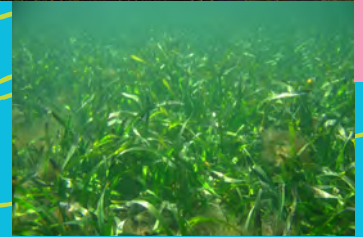




Australian Government

**Department of Sustainability, Environment,
Water, Population and Communities**



Corner Inlet

Ramsar Site

Ecological Character Description



Australian Government

**Department of Sustainability, Environment,
Water, Population and Communities**

Corner Inlet Ramsar site

Ecological Character Description

June 2011

Cover, acknowledgements, contents and executive summary only

Other chapters can be downloaded from:

www.environment.gov.au/water/publications/environmental/wetlands/13-ecd.html

CONTENTS

Contents	i
List of Figures	iv
List of Tables	vi
Acknowledgements	vii
List of Abbreviations	ix
Executive Summary	x
1 INTRODUCTION	1
1.1 Background	1
1.2 Scope and Purpose	5
1.3 Relevant Treaties, Legislation and Regulations	7
1.3.1 Australian Government Legislation or Policy Instruments	7
1.3.2 Victorian Government Legislation or Policy Instruments	9
2 SITE DESCRIPTION	12
2.1 Description of the Site	12
2.1.1 General Features of the Site and Surrounds	12
2.1.2 Overview of Wetland Types	14
2.1.2.1 <i>Information Sources</i>	14
2.1.2.2 <i>Marine/Coastal Wetland Types</i>	20
2.1.2.3 <i>Inland Wetland Types</i>	27
2.1.3 Uses and Tenure	28
2.1.3.1 <i>Adjacent Land Use</i>	28
2.1.3.2 <i>Tenure</i>	29
2.1.4 Natural Values	32
2.1.5 Socio-Economic and Cultural Values	34
2.2 Ramsar Nomination Criteria	35
2.2.1 Original Criteria under which the Site was Listed	35
2.2.2 Assessment Based on Current Information and Ramsar Criteria	37
3 CRITICAL COMPONENTS, PROCESSES AND SERVICES/BENEFITS	48
3.1 Background	48
3.2 Overview of Critical Components, Processes and Services/Benefits	50
3.3 Critical Components	53
3.3.1 C1 - Marine and Estuarine Wetland Habitats	53

3.3.2	C2 - Abundance and Diversity of Waterbirds	57
3.4	Supporting Components	63
3.4.1	Geomorphological Features	63
3.4.2	Invertebrate Megafauna	64
3.4.3	Fish Species Richness	65
3.5	Critical Processes	66
3.5.1	P1 - Waterbird Breeding	66
3.6	Supporting Processes	67
3.6.1	Regional Climate Patterns and Processes	67
3.6.2	Hydrodynamic Regime	69
3.6.3	Water Quality	71
3.6.4	Nutrient Cycling and Foodwebs	77
3.7	Critical Services/Benefits	78
3.7.1	S1 – Presence of Threatened Species	78
3.7.2	S2 – Fisheries Resource Values	82
3.8	Supporting Services/Benefits	87
3.8.1	Recreation and Tourism Values	87
3.8.2	Scientific Research	89
3.9	Conceptual Model	90
4	LIMITS OF ACCEPTABLE CHANGE	92
4.1	Background and Interpretation	92
4.2	Derivation of Limits of Acceptable Change	92
4.3	Characterising Baseline Information	93
4.4	Summary of Limits of Acceptable Change	94
5	CHANGES TO ECOLOGICAL CHARACTER AND THREATS	99
5.1	Overview of Threats	99
5.1.1	Recreational Activities	99
	(*) identified as a key hazard for the site by Carey et al. (2007)	100
5.1.2	Natural Resource Utilisation	101
5.1.3	Modified Flow Regimes	101
5.1.4	Pollutant Inputs	102
5.1.5	Urban Encroachment and Habitat Modification	103
5.1.6	Acid Sulfate Soils	104
5.1.7	Oil Spills and Other Incidents	104
5.1.8	Climate Change	104
5.1.9	Weeds	105

