Information Sheet on Ramsar Wetlands

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5. Name of wetlands: Bowling Green Bay

6. Date of Ramsar designation: 22/10/1993

7. Geographical coordinates: 147°15'E, 19°27'S

8. General location:
Centre 52km. SE of the major provincial city of Townsville; 21km NE of the Township of Ayr

9. Area:
35,500ha, divided as: a) Mountainous areas above 20 metres: Cape Cleveland, The Cone, Storth Hill, Feltham Cone: 4,000ha or approximately 11% of the area; b) Elevated Coastal Sand Dunes above 10 metres: only small areas of this land type fall within the proposed area: c) Coastal Plain below 20 metres, most much less - approximately 32,000ha or 89% of the total area.

10. Wetland type:
Natural and semi-natural wetland habitats: A,B,C,D,E,F,G,H,I,J,L,M,N,R,T,X. Various wetlands dominate in different parts of the site. In terms of overall area the three most extensive wetland habitat types are: G (Tidal mud flats); I (Mangrove/tidal forest); H (Salt marshes).
Man-made wetland habitats: 2, 5. These include an earth tank to provide stock water, and earthen-wall dams constructed in some areas to increase the extent of freshwater swamp for stock grazing and waterfowl habitat. Causeways in the northern part of the site have impeded water flow and impounded saline waters.

11. Altitude:
Mountainous areas: Mt. Cleveland to 558m. Feltham Cone to 279m. The Cone to 94m.
Remaining areas: All less than 20m; most less than 2m.

12. Overview:
The proposed Ramsar site is a diverse complex of coastal wetland systems formed on four broad physiographic types viz., mountainous areas of Cape Cleveland and Feltham Cone; the elevated parallel dune systems; the lower lying parts of the coastal plain; and the actively prograding sand spit of Cape Bowling Green. Over most of the site, coastal mangrove communities give way inland to the highly saline communities of the salt pans which in turn lead to the brackish and freshwater communities of the lower lying coastal plain further inland. These lowland areas are typified by communities whose dominant ecological characteristic is a tolerance of saline conditions. Extensive areas of open forest and woodland, and some closed forest, occur on the mountainous areas and the coastal dune systems.

13. Physical features:
The mountainous areas comprising Cape Cleveland, The Cone and Feltham Cone occur in the Northwestern part of the site. They are largely composed of adamellite and granite of Permian to Mesozoic age, with small areas of older intermediate lavas and pyroclastics. Extensive areas of

Quaternary sand dunes occur on the western side of Bowling Green Bay to the north of the Haughton river estuary. At the eastern side of Bowling Green Bay, narrow sand dunes comprise much of the long finger-like spit forming Cape Bowling Green. The remaining, most extensive area of the site comprises muds and silts of Quaternary age which, further inland, are replaced by the soils and sediments of the coastal plain. b) With the exception of the areas where water is impounded or impeded (indicated in 10 above), the wetlands of the site are the result of natural processes. c) Climate: The site is in a rain shadow area and lies between areas of substantially-higher rainfall to both the north and the south. Annual average precipitation is 1101mm at Ayr, 1256mm at Giru and 1,200mm at Cape Cleveland (Anon 1970). The rainfall occurs predominantly in summer and 70-80% falls in the months January to March. There are few figures for pan evaporation available for the area; the average annual evaporation for Townsville, some 52km from the centre of the site, is 1,664mm (Anon, 1970). Average annual temperatures at Ayr, 21km from the centre of the site are: average mean 23.3°C, average minimum 17.9°C and average maximum 29.1°C. The site is subject to the effects of severe tropical cyclones and lows during the months of November to April which bring destructive winds and intense rainfall. The return period is in the order of 30-50 years. The heavy storm rains of the summer wet-season have a notable effect in seasonally reducing the salinities of the shallow inshore marine areas (Walker 1981) and the surface soils of the saltpans and mangrove areas (Pomeroy 1990). d) Hydrology: The site is drained seaward into Bowling Green Bay by the Haughton River, three larger (Barramundi, Barratta and Sheep Station Cks) and many small creeks. Two large creeks (Cocoa Ck and Alligator Ck) and a number of minor creeks discharge into Cleveland Bay at the north western end of the site; a few small creeks drain into Upstart Bay at its southern end. The mountainous area to the south of Cape Cleveland and Feltham Cone are drained by seasonally active creeks into Cleveland and Bowling Green Bays. McKenzie and Emmett Creeks drain seasonal runoff from the steep northeastern slopes of Mt. Elliott into extensive sedge swamps situated in a shallow basin whose eastern edge is fringed by The Cone, Storth Hill and Feltham Cone. Since its catchment extends well into the hinterland of Bowling Green Bay, the Haughton river runs for 5-6 months of the year. During periods of extreme flooding it overflows northward directly into the Cromarty-Clevedon complex of swamps and floods out into Cleveland Bay. Similarly, seasonal floodwaters from the Burdekin river overflow northward to discharge into Bowling Green Bay.

