Gippsland Lakes Ramsar Site Management Plan

EAST GIPPSLAND CATCHMENT MANAGEMENT AUTHORITY

Acknowledgement of Country

We acknowledge the Gunaikurnai people, traditional owners and custodians of the land and waters of the Gippsland Lakes region, and pay our respects to their Elders past and present. In particular, we pay tribute to the Brayakaulung, Brabralung and Tatungalung clans, whose custodianship is a vital part of the heritage, knowledge and future management of the Gippsland Lakes.

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Gippsland Lakes Ramsar Site Management Plan

FOREWORD

The Gippsland Lakes are one of Victoria's most important natural assets. The health of the lakes is critical to the sustainability of the Gippsland region.

The Gippsland Lakes are recognised internationally as a Ramsar site for their very significant environmental values. Protecting these values underpins the recreational benefits of the lakes, that so many Victorians enjoy, as well as economic values such as tourism and fishing that help support the economy of the Gippsland region.

Managing such a large and complex natural system requires a strategic approach to direct government and community resources. This plan provides the framework to protect the environmental values of the Gippsland Lakes over the next eight years, in order to maintain the ecological character of the Ramsar site, as required under the Ramsar Convention on Wetlands.

The Gippsland Lakes Ramsar Site is a priority for investment in the *East Gippsland Waterway Strategy* and the *West Gippsland Waterway Strategy*. The plan complements these strategies by providing further detailed management direction for waterways within the Ramsar site. The plan provides clear direction for future investment by the Victorian Government and other investors to maintain or improve the health of the Gippsland Lakes Ramsar Site.

Through the process of developing the management plan, the East and West Gippsland catchment management authorities, other agencies, traditional owners and the community, demonstrated their willingness to work together to set the management direction for the Ramsar site. This provides a strong foundation for continuing to work together to implement the plan and achieve real outcomes over the next eight years.

We encourage you to read the plan and get involved in local activities protecting the ecological character of the Gippsland Lakes Ramsar Site.

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This report was prepared by the East Gippsland Catchment Management Authority on behalf of the Department of Environment, Land, Water and Planning

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Acronyms

AMMCF	Australian Marine Mammal Conservation Foundation
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
DELWP	Department of Environment, Land, Water and Planning, *formerly* Department of Environment and Primary Industries
DoE	Department of Environment (Australian Government)
East Gippsland CMA	East Gippsland Catchment Management Authority
ECD	Ecological Character Description
EPA	Environment Protection Authority, Victoria
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
IUCN	International Union for Conservation of Nature
GLaWAC	Gunaikurnai Land and Waters Aboriginal Corporation
GLEF	Gippsland Lakes Environment Fund
GLES	*Gippsland Lakes Environmental Strategy*
GLMAC	Gippsland Lakes Ministerial Advisory Committee
GP	Gippsland Ports Committee of Management Incorporated
LAC	Limits of Acceptable Change
MID	Macalister Irrigation District
MER	Monitoring, evaluation and reporting
PSC	Project Steering Committee
RIS	Ramsar Information Sheet
RCT	Resource Condition Target
TAG	Technical Advisory Group
TOLMB	Traditional Owner Land Management Board
VWMS	*Victorian Waterway Management Strategy*
West Gippsland CMA	West Gippsland Catchment Management Authority
WET Trust	Wetland Environmental Taskforce Trust

1 Introduction

The Gippsland Lakes Ramsar Site Strategic Management Plan (Department of Sustainability and Environment 2003) established the framework for the maintenance of ecological character through conservation and wise use. The plan is now over a decade old and there has been significant progress in both our understanding of the ecological character of the Gippsland Lakes and strategic direction in management of the site and Ramsar wetlands in Australia. A consultative and collaborative process was undertaken to review and update the Ramsar site management plan. The outputs of this review process are documented in two products:

1. A revised Gippsland Lakes Ramsar Site Management Plan (**this document**), including a full description of the plan's development and technical appendices, and
2. A Gippsland Lakes Ramsar Site Strategic Management Plan summary document for a general audience that briefly outlines the process, and details the management strategies and responsibilities.

This Ramsar site management plan sits within a framework for the management of aquatic ecosystems within Australia and the State of Victoria. At the national level, the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* establishes the basis for managing Ramsar sites. In Victoria the *Victorian Waterway Management Strategy* (VWMS) guides the management of rivers, estuaries and wetlands, and the renewal of the Gippsland Lakes Ramsar Site Management Plan addresses Action no. 12.3 of the VWMS. There are 11 Ramsar sites in Victoria and management planning for seven of these is embedded within Regional Waterway Strategies. However, the Gippsland Lakes Ramsar Site spans two Catchment Management Authority boundaries, and due to the complexity of the site's management, was considered to require a stand-alone management plan. This management plan for the Gippsland Lakes Ramsar Site supplements and complements the East and West Gippsland Waterway Strategies.

1.1 Purpose of the management plan

1.1.1 Ecological character

The "Ramsar Convention on Wetlands, especially as waterfowl habitat" was ratified in Ramsar, Iran in 1971. As of April 2015 there are 168 Contracting Parties, including Australia. Under the terms of the Convention contracting parties nominate wetlands to be designated as Wetlands of International Importance, with nominated sites required to meet at least one of nine listing criteria. The act of designating a wetland as a Ramsar site carries with it certain obligations, including managing the site to maintain its 'ecological character' and to have procedures in place to detect if any threatening processes are likely to, or have altered the 'ecological character'. The Ramsar Convention has defined "ecological character" and "change in ecological character" as (Ramsar Convention 2005):

"*Ecological character is the combination of the ecosystem components, processes and benefits/services [CPS] that characterise the wetlands at a given point in time*" and

"…*change in ecological character is the human induced adverse alteration of any ecosystem component, process and or ecosystem benefit/service*."

Under Article 3.2 of the Ramsar Convention a notification of change is required if the ecological character of a site has changed, is changing, or *is likely* to change as the result of human activities. The Australian Government has established a number of principles to guide notifications in Australia (Department of the Environment, Water Heritage and the Arts 2009):

- Assessment of change will be undertaken with respect to *critical* components, processes and benefits/services of the ecological character of the site.
- An assessment of change to support a notification must be based on best available science.
- The fact that a site was undergoing human-induced ecological character change at the time of listing does not preclude the need for an assessment, and possible

notification of change, if there is evidence of significant ongoing adverse ecological change.