5.1.10	Feral Pests	106
5.2	Changes to Ecological Character	108
5.2.1	Key Trends	108
5.2.2	Comparison to Limits of Acceptable Change	111
6	INFORMATION GAPS, MONITORING AND EDUCATION	114
6.1	Information Gaps	114
6.2	Monitoring Needs	115
6.3	Communication, Education, Participation and Awareness Messages	116
7	REFERENCES	119
8	GLOSSARY	128
APPENDIX A:	DETAILED METHODOLOGY	130
APPENDIX B:	NLWRA (2001) DATABASE RESULTS FOR ESTUARIES IN THE IMCRA BIOREGION	135
APPENDIX C:	FAUNA SPECIES LIST	137
APPENDIX D:	BIRD COUNT DATA ANALYSIS	146

LIST OF FIGURES

Figure 1-1	Locality plan showing key locations referred to in this document (Source: DSE unpublished)	2
Figure 1-2	Locality plan showing western portion of the site	3
Figure 1-3	Locality plan showing the eastern portion of the site	4
Figure 1-4	Key steps in preparing an Ecological Character Description	6
Figure 2-1	Victorian Wetland Classification System Wetland Types within the Corner Inlet Ramsar Site (Source: DSE unpublished)	18
Figure 2-2	EVC (2005) Map for the Corner Inlet Ramsar Site (Source: DSE unpublished)	19
Figure 2-3	DEM Showing Bathymetry of Corner Inlet (Reproduced from Ecos unpublished)	20
Figure 2-4	Corner Inlet Catchment and Land Use (Reproduced from Ecos unpublished)	30
Figure 2-5	Parks, Reserves and Other Land Tenure within and Surrounding the Corner Inlet Ramsar Site (Reproduced from Ecos unpublished)	31

Figure 2-6	Vegetation Communities within the Site (Source: EVC mapping by DSE)	33
Figure 3-1	Generic Conceptual Model Showing Interactions between Wetland Ecosystem Components, Processes and Services/Benefits (Source: DEWHA 2008)	49
Figure 3-2	Conceptual Model Showing Interaction of Critical and Supporting Elements	52
Figure 3-3	Maximum Annual Shorebird Counts and Reporting Rate (number of survey episodes and stations per year) based on DSE Fauna Database Records for Corner Inlet (DSE 2009)	60
Figure 3-4	Mean Maximum Temperature and Mean Rainfall at Wilsons Promontory Lighthouse between 1872 and 2009 (source: BOM 2009)	68
Figure 3-5	Average Daily Flow (Calculated) for Tarra River at Yarram from 1965 to 2009. Data Sourced from Victorian Water Resources Data Warehouse	70
Figure 3-6	Corner Inlet Ramsar Site (red outline) with Locations of Waterwatch Sampling Sites (red stars) and Outfall Locations for Foster, Toora and Port Welshpool Wastewater Treatment Plants (black squares)	73
Figure 3-7	Discharge and Summed Annual Loads of Suspended Solids, TN and TP for Major Streams Discharging into Corner Inlet (Franklin River, Agnes River, Deep Creek) and Wastewater Treatment Plants (Toora, Foster, Port Welshpool). No Data Exists for the WWTP between 1994 and 1996. Annual Loads Based on Calculations in South Gippsland Water (2002)	74
Figure 3-8	Maximum Annual Count and Reporting Rate (Number of Episodes and Stations) for Fairy Tern Abundance (Total Records in each Year) at Corner Inlet Ramsar Site (Data source: DSE fauna database)	81
Figure 3-9	Long-term Trends in Commercial Fisheries Catch Data between 1978–2008 (Source: DPI 2008)	86
Figure 3-10	Conceptual Model of Components, Processes and Services/Benefits at Corner Inlet	91