Groundwater is stored in two main underground aquifers which are recharged almost entirely by stream flows. The older aquifers are the deepest (15-45 metres) and extend from the slopes of Mt. Elliot across the Haughton River to the Burdekin delta. The younger aquifers are shallower and limited in extent to the Haughton Riverbed and some recently abandoned channels. Groundwater is also extracted from aquifers adjacent to the site at Barratta Creek (Ceplecha and Kaminskas, 1973).

(e) Soils: A varied range of soils occurs within the site and correspond largely to local elevation and the parent materials present. The soils have been little studied in the southern and eastern parts of the site, although those to the northwest of the Haughton River have been described and mapped by Murtha (1982).

The soils of the mountainous area associated with Cape Cleveland and Feltham Cone are derived largely from coarse-grained granitic parent materials. These are mostly thin sandy soils although occasional red soils with a marked texture contrast (duplex soils) also occur. On the piedmont slopes surrounding these areas, well drained earthy-textured soils (alfisols) occur.

Soils of the sand dune areas vary in degree and kind of profile development, depending on differences in age and possibly parent materials. Most are freely-drained, coarse-textured sandy soils with uniform texture profiles, although some weakly developed podzols (spodosols) with seasonal ponding of water occur in the swales.

The soils and sediments of the mangrove forests are poorly known and have been characterised by Murtha (1982) as largely "dark brown muds of unknown depth", although some sandy soils also support mangroves in the region. Limited analyses of these soils and sediments have been carried out in the vicinity by Aliano (1978), Murtha (1982), Spenceley (1976, 1982) and Pomeroy (1990), although only Aliano's study was carried out within the site. Similarly, only limited information is available on the soils of the salt pans, mostly from the above sources. Landwards from the mangrove forests of the coastal plain, sequences of soils reflect the influence of increasing elevation and changing salinity.

Surrounding the salt pans, and occasionally flooded by the higher tides. Other soils of the coastal plain include the cracking clays (vertisols) of the Brolga series found largely to the northwest of Feltham Cone. Situated slightly higher in the landscape are the alfisols of the Doughboy series which are duplex soils but which do not appear to be influenced by regular seawater inundation. All of the above soils evidence their often-lengthy periods of summer inundation by the presence of gleying and many of the soils of the coastal plain reflect the influence of smectites in their propensity to crack on drying and swell on subsequent rehydration.

(f) Water quality: There are few published water quality measurements available for the era. The mountainous area of Cape Cleveland is mapped as having water containing less than 1,000 µg g^{-1} of total dissolved solids, while the lower lying areas are mapped as having total dissolved solids in the range 1,000-3,000 µg g-1, or their being insufficient data. The latter areas include the saltpans, mangroves and other areas of known saline and brackish waters. it also includes the areas of coastal sand dunes at the western end of Bowling Green Bay. Aquifers in the hinterland of the site are of mixed quality, while waters of the younger alluvium are of good quality. Those of the older alluvium and those close to the coast may have total dissolved salts exceeding 3,000 µg g-1. There is a risk of saltwater intrusion into the freshwater aquifers if excessive agricultural consumption occurs (Ceplecha and Kaminskas, 1973).
Between the Haughton and Burdekin Rivers extensive areas of agricultural development are located upstream of all watercourses flowing into Bowling Green Bay. It is assumed that agricultural chemicals and nutrients are flushed into the area during periods of local flooding. The impact of this on water quality of the site is unknown. However, it is likely to be significant since recharge of underground aquifers appears to be by direct infiltration over the delta from rainfall, river flow and floods (Ceplecha and Kaminskas 1973). Water quality is least likely to be affected by agricultural contaminants for that portion of the site to the north of the Haughton River.
(g) Water depth, fluctuations and permanence: There is considerable variation throughout the site as indicated below: (i) sub-tidal areas - below mean low water neaps and permanently flooded with sea water; (ii) riverine channels - varying depths and permanently flooded with sea water except during periods of wet season freshwater discharge when salinities fall to below 0.5 parts per thousand; (iii) Mangrove areas - shallow areas (less than 2.0m) inundated diurnally to monthly, depending on tidal range; (iv) Saltpan areas - shallow areas (less than 0.8m) occasionally flooded by oceanic water and seasonally by freshwater; (v) brackish areas - shallow areas (less than 2.0m) seasonally and semi-permanently flooded with sea water except during periods of wet season freshwater discharge when salinities fall to below 0.5 parts per thousand; and (vi) freshwater areas - shallow areas (less than 2.0m) seasonally inundated with freshwater.
(h) Tidal variation: The highest astronomical tides and mean high water springs are, respectively, 2.25 and 1.15m above mean sea level.
(i) Catchment area: The major catchment is located beyond the extent of the site although there are some internal catchments associated with The Cone, Storth Hill, Feltham Cone and Cape Cleveland. Beyond the site the Mt. Elliot catchment immediately adjacent, and the catchments of Majors Creek, Haughton River and Barratta Creek some 70km inland drain the eastern slopes of the coastal ranges and some outliers. Land use within the catchment area is almost entirely agricultural and pastoral. The Burdekin River which drains some two thirds of Queensland overflows northward into Bowling Green Bay during periods of seasonal flooding.
(j) Downstream area: No relevant comment.