- Where the natural variability of a site cannot reasonably be established for the critical component process, benefit or service against which change is being assessed, a notification, if made, will only be on the basis of *'is likely to'* change.
- A notification will not be made where the apparent character change has been identified as arising from the use of inadequate data sets at the time of listing.
- A notification will not be made where climate change is the principal cause of identified ecological character change.

Ramsar: A network of sites

There is a network of over 2000 Ramsar wetlands across the globe that is dedicated to sustaining biodiversity and wise use. One of the important functions, and a primary purpose for the establishment of the Convention, is to protect sites in different countries that are important for migratory birds.

The migratory birds that visit Australia are part of the East Asian-Australasian Flyway and most of them migrate from breeding grounds in North-east Asia and Alaska to non-breeding grounds in Australia and New Zealand, covering the journey of 10 000 kilometres twice in a single year.

The lifecycle of most international migratory shorebirds involves (Bamford et al. 2008):

- breeding in May to August (northern hemisphere);
- southward migration to the southern hemisphere (August to November);
- feeding and foraging in the southern hemisphere (August to April); and
- northward migration to breeding grounds (March to May).

During both northward and southward migration, birds may stop at areas on route to rest and feed. These stopovers are referred to as “staging” areas and are important for the birds’ survival. In addition, birds on their first southward migration that have not yet reached breeding maturity and may remain in Australia over the southern winter period.

The Gippsland Lakes Ramsar Site supports over 20 species that are international migrants and listed under migratory agreements with China, Japan and the Republic of South Korea. Important habitats within the site include intertidal mudflats and saltmarsh such as those at Lake Reeve, where migratory waders feed. High tide roosting sites, where waders can rest are also important.

Migratory waders in Australia need to build up their energy reserves for the homeward journey. This means that they not only require abundant food sources, but they need to minimise their activity. Disturbance of waders when roosting or feeding may result in a significant loss of energy. This may even compromise their ability to build up enough reserves to complete the return journey to breeding grounds. Disturbance of migratory shorebirds may occur as a result of recreational fishing (in some instances), four wheel driving on beaches or in saltmarsh and intertidal areas, unleashed dogs; boating and jet skiing and any activity in the intertidal zone that causes significant noise or light. Migratory waders are also susceptible to predation by foxes and cats.

Populations of many migratory wader species are in decline, primarily through loss of habitat in breeding and staging areas outside Australia. This makes them more vulnerable while in Australia and increases the importance of doing everything in our power to maintain habitat and conditions at winter sites. Residents and visitors to the Gippsland Lakes need to work together to help protect and conserve these important species.

Ramsar site management to maintain ecological character is reliant on a number of key documents and processes as illustrated in Figure 1. The three key documents are:

Ramsar Information Sheet (RIS) - compiled for each site and documents the essential information related to the site and its management. The Administrative Authority of each Contracting Party submits the RIS to the Ramsar Secretariat. In the case of Australia this is the Australian Government Department of the Environment (DoE). The Parties have committed to providing updated RIS information for their Ramsar sites every six years, or on the occasion of any significant change in a site's ecological character. The most recent RIS for the Gippsland Lakes was compiled in 1999 and can be obtained from the DoE website (http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=21#).

Ecological Character Description (ECD) – provides a more detailed and quantitative description of ecological character for a Ramsar site. The ECD establishes a benchmark, at the time of listing, which in the case of the Gippsland Lakes is 1982. The ECD identifies the critical components, processes and services of the site (critical CPS) and sets limits of acceptable change (LAC). The Australia Government has developed a standard method for describing ecological character (Department of the Environment, Water, Heritage and the Arts 2008). The ECD for the Gippsland Lakes was completed in 2011 and can be accessed from the DoE website (http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=21#).

Management plan – documents the management strategies required to protect and restore the ecological character of a Ramsar site. In Australia, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes the framework for management of Australian Ramsar sites, and Schedule 6 of the EPBC Regulations outlines the principles relevant to the preparation of Ramsar site management plans (Text Box 1).

Ramsar site management plans must adhere to these principles. Of note is that the primary purpose of the management plan must be in accordance with the Ramsar Convention:

- to describe and maintain the ecological character of the wetland; and
- to formulate and implement planning that promotes:
    - conservation of the wetland; and
    - wise and sustainable use of the wetland for the benefit of humanity in a way that is compatible with maintenance of the natural properties of the ecosystem.

Ramsar Rolling Review – The Department of Environment has developed a three-year Ramsar Rolling Review program for reporting the status of the ecological character of Australia's Ramsar sites. The broad aims of the Ramsar Rolling Review program are to:

- Review and report the on status of the ecological character of Australia's Ramsar sites.
- Be a tool to assist managing sites in order to maintain their ecological character, improving links between ecological character, site management plans and monitoring programs for critical components, processes and services and associated threats.
- Provide input to a database of baseline and threat data.
- Record updates as knowledge gaps are addressed and refinement of Limits of Acceptable Change.
- Highlight issues and facilitate assessment of a potential change of character, focussing on proactive management before the situation requires notification.
- Identify broad trends or common threats across site and jurisdiction boundaries.

1 General principles

1.01 The primary purpose of management of a declared Ramsar wetland must be, in accordance with the Ramsar Convention :

(a) to describe and maintain the ecological character of the wetland; and

(b) to formulate and implement planning that promotes:

(i) conservation of the wetland; and

(ii) wise and sustainable use of the wetland for the benefit of humanity in a way that is compatible with maintenance of the natural properties of the ecosystem.

1.02 Wetland management should provide for public consultation on decisions and actions that may have a significant impact on the wetland.

1.03 Wetland management should make special provision, if appropriate, for the involvement of people who:

(a) have a particular interest in the wetland; and

(b) may be affected by the management of the wetland.