LIST OF TABLES

Table E-1	Summary of Critical Components, Processes and Services/Benefits	x
Table E-2	Limits of Acceptable Change for each Critical Component and Service/Benefit – Corner Inlet Ramsar Site	xii
Table 2-1	Summary of Key Features of the Corner Inlet Ramsar Site	13
Table 2-2	Ramsar Wetland Types, as translated from the Victorian Wetland Classification System (VWCS) Wetland Types, within the Ramsar site	16
Table 2-3	Comparison of Current and Pre-1999 Ramsar Nomination Criteria	38
Table 3-1	Summary of Critical Components, Processes and Services/Benefits	51
Table 3-2	Summary of Total Areas of Various Seagrass Communities Mapped at Corner Inlet and Nooramunga by Roob et al. (1998) (surveyed in 1998)	56
Table 3-3	Mapped Area of Different Habitat Features in Corner Inlet (Source: NLWRA 2001)	57
Table 3-4	Migratory Shorebirds within the Site that are Listed Under Bilateral Agreements	58
Table 3-5	Patterns in Abundant Waterbird Species at Corner Inlet	61
Table 3-6	Waterwatch data of stations within the Ramsar site (refer to Figure 3-6). The data were calculated to give the 80 th Percentile (20 th and 80 th Percentiles for pH) and Compared against the ANZECC/ARMCANZ (2000) for Southeast Australian Estuaries where applicable*	76
Table 3-7	Key Fisheries Species present in the Corner Inlet Ramsar site, and their Primary Habitats at Different Stages of their Life-cycle (Data: Kailoa et al. 1993)	83
Table 3-8	Catch Per Unit Effort (Commercial Production in Tonnes Caught Divided by Number of Boats) for Corner Inlet (20 th , 50 th and 80 th Percentile Values) around the time of listing (1978/79 to 1988/89) and post 1989	85
Table 4-1	Limits of Acceptable Change for each Critical Service – Corner Inlet Ramsar Site	95
Table 5-1	Summary of Key Threats to the Ecological Character of the Corner Inlet Ramsar Site	100
Table 5-2	Comparison of LACs to Observed Trends Post-Ramsar Listing	111
Table 6-1	Stakeholder Groups of the Relevance to the Corner Inlet Ramsar Site	118

ACKNOWLEDGEMENTS

This report was prepared by BMT WBM Pty Ltd with expert input from Austecology Pty Ltd under contract to the Department of Sustainability, Environment, Water, Population and Communities. Paul Boon (Dodo Environmental) provided strategic advice to the project team and peer review comments on the draft report.

The consultant project team wish to express their thanks to the members of the Inter-Governmental Steering Group formed for the project for their assistance and guidance. Appendix A provides details about the Steering Committee.

Photos that appear in the report are supplied by BMT WBM or other organisations where noted. Figures that have been reproduced (without modification) from other sources have been referenced accordingly.

Disclaimer: In undertaking this work the authors have made every effort to ensure the accuracy of the information used. Any conclusions drawn or recommendations made in the report are done in good faith and BMT WBM take no responsibility for how this information and report are used subsequently by others. Note also that the views expressed, and recommendations provided in this report are those of the report authors and do not necessarily reflect those of the persons or organisations that have contributed their views or other materials.

The views and opinions expressed in this publication do not necessarily reflect those of the Australian Government or the Minister for Sustainability, Environment, Water, Population and Communities or the Administrative Authority for Ramsar in Australia.

While reasonable efforts have been made to ensure the contents of this publication are factually correct, the Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.

Guidance on the development of Ecological Character Descriptions, including Limits of Acceptable change, are areas of active policy development. Accordingly there may be differences in the type of information contained in this Ecological Character Description, to those of other Ramsar wetlands.

This information does not create a policy position to be applied in statutory decision making. Further it does not provide assessment of any particular action within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*, nor replace the role of the Minister or his delegate in making an informed decision on any action.

This report is not a substitute for professional advice rather it is intended to inform professional opinion by providing the authors' assessment of available evidence on change in ecological character. This information is provided without prejudice to any final decision by the Administrative Authority for Ramsar in Australia on change in ecological character in accordance with the requirements of Article 3.2 of the Ramsar Convention. Users should obtain any appropriate professional advice relevant to their particular circumstances.

Use of terms and information sources: All definitions and terms used in this report were correct at the time of production in November 2010. Refer to Section 7 for works cited and Section 8 for a list of key terms and terminology used.

Citation: When finalised, this report can be cited as follows:

BMT WBM (2011). Ecological Character Description of the Corner Inlet Ramsar Site – Final Report. Prepared for the Australian Government Department of Sustainability, Environment, Water, Population and Communities. Canberra.

