus fertilis*	Mainly isolated, scattered in one zone
Glory lily [D]	*Gloriosa superba*	Isolated occurrence in one zone
Ground asparagus	*Asparagus aethiopicus*	Isolated in one zone, scattered in one zone
Groundsel bush [D]	*Baccharis halimifolia*	Isolated in one zone and unknown distribution in three zones
Japanese honeysuckle	*Lonicera japonica*	Isolated occurrences in two zones
Lantana [A C]	*Lantana camara*	Scattered in most zones, widespread in two zones, some isolated occurrences
Madeira vine [A C]	*Anredera cordifolia*	Isolated occurrence in two areas
Mango	*Mangifera indica*	Isolated occurrence in one area
Mistflower	*Ageratina riparia*	Mainly scattered but widespread in one zone
Moonflower [D]	*Ipomoea alba*	Isolated to scattered occurrences
Mother of millions	*Bryophyllum delagoense*	Isolated occurrences
Ragweeds	*Ambrosia spp.*	Mainly isolated occurrences, scattered in one zone
Umbrella tree	*Schefflera actinophylla*	Isolated in two zones, unknown distribution in two zones
Wild tobacco bush	*Solanum mauritianum*	Isolated to scattered occurrences
Winter senna	*Senna pendula var. glabrata*	Widespread with some scattered and isolated occurrences

Source: OEH (2012b)

Key:

[A] Weeds of National Significance

[B] Declared key threatening process under the *Biosecurity Act 2015*

[C] Statewide priority weed under the Biosecurity Act

[D] Regional priority weed (LLS 2017).