1.04 Wetland management should provide for continuing community and technical input.

2 Management planning

2.01 At least one management plan should be prepared for each declared Ramsar wetland.

2.02 A management plan for a declared Ramsar wetland should:

(a) describe its ecological character; and

(b) state the characteristics that make it a wetland of international importance under the Ramsar Convention; and

(c) state what must be done to maintain its ecological character; and

(d) promote its conservation and sustainable use for the benefit of humanity in a way that is compatible with maintenance of the natural properties of the ecosystem; and

(e) state mechanisms to deal with the impacts of actions that individually or cumulatively endanger its ecological character, including risks arising from:

(i) physical loss, modification or encroachment on the wetland; or

(ii) loss of biodiversity; or

(iii) pollution and nutrient input; or

(iv) changes to water regimes; or

(v) utilisation of resources; or

(vi) introduction of invasive species; and

(f) state whether the wetland needs restoration or rehabilitation; and

(g) if restoration or rehabilitation is needed--explain how the plan provides for restoration or rehabilitation; and

(h) provide for continuing monitoring and reporting on the state of its ecological character; and

(i) be based on an integrated catchment management approach; and

(j) include adequate processes for public consultation on the elements of the plan; and

(k) be reviewed at intervals of not more than 7 years.

3 Environmental impact assessment and approval

3.01 This principle applies to the assessment of an action that is likely to have a significant impact on the ecological character of a Ramsar wetland (whether the action is to occur inside the wetland or not).

3.02 Before the action is taken, the likely environmental impact of the action on the wetland's ecological character should be assessed under a statutory environmental impact assessment and approval process.

3.03 The assessment process should:

(a) identify any part of the ecological character of the wetland that is likely to be affected by the action; and

(b) examine how the ecological character of the wetland might be affected; and

(c) provide adequate opportunity for public consultation.

3.04 An action should not be approved if it would be inconsistent with:

(a) maintaining the ecological character of the wetland; or

(b) providing for the conservation and sustainable use of the wetland.

3.05 Approval of the action should be subject to conditions, if necessary, to ensure that the ecological character of the wetland is maintained.

3.06 The action should be monitored by the authority responsible for giving the approval (or another appropriate authority) and, if necessary, enforcement action should be taken to ensure compliance with the conditions.

Text Box 1: Australian Ramsar Management Principles.

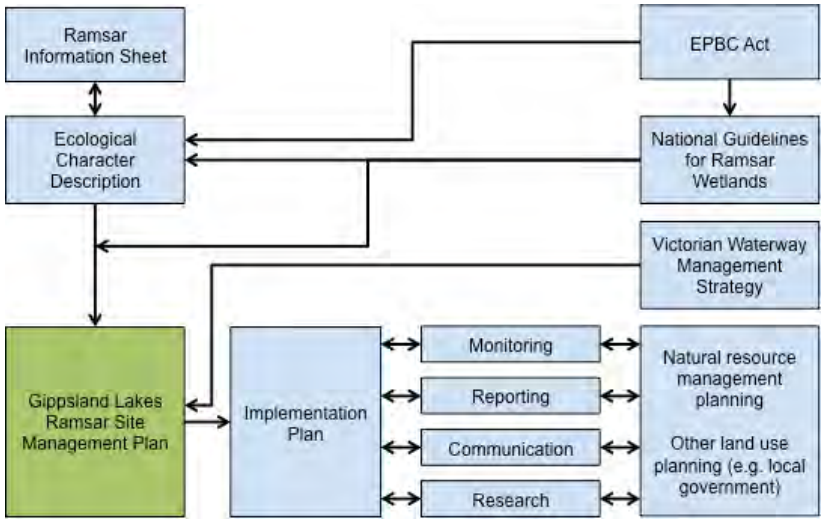


Figure 1: The Gippsland Lakes Ramsar Site Management Plan in context of other requirements for the management of Ramsar sites (adapted from DEWHA 2008).

1.1.2 Objectives of the management plan

The primary purpose of the Gippsland Lakes Ramsar Site Management Plan is to maintain ecological character and promote wise use of the site. Wise use is defined by the Convention as (Ramsar Convention 2005):

"*the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development*".

The Gippsland Lakes Ramsar Site supports a number of ecological, socio-economic and cultural values (see chapter 4). While ecological character can (and does) include some socio-economic values, such as commercial fishing, additional socio-economic and cultural values of the site (e.g. tourism, recreation) result from maintaining the condition of the Ramsar site (GLMAC 2013). This plan has adopted the principle that by maintaining (or improving) ecological character, the socio-economic and cultural values associated with the Ramsar site will also be conserved, within the concept of wise use. Therefore, the primary objective of the Gippsland Lakes Ramsar Site Management Plan is:

"***To maintain, and where necessary improve, the ecological character of the Gippsland Lakes Ramsar Site and promote wise use***".

1.2 Relevant policy and legislation

1.2.1 International

Ramsar Convention

The Convention on Wetlands of International Importance, otherwise known as the Ramsar Convention, was signed in Ramsar Iran in 1971 and came into force in 1975. It provides the framework for local, regional and national actions, and international cooperation, for the conservation and wise use of wetlands. Wetlands of International Importance are selected on the basis of their international significance in terms of ecology, botany, zoology, limnology and/or hydrology.

Migratory bird bilateral agreements and conventions

Australia is party to a number of bilateral agreements, initiatives and conventions for the conservation of migratory birds, which are relevant to the Gippsland Lakes Ramsar Site. The bilateral agreements are:

- *Japan-Australia Migratory Bird Agreement (JAMBA)* – The agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment, 1974;

- *China-Australia Migratory Bird Agreement (CAMBA)* - The Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986;
- *Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)* - The Agreement between the Government of Australia and the Republic of Korea for the Protection of Migratory Birds and their Environment, 2006; and
- *The Bonn Convention on Migratory Species (CMS)* - The Bonn Convention adopts a framework in which countries with jurisdiction over any part of the range of a particular species co-operate to prevent migratory species becoming endangered. For Australian purposes, many of the species are migratory birds.

1.2.2 National

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
The EPBC Act regulates actions that will have or are likely to have a significant impact on any matter of national environmental significance, which includes the ecological character of a Ramsar wetland (EPBC Act 1999 s16(1)). An action that will have or is likely to have a significant impact on a Ramsar wetland will require an environmental assessment and approval under the EPBC Act. An 'action' includes a project, a development, an undertaking or an activity or series of activities (http://www.environment.gov.au/epbc/index.html).