LIST OF ABBREVIATIONS

ABS	Australian Bureau of Statistics
ANZECC/ARMCANZ:	Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand
ARI:	Arthur Rylah Institute for Environmental Research
CAMBA:	China-Australia Migratory Bird Agreement
CMA:	Catchment Management Authority
CMS:	Convention on Migratory Species
CSIRO:	Australian Commonwealth Scientific and Research Organization
DEM:	Digital Elevation Model
DEWHA:	Department of the Environment, Water, Heritage and the Arts (now DSEWPaC)
DoD:	Department of Defence
DSE:	Department of Sustainability and Environment (Victoria)
ECD:	Ecological Character Description
EPBC:	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESO:	Environmental Significance Overlay
EVC:	Ecological Vegetation Class
EWR:	Environmental Water Reserve
FIS:	Flora Information System
GAP:	Global Action on Peatlands
GCB:	Gippsland Coastal Board
GMA:	Groundwater Management Area
HAT:	Highest Astronomical Tide
IMCRA:	Integrated Marine and Coastal Regionalisation of Australia
IUCN:	International Union for Conservation of Nature
JAMBA:	Japan-Australia Migratory Bird Agreement
LAC:	Limit(s) of Acceptable Change
MAFRI:	Marine and Freshwater Resources Institute
NLWRA	National Land and Water Resources Audit
NRM:	Natural Resource Management
RIS:	Ramsar Information Sheet
ROKAMBA:	Republic of Korea- Australia Migratory Bird Agreement
SEPP:	State Environment Protection Policy
DSEWPaC	Australian Government Department of Sustainability, Environment, Water, Population and Communities
sp.:	Species (singular)
spp.:	Species (plural)
VWCS	Victorian Wetland Classification Scheme
VWSG:	Victorian Wader Study Group
WGCMA:	West Gippsland Catchment Management Authority
WWTP:	Wastewater Treatment Plant

EXECUTIVE SUMMARY

Corner Inlet is a large tide-dominated embayment located adjacent to the southernmost tip of the Australian mainland. The inlet consists of a submerged plain covered by sand or mud flats with well developed seagrass beds, and large sand islands. A radiating system of deeper channels supports efficient tidal exchange over the flats and the areas between the islands. Due to its large area and the diversity of habitats present, Corner Inlet supports internationally significant populations of a number of aquatic and semi-aquatic species. The inlet was listed as a Wetland of International Importance under the Ramsar Convention in 1982.

As part of its role as a Contracting Party to the Ramsar Convention on Wetlands, Australia is expected to manage its Ramsar sites so as to maintain the ecological character of each site and notify the Ramsar Secretariat of any change. Ecological character is defined by the Ramsar Convention as the combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time.

This report provides the Ecological Character Description (ECD) for the Corner Inlet Ramsar site, prepared in accordance with the *National Framework and Guidance for Describing the Ecological Character of Australia's Ramsar Wetlands* (DEWHA 2008) (the National ECD Framework). In parallel with the preparation of the ECD, the Ramsar Information Sheet (RIS) for the site has been updated for submission to the Australian Government and Ramsar Secretariat. This report updates and replaces an unpublished draft ECD document for the site prepared by the Ecos Consortium in 2008 hereafter referenced as Ecos (unpublished).

Major topics covered include the background context and purpose of the ECD, relevant treaties, legislation and regulations, a site description and justification for the existing Ramsar listing of the inlet, project methodology, and a description of the critical components, processes and services/benefits supported by the site. Furthermore, a conceptual model of interactions between critical components, processes and services/benefits operating in the inlet is presented. The ECD also covers identification of any changes to the ecological character of the inlet since its Ramsar listing in 1982, natural variability and limits of acceptable change (LACs), likely threats and impacts, knowledge gaps, key monitoring needs and important communication, education, participation and awareness messages.

The major features of Corner Inlet that form its ecological character are its large geographical area, the wetland types present (particularly the extensive subtidal seagrass beds), diversity of aquatic and semi-aquatic habitats and abundant flora and fauna (including significant proportions of the total global population of a number of waterbird species). The critical and supporting components, processes and benefits/services that were determined as having a high influence on the ecology of Corner Inlet are presented in Table E-1. The way in which these components, processes and services/benefits interact is presented in this document through the use of a conceptual model.