14. Ecological features:
A range of different habitats intergrading with one another occur throughout the site (Blackman 1978):
(a) Mountainous habitats: Open forest and woodland communities (E. crebra, E. platyphylla, E. papuana) predominate, with complex associations of vine thickets and Araucaria cunninghamii emergents in protected gullies.
(b) Coastal dune habitats: These comprise dune-swale systems of predominantly Casuarina equisetifolia on the foredunes with eucalypt and Melaleuca open forest and woodland (E. tesselaris, E. teretircornis, E. alba, Lophostemon suaeveolens, Melaleuca leucadendron, M. quinquevervia) on the older dunes behind these. Submerged and emergent aquatics, grasses, sedges, palms and a complex of littoral forest - often dominated by Melaleuca species - occur in the swales.
(c) Mangrove/tidal forest habitats: These comprise closed, open forest and woodland communities dominated by Avicennia eucalyptifolia, Ceriops tagal and Rhizophora stylosa. Within the site some nine species of mangrove occur, three of which (Aegiceras corniculatum, Osbornia octodonta and Lumnitzera racemosa) are poorly represented.
(d) Tidal mudflat habitats: On the seaward side these comprise open, largely-unvegetated mudflats. Inland, behind the fringing mangrove communities, the most hypersaline of the areas are devoid of macrophytic vegetation, while other less saline areas are dominated by open forblands comprising samphire communities. In some areas, causeways associated with roads have impeded water flow and impounded saline waters, resulting in an invasion of mangrove communities into these mudflat habitats.
(e) Salt marsh habitats: These comprise slightly elevated plains dominated by Sporobolus virginicus and brackish sedge communities dominated by Scirpus littoralis.

(f) Stream and tidal channel habitats: These comprise open water and unconsolidated bottoms frequently with fringing mangrove, grass and samphire communities in the saline areas, while fringing forest and woodland communities dominated by Melaleuca species occur in brackish and freshwater areas.
(g) Freshwater marsh habitats: These comprise extensive sedge communities dominated by Eleocharis dulcis and a range of submerged and emergent aquatic communities, depending on the water regime. A number of areas within these habitats have been modified by the construction of earth walls which have increased the extent of freshwater habitat.

15. Land tenure/ownership of:
The greater portion of the site is gazetted as National Park, or proposed as such. (a) site: The bulk of the site comprises a portion of bowling Green Bay National Park which is under the management of the Queensland National Parks and Wildlife Service. The site also includes a number of portions of Vacant Crown Land, Leasehold land, and Special Purpose Reserves all of which are designated for future inclusion into the National Park. The site surrounds, or is contiguous with portions of freehold and leasehold land. Below Mean High Water Springs, the site is contiguous with the Great Barrier Reef Marine Park and the Bowling Green Bay Fish Habitat Reserve which overlays the Marine Park in that area.
(b) surrounding area: Lands contiguous with the site comprise portions of privately owned freehold land; Commonwealth, State and Local Government land; and State land; Commonwealth, State and Local Government land; and State land leased under a variety of tenures.