The EPBC Act establishes a framework for managing Ramsar wetlands, through the Australian Ramsar Management Principles (EPBC Act 1999 s335), which are set out in Schedule 6 of the *Environment Protection and Biodiversity Conservation Regulations 2000*. These principles are intended to promote national standards of management, planning, environmental impact assessment, community involvement, and monitoring, for all of Australia's Ramsar wetlands in a way that is consistent with Australia's obligations under the Ramsar Convention. Some matters protected under the EPBC Act are not protected under local or state/territory legislation, and as such, many migratory birds are not specifically protected under State legislation. Species listed under international treaties JAMBA, CAMBA and CMS have been included in the List of Migratory species under the Act. Threatened species and communities listed under the EPBC Act may also occur, or have habitat in the Ramsar site; some species listed under State legislation as threatened are not listed under the EPBC Act as threatened, usually because they are not threatened at the national (often equivalent to whole-of-population) level. The Regulations also cover matters relevant to the preparation of management plans, environmental assessment of actions that may affect the site, and the community consultation process.

Native Title Act 1993
This Act provides for the recognition and protection of native title. It establishes ways in which future dealing affecting native title may proceed and sets standards for such dealing. It establishes a mechanism for determining claims to native title. It provides for, or permits, the validation of past acts, and intermediate period acts, invalidated because of the existence of native title.

1.2.3 Victorian state policy and legislation

*Crown Land (Reserves) Act 197*8
This Act provides the framework for the administration and management of Crown land reserves including nature conservation reserves. The Act also deals with the making of regulations, committees of management and leasing and licensing.

The Environment Protection Act 1970
This Act establishes the Environment Protection Authority and makes provision for the Authority's powers, duties and functions. These relate to improving the air, land and water environments by managing waters, control of noise and control of pollution. State Environment Protection Policies (SEPPs) are subordinate legislation made under the provisions of the Act. SEPP (Waters of Victoria) sets water quality objectives to protect the beneficial uses of waters. SEPP (Waters of Victoria) is currently under review.

Fisheries Act 1995
The Act provides a framework for the regulation, management and conservation of Victorian fisheries. It deals with commercial and recreational licences, fish culture, noxious aquatic species, research and development, the declaration and management of fisheries reserves; and the preparation of management plans for individual fisheries, declared noxious aquatic species and fisheries reserves.

Flora and Fauna Guarantee Act 1988
The Act provides a legislative and administrative framework for the conservation of biodiversity in Victoria. The Act provides for the listing of threatened taxa, communities and potentially threatening processes. It requires the preparation of action statements for listed species, communities and potentially threatening processes and sets out the process for implementing interim conservation orders to protect critical habitats. The Act also seeks to provide programs for community education in the conservation of flora and fauna and to encourage co-operative management of flora and fauna.

National Parks Act 1975
The Act makes provision for the preservation and protection of the natural environment including wilderness areas and remote and natural areas. This includes the protection and preservation of indigenous flora and fauna and of features of scenic or archaeological, ecological, geological, historic or other scientific interest in those parks. It allows for the study of ecology, geology, botany, zoology and other sciences relating to the conservation of the natural environment in those parks; and for the responsible management of the land in those parks.

Water Act 1989
The Act establishes rights and obligations in relation to water resources and provides mechanisms for the allocation of water resources. This includes the consideration of environmental water needs of rivers and wetlands as well as for human uses such as urban water supply and irrigation.

Wildlife Act 1975
The Act ensures procedures are in place to protect and conserve Victoria's wildlife and prevent any taxa of wildlife from becoming extinct. The Act also provides for the establishment of State Game Reserves. Regulations under the Act ensure that the consumptive use or other interactions with flora and fauna in Victoria does not threaten the sustainability of wild populations, while facilitating cultural and recreational pursuits in a humane, safe, ethical and sustainable manner.

Catchment and Land Protection Act 1994 (CaLP Act)
The Act sets up a framework for the integrated management and protection of catchments. It establishes processes to encourage and support community participation in the management of land and water resources and provides for a system of controls on noxious weeds and pest animals.

Aboriginal Heritage Act 2006
The Act provides for the protection and management of Victoria's Aboriginal heritage. It establishes the Victorian Aboriginal Heritage Council to advise the Minister in the management of cultural heritage and registered Aboriginal parties. The Act also deals with cultural heritage management plans, cultural heritage permits and agreements. The Act also includes enforcement provisions and processes for handling dispute resolution. This includes the review of certain decisions through the Victorian Civil and Administrative Tribunal (VCAT).

Port Management Act 1995
The Act to provides for the establishment, management and operation of commercial trading and local ports in Victoria and appointed Gippsland Ports as the manager for local ports in Gippsland. The Act requires (among other functions) for Gippsland Ports to develop and implement Safety and Environment Management Plans (SEMPs) for ports and waterways under its control, including the Port of Gippsland Lakes.

Victorian Waterway Management Strategy

The 2013 Victorian Waterway Management Strategy (VWMS) provides the framework for government – in partnership with the community - to maintain or improve the condition of rivers, estuaries and wetlands so that they can continue to provide environmental, social, cultural and economic values for all Victorians. The framework is based on regional planning processes and decision-making, within the broader system of integrated catchment management in Victoria.

1.2.4 Regional plans and policy

There are a very large number of regional and local plans that are relevant to the management of the Gippsland Lakes Ramsar Site. A few of the most significant of these are outlined here. Further information can be found on the East and West Gippsland Catchment Management Authority's (CMAs) respective websites (http://www.egcma.com.au/resources/166/ and http://www.wgcma.vic.gov.au/index.php/publications/regional-menu.html).

Regional Catchment Strategies (RCS)

RCSs are statutory documents under the CaLP Act that provide the overarching framework for land, water and biodiversity management and conservation in each of the ten catchment management regions of Victoria. There are two catchment regions relevant to the Gippsland Lakes, each with their own RCS: West Gippsland RCS (http://www.wgcma.vic.gov.au/images/stories/PDF/Publications/Regional/rcs_2013-19.pdf) East Gippsland RCS (http://www.egcma.com.au/file/file/East%20Gippsland%20Regional%20Catchment%20Strategy%202013-2019.pdf).

The two RCSs are the primary planning documents for their respective regions. They identify priorities for natural resource management for water and biodiversity and provide a framework for integrated management of catchments.