The study has sought to define the natural variability and LACs for the critical components and services/benefits identified. A summary of the LACs is shown in Table E-2.

Table E-1 Summary of Critical Components, Processes and Services/Benefits

Critical Components	Critical Processes	Critical Services/Benefits
<p>C1. Several key wetland mega-habitat types are present:</p> <ul style="list-style-type: none"> • seagrass • intertidal sand or mud flats • mangroves • saltmarshes • permanent shallow marine water <p>C2. Abundance and diversity of waterbirds</p>	<p>P1. Waterbird breeding is a key life history function in the context of maintaining the ecological character of the site, with important sites present on the sand barrier islands</p>	<p>S1. The site supports nationally threatened fauna species including:</p> <ul style="list-style-type: none"> • orange-bellied parrot • growling grass frog • fairy tern • Australian grayling <p>S2. The site supports outstanding fish habitat values that contribute to the health and sustainability of the bioregion</p>
Supporting Components	Supporting Processes	Supporting Services/Benefits
<p>Important geomorphological features that control habitat extent and types include:</p> <ul style="list-style-type: none"> • sand barrier island and associated tidal delta system • the extensive tidal channel network • mudflats and sandflats. <p>Invertebrate megafauna in seagrass beds and subtidal channels are important elements of biodiversity and control a range of ecosystem functions.</p> <p>The diverse fish communities underpin the biodiversity values of the site</p>	<p>Climate, particularly patterns in temperature and rainfall, control a range of physical processes and ecosystem functions</p> <p>Important hydraulic and hydrological processes that support the ecological character of the site includes:</p> <ul style="list-style-type: none"> • Fluvial hydrology. Patterns of inundation and freshwater flows to wetland systems • Physical coastal processes. Hydrodynamic controls and marine inflows that affect habitats through tides, currents, wind, erosion and accretion. • Groundwater. For those wetlands influenced by groundwater interaction, the level of the groundwater table and groundwater quality. <p>Water quality underpins aquatic ecosystem values within wetland habitats. The key water quality parameters for the site are salinity, turbidity, dissolved oxygen and nutrients</p> <p>Important biological processes include nutrient cycling and food webs.</p>	<p>The site supports recreation and tourism values (scenic values, boating, recreational fishing, camping, etc.) that have important flow-on economic effects for the region.</p> <p>The site provides a range of values important for scientific research, including a valuable reference site for future monitoring.</p>

Table E-2 Limits of Acceptable Change for each Critical Component and Service/Benefit – Corner Inlet Ramsar Site