16. Conservation measures taken:
(a) Legislative protection: The 32,100ha site is wholly within the Bowling Green Bay National Park (767) with the exceptions specified in 15(a) above. The park was established in 1977. Within the State of Queensland, National Parks are gazetted under the national Parks and Wildlife Act 1975. National Park status provides complete protection of flora, fauna and landscapes within Park boundaries. National Park status of the site therefore represents one of the most stringent forms of protection available in Queensland.
(b) Management: No management plan is current for the site. However, government policy requires that management plans be put into operation and a plan for Bowling Green Bay National Park is currently in preparation. Despite the lack of a general management plan, portions of the park are subject to control burning practices to reduce the damaging effects of wildfire. The shallow seasonal wetlands are also subject to uncontrolled grazing to maintain the wetlands for waterfowl by preventing the invasion of upland grasses into the swamps during the dry spring. Limited public access is available to the whole park area for fishing and camping. Minor facilities are available at one location (Barramundi Ck) and proposed for another (Bald Rock, Cape Cleveland). The area is actively patrolled by two full-time rangers of the Q.NPWS who enforce regulations pertaining to the park.

17. Conservation measures proposed but not yet implemented:
Current surveys of the vegetation of the site are aimed at description and mapping of the vegetation communities and the production of species lists. Similarly, fauna surveys are planned to provide information on the distribution, abundance and habitat associations of mammals, birds, reptiles and frogs occurring in the park.

18. Current land use:
(a) site: Livestock (cattle) grazing is carried out in portions of the site, mainly in the brackish and freshwater areas north-west of the Haughton River. Grazing of these areas is crucial to the maintenance of the waterbird habitat.
(b) surroundings/catchment: The northern seaward portion of the site abutts the Great Barrier Reef Marine Reef. Grazing is the predominant land use in almost all the adjacent portions contiguous with the inland boundaries of the site. however, several small townships (Cungulla, Hucks Landing) are encompassed by the site but do not form part of it. At the northern extremities of Capes Bowling Green and Cleveland, small lighthouse reserves (approx. 80ha and 3ha respectively) occur and a further area (208ha) has been excised at the western end of Bowling Green Bay for the Australian Institute of Marine Science. Extensive agricultural lands associated with the Burdekin River irrigation area occur further inland.

19. Disturbances/threats, including changes in land use and major development projects:
Agricultural, urban and industrial developments in the catchment area external to the site pose the

most significant threats to the integrity of the site, particularly the lowland areas. The potential impact posed by these is through cumulative changes to water regimes and the chemistry of both surface and sub-surface waters. As already evident within the coastal region, such changes initiate rapid changes in biological communities and degrade the natural functioning of wetlands within the landscape and their value as habitat (Blackman and Brooke, in press).
The low lying topography of the site would make it extremely susceptible to marine flooding as the result of relatively small rises in sea level, one of the predicted outcomes of the greenhouse effect. Some simulation modelling has been undertaken to show the potential extent of this over the area of the site to the north of the Haughton River (Marshall and Blackman, in press).

20. Hydrological and physical values:
(a) Recharge and discharge of ground water: No information is available for the site or its role in the recharge and discharge of ground water. However, because of the extent of the fresh and brackish swamps it is likely to play a significant role in the recharge of underground fresh and saline aquifers from direct infiltration, rainfall, river flow and floods (Ceplecha and Kaminskas 1973).
(b) Sediment trapping: The mangrove communities of Bowling Green Bay play an important role in the trapping of tide born sediments.
(c) Prevention of coastal erosion: The mangrove communities exert a major influence in the control of coastal erosion in Bowling Green Bay. The area is subject to tropical cyclones and lows during the summer wet season. The strong winds, tidal surges and the intense and sustained rainfalls associated with these all have considerable potential for eroding the foreshores and the coastal streams and rivers. Throughout the site mangrove and other wetland plant communities play a critical role in limiting the severity of erosive losses.
(d) Maintenance of water quality: There is a delicate balance of salinity in the area which has important implications for the seasonal distribution, dynamics and productivity of the vegetation of the fresh and brackish water swamps and of the tidal wetlands.
(e) Support of food chains: Extensive bait fish breeding occurs in the site and supports important bill (black marlin, sailfish) and pelagic fisheries (spanish mackerel and other predatory species). In addition, the role of these wetlands in exporting carbon to offshore sites contributes to the overall productivity of the adjacent marine system. The intertidal and subtidal seagrass beds of both Bowling Green and Cleveland Bays directly provide feeding habitat for the threatened herbivores Dugong dugon and Chelonia mydas and nursery areas for a prawn industry. Commercial and recreational harvesting of prawns and the mud crab (Scylla serrata) within the site and adjacent marine areas is based on the productivity of the local wetland communities. The importance of the wetlands of the site and of Bowling Green Bay has bee recognised in the protection of the entire bay as a Fish Habitat Reserve (gazetted 25 November 1989).
Further inland the brackish and freshwater wetlands of the site provide an abundant source of food for a diverse and rich waterbird community; in particular the tubers of the dominant freshwater sedge Eleocharis dulcis provide the major source of food for populations of the brolga and magpie goose which concentrate on these swamps in the post breeding season (Blackman, 1978). In addition, while no published work is available, the fresh and brackish swamps also support an important local fishery based on the barramundi (Lates calcarifer). Tagging studies have shown that juveniles of this species breed prolifically in the fresh water swamps of the site and these are later found in the estuarine waters of Bowling Green Bay.