Regional Waterway Strategies

RWSs have been developed for each of the ten catchment management regions in Victoria. These sit under the VWMS and RCS frameworks and outline the detailed planning and management for rivers, estuaries and wetlands across the State. Ramsar management planning has been embedded in the RWSs for the majority of the Ramsar sites in Victoria. The Gippsland Lakes is an exception to this, due to its complexity and the fact that it spans two CMA boundaries. The East Gippsland Waterway Strategy (East Gippsland CMA 2014) and the West Gippsland Regional Waterway Strategy (West Gippsland CMA 2014) both identify the Gippsland Lakes as a priority waterway, within their regions. The Gippsland Lakes Ramsar Site Management Plan will complement and supplement the information on management of the site within these two RWS documents.

Gippsland Lakes Environmental Strategy (GLES)

The GLES was developed by the Gippsland Lakes Ministerial Advisory Council (GLMAC) to guide investment in on-ground works, knowledge building, and advocacy for the Lakes. The GLES is a suite of action programs to manage the future health of the Lakes. It incorporates and builds on past work, providing a single reference to the key areas of action for effective investment in the health of the Lakes. The aim of the GLES is to:

- Bring together in one place the key scientific knowledge, policy directions and viewpoints on the health of the Gippsland Lakes.
- Strengthen linkages between the environmental, social and economic values relating to health of the Lakes.
- Include the views and opinions of all sectors of the community.
- Set an agreed framework for investment through the Gippsland Lakes Environment Fund and other resources.
- Drive positive action and build confidence for the future.

1.3 Development of the plan

1.3.1 Objectives of the development process

The Department of Environment, Land, Water and Planning (DEWLP) commissioned the project to renew the 2003 Gippsland Lakes Ramsar Site Management Plan. The project had four objectives:

1. Develop and implement a robust approach for analysis and prioritisation of values and locations within the Gippsland Lakes Ramsar Site
2. Identify high level strategic actions for each agency with clear responsibility for actions
3. Identify requirements for:
    (i) monitoring the implementation of the renewed Gippsland Lakes Ramsar Site Management Plan; and,
    (ii) monitoring of condition, to identify changes in the ecological character; and,
4. Develop a high level strategic plan aligning with guidelines and an accompanying management report documenting the development of the plan.

A work plan and Gantt chart were developed (see Appendix A) to meet each of the stated objectives of the project to renew the Gippsland Lakes Ramsar Site Management Plan. Further detail on the methods used is provided in the sections below:

- Risk assessment – section 3.1
- Identification of priority values – section 4.1
- Identification of priority threats – section 5.1
- Management strategies – section 6.1.

1.3.2 Principles of the planning process

Throughout the development of the Gippsland Lakes Ramsar Site Management Plan, a number of principles were adopted and underpinned the planning process, consistent with the guiding principles of the VWMS (Department of Environment and Primary Industries 2013):

Stakeholder involvement – this plan has been developed with the input of a broad range of stakeholders through every phase (see section 1.3.3).

Evidence-based approach – best available knowledge has been used to underpin the development of this plan including the risk assessment and prioritisation of values and threats.

Precautionary principle – lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation.

Building on existing activities – there are a large number of activities already being implemented within the catchment and the Gippsland Lakes to maintain and improve condition and ecosystem services. This plan seeks to build on these existing activities rather than duplicate effort.

Adaptive management – the plan life is for eight years, with a mid-term review after four years. A monitoring program has been included and the principles of monitor, evaluate, report and improve have been adopted.

1.3.3 Stakeholder involvement

The importance of stakeholder engagement in the development of management plans for Ramsar sites is recognised by the Convention and in the Australian Ramsar Management Principles (Text Box 1). In terms of the development of this management plan, stakeholders were involved in every step of the process (Table 1). A stakeholder engagement plan was developed prior to the commencement of the project (see Appendix B).

The major groups involved in the development of this project were:

Project Steering Committee (PSC): Representatives of agencies primarily responsible for the management of the Ramsar site (East and West Gippsland CMAs, GLMAC, DELWP, Parks Victoria, GLaWAC and DoE).

Technical Advisory Group (TAG):

1. Technical experts in their respective fields were contacted individually for advice / input; and
2. Agencies with an interest and responsibility in managing aspects of the Gippsland Lakes were engaged and invited to participate in workshops related to identifying priority vales and threats and high level strategic actions. Members of the TAG comprised representatives of:
    - Parks Victoria
    - East Gippsland CMA
    - West Gippsland CMA
    - Victorian Environment Protection Authority
    - BirdLife Australia (including BirdLife East Gippsland)
    - Gippsland Ports
    - Southern Rural Water
    - Department of Environment, Land, Water and Planning (Gippsland Region, Catchments and Water Group, Arthur Rylah Institute)
    - Commercial Fishermen
    - Field and Game Australia
    - Friends of the Gippsland Lakes
    - East Gippsland Shire

Community: Broader community and stakeholder engagement through the GLMAC and the Gippsland Lakes E-Engagement website (http://glee.gippslandlakes.net.au/).

Table 1: Summary of stakeholder engagement activities associated with the development of the Gippsland Lakes Ramsar Site Management Plan (further details provided in each of the relevant method sections below).

Task	Approach	Stakeholder involvement	Outputs
Prioritisation approach	Develop draft criteria for the prioritisation of values and threats Preliminary identification of values and threats	Workshop with PSC to review approach and criteria; identify values and threats	Agreed prioritisation method and list of values and threats to be considered
Data collation	Collation of relevant data and information on values, condition and threats to inform risk assessment and prioritisation	Unpublished data / information from PSC and TAG	Summary of values and condition mapped to mega-habitats
Risk assessment	Draft risk assessment using impact pathways approach	Workshop with PSC and TAG to review risk assessment and identify critical knowledge gaps Individual input from scientific experts from research organisations. Community update on the Gippsland Lakes E-Engagement website.	Finalised risk assessment Critical knowledge gaps
Prioritisation	Preliminary prioritisation of values and threats	Workshop with PSC and TAG: review risk assessment Individual input from scientific experts from research organisations Community update on the Gippsland Lakes E-Engagement website.	Priority values and threats for the management plan

Task	Approach	Stakeholder involvement	Outputs
Review	Review of achievements under the current management plan	Stakeholder interviews and input through the PSC and TAG	Summary of achievements
Resource condition targets, strategic actions and monitoring needs	Draft realistic resource condition targets for priority values / locations. Draft approach to prioritising strategic actions	Workshop(s) with steering committee and TAG members to: • Review resource condition targets • Identify strategic actions and monitoring requirements. • Identifying existing relevant activities. • Determine timelines and responsibilities Meeting with indigenous groups to identify relevant actions and strategies.	Final resource condition targets, strategic actions and monitoring needs
Reporting	Draft two report formats: • Gippsland Lakes Ramsar Site Management Plan • Summary document for general audience	Draft reports circulated to PSC for review and comment.	Final draft reports for public consultation
Public consultation	Briefings with relevant agencies Open House events in Sale and Bairnsdale Individual briefings on request Launch of draft / final plans	Draft reports available for agency and community review. Feedback from broad range of stakeholders. Common and shared understanding of management responsibilities	Final reports

2 Gippsland Lakes Ramsar Site

A complete description of the ecological character of the Gippsland Lakes Ramsar Site is contained in the ECD (BMT WBM 2010a). A summary of this information relevant to the management plan for the site is provided below.