Number	Indicator for Critical Component / Process/Service for the LAC	Relevant timescale ¹	Limit(s) of Acceptable Change	Spatial scale/temporal scale of measurements	Underpinning baseline data	Secondary critical C,P,S addressed through LAC
Critical Components						
C1	Seagrass extent	Long Term	<ul style="list-style-type: none"> Total mapped extent of dense <i>Posidonia</i> will not decline by greater than 10 percent of the baseline value outlined by Roob et al. (1998) at a whole of site scale (baseline = 3050 hectares; LAC = mapped area less than 2745 hectares) on any occasion. (Note: the small degree of allowable change recognises that this seagrass species is a critical habitat resource and generally shows low natural variability.) Total mapped extent of the dense and medium density <i>Zosteraceae</i> will not decline by greater than 25 percent of the baseline values outlined by Roob et al. (1998) at a whole of site scale on two sampling occasions within any decade. <ul style="list-style-type: none"> Dense <i>Zostera</i> - Baseline = 5743 hectares (LAC = mapped area less than 4307 hectares) Medium <i>Zostera</i> - Baseline = 1077 hectares (LAC = mapped area less than 807 hectares) <p>(Note: the moderate degree of allowable change recognises that these seagrass species generally show moderate degrees of natural variability)</p>	<p>Sampling to occur at least twice within the decade under consideration.</p> <p>Note that the seagrass assessment by Hindell (2008) did not produce mapping but did use similar sampling sites to Roob <i>et al.</i></p>	<p>Recent quantitative data describes seagrass condition at various sites but over a limited timeframe. It is thought that the Roob <i>et al.</i> (1998) study under-estimated the total available seagrass habitat (J. Stevenson, Parks Victoria, pers. comm. February 2011), hence a 10 per cent change from this baseline value would represent a larger actual change from the true baseline.</p> <p>Note: Prior to declaration, <i>Posidonia</i> covered approximately 44 per cent (11 900 hectares) of the site (Poore 1978). Morgan (1986) estimated that <i>Posidonia</i> meadows covered 11 900 hectares in 1965 and 9000 to 9500 square kilometres in 1983–84. There is uncertainty regarding these mapping data and therefore empirical LACs have not been developed from these data.</p>	S2
	Mangrove forest extent	Long term	<ul style="list-style-type: none"> Based on EVC mapping, it is estimated that mangroves presently cover an area of 2137 hectares within the site (see Section 3.3.1). A 10 percent reduction in the total mapped mangrove area, observed on two sampling occasions within any decade, is an unacceptable change. (LAC – mapped area less than 1924 hectares). (Note: the small degree of allowable change recognises that mangroves are a critical habitat resource and generally shows low natural variability) 	Sampling to occur at least twice within the decade under consideration.	No available data to determine changes in extent over time. It is unlikely that this has changed markedly since Ramsar listing. Note that there are uncertainties regarding the quality of existing mapping, and therefore the baseline value should be considered as indicative only.	S2
	Saltmarsh extent	Long term	<ul style="list-style-type: none"> Based on EVC mapping, it is estimated that intertidal saltmarsh presently covers an area of 6500 hectares within 	Sampling to occur at least twice within the	No available data to determine changes in extent over time. It is	S2

¹ Short Term – measured in years; Medium Term – five to 10 year intervals; Long term – 10+ year intervals.

EXECUTIVE SUMMARY

Number	Indicator for Critical Component / Process/Service for the LAC	Relevant timescale ¹	Limit(s) of Acceptable Change	Spatial scale/temporal scale of measurements	Underpinning baseline data	Secondary critical C,P,S addressed through LAC
			the site (see Section 3.3.1). A 10 percent reduction in the total mapped saltmarsh area, observed on two sampling occasions within any decade, is an unacceptable change (LAC – mapped area less than 5850 hectares). (Note: the small degree of allowable change recognises that saltmarsh is a critical habitat resource and generally show low natural variability)	decade under consideration.	unlikely that this has changed markedly since Ramsar listing. The note regarding data quality for mangroves applies also to saltmarsh.	
	Shallow subtidal waters	Long term	<ul style="list-style-type: none"> A greater than 20 percent reduction in the extent of subtidal channel (areas mapped by NLWRA = 16 349 hectares), observed on two sampling occasions within any decade, will represent a change in ecological character (LAC – mapped area less than 13 079 hectares). (Note: the moderate degree of allowable change recognises that shallow subtidal waters represent a critical habitat resource, generally show low natural variability, but data reliability is low) 	Sampling to occur at least twice within the decade under consideration.	<p>NLWRA mapping data describes wetland extent. This is coarse scale mapping and should be considered as indicative only.</p> <p>Note: there is a need to develop a condition-based LAC for this critical component. While some water quality data exists, this is presently insufficient to derive a LAC (i.e. whether a change in water quality represents a true change in ecological character of the wetland)</p>	S2
	Inlet waters (intertidal flats)	Long term	<ul style="list-style-type: none"> A greater than 20 percent reduction in the extent of permanent saline wetland – intertidal flats (areas mapped by DSE = 40 479 hectares, see Figure 3-1), observed on two sampling occasions within any decade, will represent a change in ecological character (LAC – mapped area less than 36 431 hectares). (Note: the moderate degree of allowable change recognises that intertidal flats represent a critical habitat resource and generally show low natural variability. A loss of intertidal flat would also result in changes in seagrass) 	Sampling to occur at least twice within the decade under consideration.	<p>VMCS mapping data describes wetland extent. This is coarse scale mapping and should be considered as indicative only.</p> <p>Note: there is a need to develop a condition-based LAC for this critical component. While some water quality data exists, this is presently insufficient to derive a LAC (i.e. whether a change in water quality represents a true change in ecological character of the wetland)</p>	S2
C2	Abundance and of waterbirds	Short term (All species)	<ul style="list-style-type: none"> Mean annual abundance of migratory bird species - Birds Australia (2009c) notes that there is a maximum annual abundance of migratory species of 42 811 birds, with a mean annual abundance of migratory species being 31 487 birds (deriving from 28 years of data collection to September 2008). The annual abundance of migratory shorebirds will not decline by 50 per cent of the long-term annual mean value (that is, must not fall below 15 743 individuals) in three consecutive years. (Note: the large degree of allowable 	At least four annual surveys (summer counts) within the decade under consideration.	Bird count data are available from a variety of programs, most notably Birds Australia monitoring programs	P2