21. Social and cultural values:
The site is of high aesthetic and cultural value. It has enormous potential for environmental education and nature based recreation, both of which have still to be realised.

22. Noteworthy fauna:
The avifaunal diversity of the site reflects the range of terrestrial and marine coastal habitats present. A provisional list of bird species recorded from within the site is provided as Appendix 1. Of the 244 birds known to occur in the site, 103 are known to breed within its confines; these are flagged in Appendix 1 as are a total of 13 species that are rare or whose conservation status is endangered, vulnerable or rare (Draft list of the Conservation Status of Queensland Vertebrates, Queensland National Parks and Wildlife Service, unpublished).
Currently, most information is available for the bird fauna. Information on other vertebrate species is too incomplete for inclusion at this time, although this is being redressed by surveys in progress. Little information is available on the invertebrate fauna of the site.
The site is important as habitat for some 50% of species listed in the Appendices of both the Japan

Australia Migratory Bird Agreement (JAMBA - 38 of the 76 species with four breeding), and China Australia Migratory Bird Agreement (CAMBA - 40 of the 81 species with three breeding). The site also provides habitat for species listed in the Appendices of the Bonn Convention (two endangered sea turtle species; two species - estuarine crocodile and dugong - with unfavourable conservation status). Appendix 2 provides a list of the above species.
One of the most noteworthy aspects of the avifauna of the site is the richness and local abundance of species present (Blackman 1978). This diversity is particularly evident within the waterbirds at both Family and Species levels - see the Appendix 1 representatives of the Podicipitiformes, Pelecaniformes, Ardeiformes, Anseriformes, Gruiformes and Charadiformes. This is also evident within other groups notably the Accipitriformes.
The brolga and magpie goose are the most noteworthy species of the shallow sedge swamps and marine plains of the site (Blackman 1988). Both species breed extensively in the sedge swamps during late summer. In addition, the site supports a post breeding (May - September) concentration of regional populations of both species. These concentrations are the largest in north east Queensland and the site forms part of the main stronghold of these two species in eastern Australia. Other notable species include the little tern which breeds on the Bowling Green Bay spit and occurs in flocks of 1000 individuals; and dugongs and green turtles which depend on the extensive areas of intertidal sea grass beds.

23. Noteworthy flora:
The flora of the site is noteworthy because of the extensive wetland communities of intertidal algae, seagrasses, mangroves, saline grasses and herbs, sedges and other aquatic species, as well as the distinctive seasonal wetland communities of the forested swales. Similarly, the varied terrestrial communities present - open and closed Eucalypt and Melaleuca dominant communities of the beach ridges and the granitic hills, the monsoon and araucarian closed forests of the sheltered slopes - provide a representation of the major coastal communities of the north Australian wet-dry tropics. Three species classified as rare or threatened by Q.NPWS (Cynanchum leptolepus, Bonamia dietrichiana, Livistona drudeir) occur within the site.

24. Current scientific research and facilities:
Programmes to map and characterise the natural resources (landscape, fauna, flora and the communities present) of the site are currently in progress.

25. Current conservation education: No specific programmes currently exist for the site.

26. Current recreation and tourism:
The major recreational pursuits are fishing, camping, bushwalking, birdwatching and other nature related activities. At present there is no commercial exploitation of the site.

27. Management authority:
Queensland National Parks and Wildlife Service, 160 Anne Street, Brisbane, Qld 4000, Australia

28. Jurisdiction: Q.NPWS has jurisdiction over the terrestrial areas of the site. It shares jurisdiction over the adjacent Bowling Green Bay Management Area of the Townsville - Whitsunday Marine Park. The Beach Protection Authority has some jurisdiction over the foreshores of the site and Queensland Department of Primary Industries has jurisdiction over the Fish Habitat Reserves.

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30. Reasons for inclusion: 1a, 1b, 1c; 2a, 2b, 2c; 3a, 3b, 3c.