2.1 Location

The Gippsland Lakes Ramsar Site is located approximately 300 kilometres east of Melbourne in the State of Victoria in south-east Australia. The site extends from Sale Common east to Lake Tyers covering an area of approximately 60 000 hectares (Figure 2). The Ramsar site comprises a series of coastal lagoons formed behind a barrier dune system, however, the ocean beaches and dunes of the Gippsland Coast are outside the site boundary (BMT WBM 2010a).

The Gippsland Lakes have been connected to the Southern Ocean (Bass Strait) by an artificially maintained channel at Lakes Entrance since 1889 and receive freshwater inflows from seven major river systems (Tilleard et al. 2009). Prior to 1889 the Gippsland Lakes was periodically connected to the Southern Ocean and active commercial shipping was in place. The major waterbodies comprising the Gippsland Lakes are Lake Wellington, Lake Victoria and Lake King, which are all large and shallow and occur along a salinity gradient. Lake Reeve is a narrow, shallow water body lying along the coastal dune barrier and has an area of 50 square kilometres. It is usually dry, except for times of high rainfall (Webster et al. 2001) and salinity is generally classified as hypersaline (Tilleard et al. 2009). A number of wetlands that fringe the main lakes are within the site boundary and these range from fresh (Sale Common and Macleod Morass), through brackish to hypersaline.

The Gippsland Lakes Ramsar Site was listed in 1982, and the boundary most likely established on the basis of land tenure and management responsibilities. However, this has meant that a number of wetlands are partially inside the Ramsar site. The most obvious example of this is Lake Coleman, which is essentially bisected by the Ramsar site boundary (Figure 3). However, there are a number of other instances where the boundary cuts through fringing wetlands. Similarly, the estuarine reaches of some of the inflowing rivers, such as the Nicholson River are within the Ramsar boundary, but not all. Parts of the estuaries of the Avon, Mitchell and Latrobe Rivers are outside the site boundary. In terms of this management plan, a more holistic approach has been adopted whereby all of the fringing wetlands and estuarine reaches of the inflowing rivers have been included in the management planning process.

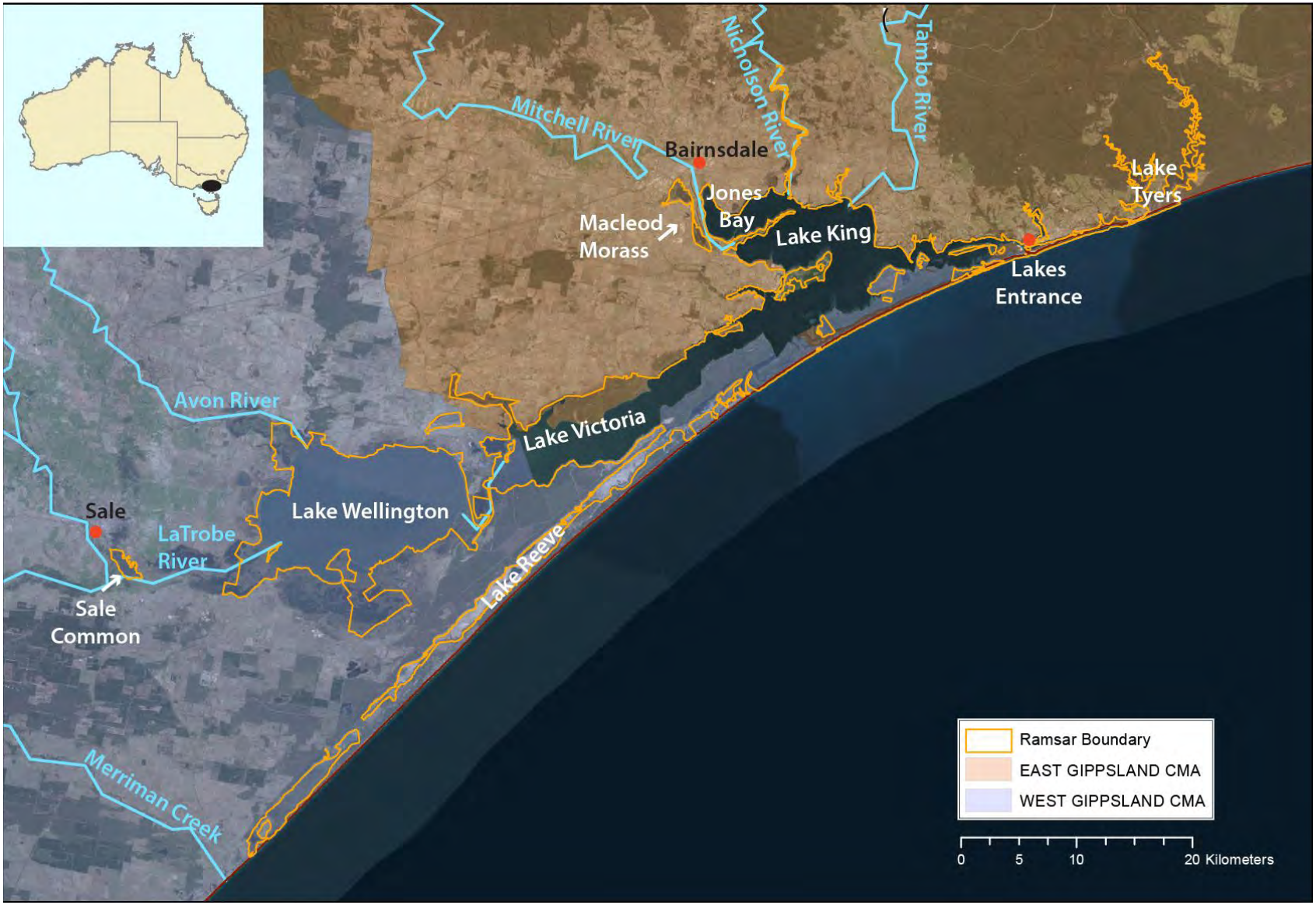


Figure 2: Location of the Gippsland Lakes Ramsar Site.