EXECUTIVE SUMMARY

Number	Indicator for Critical Component / Process/Service for the LAC	Relevant timescale ¹	Limit(s) of Acceptable Change	Spatial scale/temporal scale of measurements	Underpinning baseline data	Secondary critical C,P,S addressed through LAC
			change recognises that these species can show high levels of natural variability, and that limitations of existing baseline data)			
		Short term (individual species)	<ul style="list-style-type: none"> Mean annual abundance of migratory species that meet the one per cent criterion will not be less than 50 per cent of the long-term annual mean value in five years of any ten year period. These values are follows: <ul style="list-style-type: none"> curlew sandpiper – baseline = 2588 birds, LAC = 1294 birds bar tailed godwit – baseline = 9727 birds, LAC = 4863 birds eastern curlew – baseline = 1971 birds, LAC = 985 birds pied oystercatcher – baseline = 893 birds, LAC = 446 birds sooty oystercatcher – baseline = 285 birds, LAC = 142 birds double-banded plover– baseline = 523 birds, LAC = 261 birds <p>There are insufficient baseline data to determine long-term average abundance of fairy tern and Pacific gull. (Note: the large degree of allowable change recognises that these species can show high levels of natural variability, and that limitations of existing baseline data)</p>	At least five annual surveys (summer counts) within the decade under consideration.	Bird count data are available from a variety of programs, most notably Birds Australia monitoring programs	P2
Critical Processes						
P1	Waterbird breeding	Short Term	<p>A greater than 50 per cent decrease in nest production at two or more monitoring stations (based on two sampling episodes over a five year period) within any of the following locations and species:</p> <ul style="list-style-type: none"> Clomel Island - fairy tern, hooded plover, Caspian tern, crested tern Dream Island - fairy tern, hooded plover, crested tern Snake Island and Little Snake Island - pied oystercatcher 	Recommended baseline monitoring program should comprise a minimum two annual sampling periods separated by at least one year (and within a five year period).	The use of the site by these species is well documented. However, there are no empirical data describing nest or egg production rates. Baseline data will need to be collected to assess this LAC.	C2
Critical Services/Benefits						
S1	Threatened Species	N/A	For orange-bellied parrot and growing grass frog, an unacceptable change will have occurred should the site no longer support these species.	Based on multiple targeted surveys at appropriate levels of spatial and temporal replication (at least four annual surveys in preferred habitats) over a	Most site records are based on opportunistic surveys	P1, C3

EXECUTIVE SUMMARY

Number	Indicator for Critical Component / Process/Service for the LAC	Relevant timescale ¹	Limit(s) of Acceptable Change	Spatial scale/temporal scale of measurements	Underpinning baseline data	Secondary critical C,P,S addressed through LAC
		Short Term	For Australian grayling, an unacceptable change will have occurred should all of the drainages that drain into Corner Inlet no longer support this species.	10 year period. Based on four annual surveys in a 10 year period at multiple sites located in all major catchments.	This species has been recorded in the major drainages that drain into the site. There are no data describing the population status of this species in the site. Abundance data are available for drainages that discharge into the site (Ecowise 2007; O'Connor <i>et al.</i> 2009). O'Connor <i>et al.</i> (2009) notes that collection of this species is difficult and requires targeted survey techniques. Few targeted empirical surveys have been undertaken in the site's drainages to date	P1, C1, C2
S2	Fish abundance (using fish catch of key species as a surrogate)	Medium term	An unacceptable change will have occurred if the long term (greater than five years) median catch falls below the 20 th percentile historical baseline values in standardised abundance or catch-per unit effort of five or more commercially significant species (relative to baseline) due to altered habitat conditions within the site. The 25 th percentile pre-listing baseline commercial catch per unit effort values for the site are as follows (units are tonnes per annum per number of boats – see Table 3-8): <div style="margin-left: 40px;"> Australian salmon 379 rock flathead 316 southern sand flathead 373 greenback flounder 514 southern garfish 1452 yelloweye mullet 740 gummy shark 167 King George whiting 1347 </div>	Annual fish catch measured over a greater than five year period.	Commercial fish catch data. Note that there are presently no fisheries-independent baseline data (collected using empirical, systematic methods) describing patterns in the distribution and abundance of key species. Therefore, the limits of acceptable change should be treated with caution, noting socio-economic factors should be taken into account when assessing catch data underpinning this LAC.	S2

In the context of changes to ecological character of the site, the study has examined:

- current and future threats to ecological character
- changes that have been observed or documented since listing of the site as a wetland of International Importance in 1982.

A range of threats to the ecological character of Corner Inlet were identified as follows:

- poor water quality (nutrients, sediment loads, suspended sediments and water-column turbidity)
- invasive plants including spartina (*Spartina angelica* and *Spartina x townsendii*) and the green macroalga (*Codium fragile* ssp *tomentosoides*)
- invasive animals including the northern Pacific seastar (*Asterias amurensis*), European shore crab (*Carcinus maenas*), and Mediterranean fanworm (*Sabella spallanzanii*)
- oil spills
- land use and development
- flow modifications
- recreational impacts
- rising sea levels and increased frequency in storm surges
- changes in rainfall and runoff.

It is concluded that no changes to the ecological character of the site have occurred since listing, although some habitats, such as *Posidonia* seagrass meadows, appear to have suffered ongoing losses due to water quality degradation.

The ECD preparation process promotes the identification of information or knowledge gaps about the Ramsar site that are principally derived through interrogation of the nominated ecosystem components, processes and services/benefits and associated understanding of natural variability and limits of acceptable change.

In analysing the information gaps identified in the ECD, the following thematic information gaps are identified as priority areas for future investment:

- baseline water quality characteristics within representative habitats throughout the site. This is considered to represent the most critical information gap in terms of identifying potential future impacts to most critical services and components
- additional research and monitoring expenditure to establish an ecological character baseline for the key waterbodies/wetland habitats, with a priority on habitats such as seagrass and fringing littoral vegetation, which support important flora and fauna species, habitats and life-history functions (for example, breeding sites, roosting sites, spawning sites, etc.) that are at most risk of future ecological change
- the need for better information and data sets about the presence and natural history of critical wetland species and their habitat; and more systematic surveys of important avifauna and fish species and populations
- better information and understanding about the natural variability of critical wetland fauna populations and key attributes and controls on those populations (including whether or not

any non-avian fauna species meet the one per cent population requirement in Ramsar nomination criterion 9)

- the ecological character thresholds of particular habitats and communities for changes in key attributes/controls such as water quality and hydrology need additional investigation. Noting that any interim limits of acceptable change stated in the ECD should be revised as improved information becomes available
- resilience of habitats, community structure and key species to acute or prolonged impacts from water quality degradation such as nutrient enrichment, increased levels of salinity and sedimentation/turbidity (for example similar to the approach in ANZECC for toxicants). This is important in the context of defining threshold-based limits of acceptable change
- more specific assessment of the vulnerability of the site to the impacts of climate change and adaptation options that could be explored to reduce the impacts.

Monitoring recommendations that would fill these information gaps and identify unacceptable changes to character are provided.

A combined set of communication, education, participation and awareness messages relevant to the ECD have been presented and can be used to communicate the importance of the site, why it was listed, possible changes to ecological character, the threats to the site and future actions required. These messages should be considered as part of existing objectives and strategic actions about community awareness in the Ramsar Strategic Management Plan (DSE 2003).