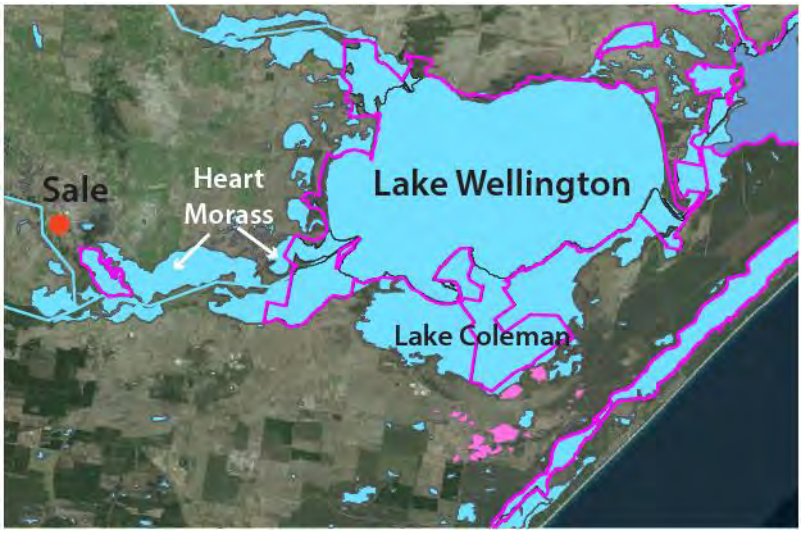


Figure 3: Ramsar site boundary around Lake Wellington, illustrating that a portion of Lake Coleman and Heart Morass lie outside the site boundary. Blue is mapped wetland areas, pink line is the Ramsar site boundary.

The Gippsland Lakes Ramsar Site is large, complex and made up of a variety of wetland types. In order to better guide the identification of values, threats and management strategies, a finer spatial scale was deemed to be appropriate. After consideration of a number of options, the project steering committee agreed that the mega habitats of Tilleard et al (2009) would provide the most applicable spatial template for the renewal of the Gippsland Lakes Ramsar Site Management Plan. The mega-habitats are broadly aligned with Ramsar wetland types, and their use in Gippsland Lakes Ramsar Site Management Plan aligns with other plans and strategies in place for the Gippsland Lakes.

There are three broad categories, with six finer scale mega-habitats within the Gippsland Lakes Ramsar Site (Figure 4):

Main Lakes

- **Deep Lakes** – permanent deep waterbodies, such as Lakes King, Victoria and Tyers;
- **Shallow Lakes** – shallow permanent waterbodies, such as Jones Bay and Lake Wellington;

Fringing wetlands

- **Freshwater wetlands** – two fringing wetlands that have freshwater, Sale Common and Macleod Morass;
- **Variably saline wetlands** – intermittent wetlands that fluctuate between fresh or brackish and saline, such as Heart Morass, Clydebank Morass and Dowd Morass;
- **Hypersaline wetlands** – wetlands with salinity generally greater than seawater, such as Lake Reeve and Victoria Lagoon; and

Estuarine reaches of the inflowing rivers.

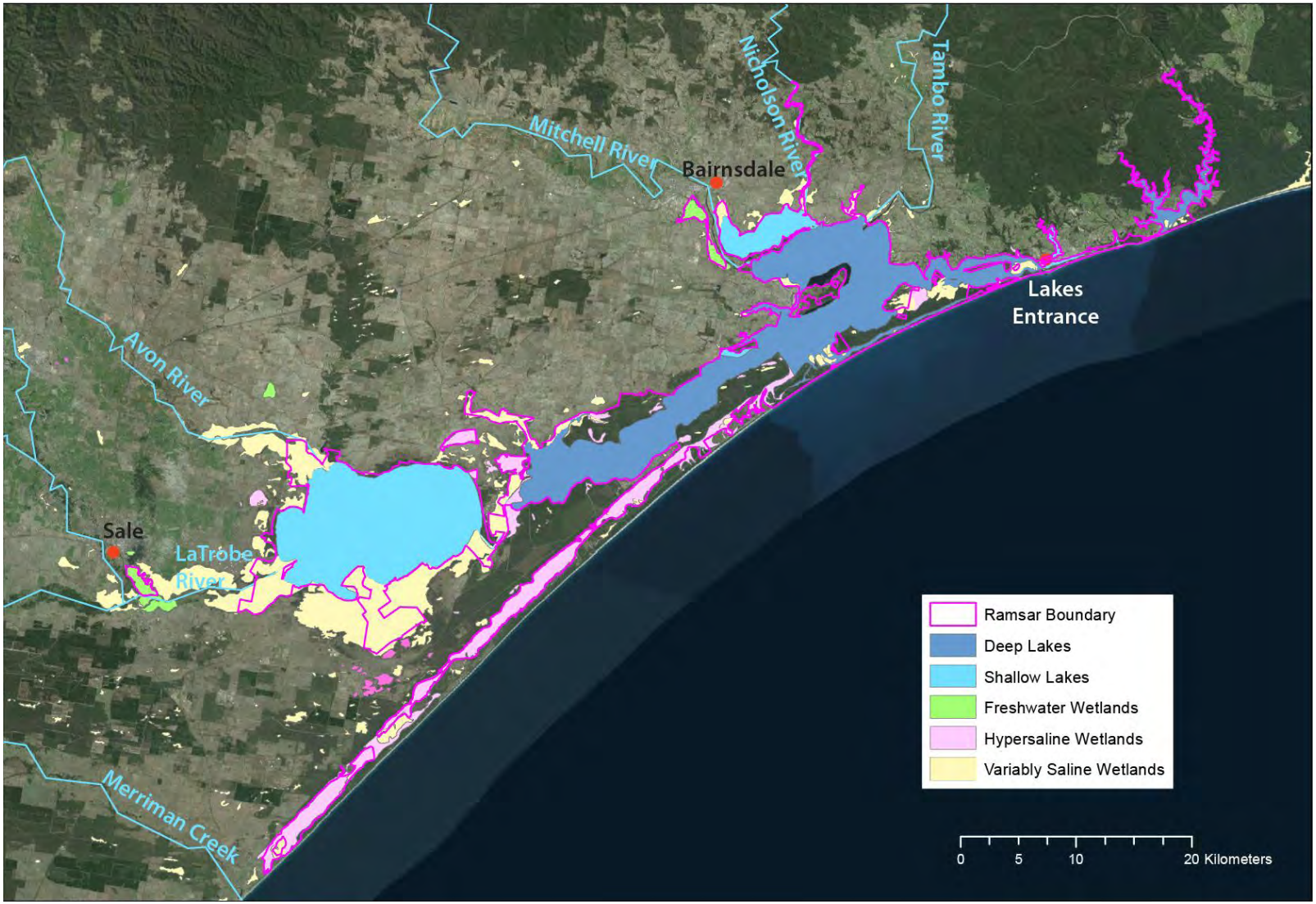


Figure 4: Mega habitats of the Gippsland Lakes Ramsar Site (modified from Tilleard et al. 2009).

2.2 Land use and tenure

The catchment contains a number of major towns and associated urban centres (Sale, Bairnsdale, Warragul, Traralgon, Morwell and Moe); extensive coal mining and power generation in the west and the Latrobe Valley industrial development area. The catchment is predominantly forested (65 percent), but also includes large areas of dryland pasture (25 percent). There is significantly more development, industry and intensive land use in the west catchment than the east (Grayson 2006).

There are a variety of tenures associated with the lands and waters of the Gippsland Lakes Ramsar Site, and these are detailed in Table 2. There are also a number of different agencies with responsibilities associated with managing aspects of the site, and these are summarised in Table 3.

Table 2: Land tenure and management of the Gippsland Lakes Ramsar Site (BMT WBM 2010a).

Area	Land tenure	Legal status	Management
Sale Common	Nature Conservation Reserve – Wildlife Reserve	*Crown Land (Reserves) Act 1978 and Wildlife Act 1975*	Parks Victoria
Dowd Morass (part) Heart Morass	State Wildlife Reserve classified as State Game Reserve	*Crown Land (Reserves) Act 1978* and *Wildlife Act 1975*	Parks Victoria
Clydebank Morass	State Wildlife Reserve classified as State Game Reserve	*Crown Land (Reserves) Act 1978* and *Wildlife Act 1975*	Parks Victoria
Lake Wellington (western shoreline)	Public Purposes Reserve	*Crown Land (Reserves) Act 1978*	DELWP
Lake Wellington (shoreline – Disher Bay)	Public Purpose Reserve, Unreserved Crown Land	*Crown Land (Reserves) Act 1978*	DELWP
Lake Wellington (shoreline – Swell Point to Roseneath Point)	Public Purpose Reserve	*Crown Land (Reserves) Act 1978*	DELWP
Lake Wellington (eastern shoreline)	Public Purpose Reserve, Salt Lake – Unreserved Crown Land	*Crown Land (Reserves) Act 1978*	DELWP
Lake Wellington	Crown Land Reserve	*Crown Land (Reserves) Act 1978*	DELWP
Lake Coleman	State Wildlife Reserve classified as State Game Reserve	*Crown Land (Reserves) Act 1978* and *Wildlife Act 1975*	Parks Victoria
Land adjoining Lake Coleman Wildlife Reserve to south	Land vested in Gippsland Water	*Water Act 1989*	Gippsland Water
Lake Reeve	Gippsland Lakes Coastal Park	*National Parks Act 1975*	Parks Victoria
Gippsland Lakes Coastal Park	Coastal Park	*National Parks Act 1975*	Parks Victoria
Land near McLennan Strait	Part of Gippsland Lakes Coastal Park	*National Parks Act 1975*	Parks Victoria
	Public Purpose Reserve	*Crown Land (Reserves) Act 1978*	DELWP
Morley Swamp	Natural Features Reserve – Gippsland Lakes Reserve	*Crown Land (Reserves) Act 1978*	Parks Victoria
Backwater Morass	Natural Features Reserve – Gippsland Lakes Reserve	*Crown Land (Reserves) Act 1978*	Parks Victoria
Red Morass	Natural Features Reserve – Gippsland Lakes Reserve	*Crown Land (Reserves) Act 1978*	Parks Victoria
Victoria Lagoon	Natural Features Reserve – Wildlife Reserve classified as State Game Reserve	*Crown Land (Reserves) Act 1978*	Parks Victoria
Lake Victoria	Crown Land Reserve	*Crown Land (Reserves) Act 1978*	DELWP

Area	Land tenure	Legal status	Management
The Lakes National Park	The Lakes National Park	*National Parks Act 1975*	Parks Victoria
Blond Bay	Natural Features Reserve – Wildlife Reserve classified as State Game Reserve	*Crown Land (Reserves) Act 1978* and *Wildlife Act 1975*	Parks Victoria
Lake King	Public Purposes Reserve	*Crown Land (Reserves) Act 1978*	DELWP
Macleod Morass	Natural Features Reserve – Wildlife Reserve classified as State Game Reserve	*Crown Land (Reserves) Act 1978* and *Wildlife Act 1975*	Parks Victoria
Jones Bay	Natural Features Reserve – Wildlife Reserve classified as State Game Reserve* and Natural Features Reserve – Gippsland Lakes Reserve	*Crown Land (Reserves) Act 1978* and *Wildlife Act 1975*	Parks Victoria
Mitchell River	Water Reserve	*Land Act 1958*	Parks Victoria
Swan Reach	Natural Features Reserve – Gippsland Lakes Reserve	*Crown Land (Reserves) Act 1978* and *Wildlife Act 1975*	Parks Victoria
Lake Tyers	Forest Park	*Crown Land (Reserves) Act 1978*	DELWP, Shire
Land to the south of Lake King	Gippsland Lakes Coastal Park	*National Parks Act 1975*	Parks Victoria
North Arm (near Lakes Entrance)	Public Purpose Reserve	*Crown Land (Reserves) Act 1978*	DELWP
Lakes Entrance to Lake Tyers including Lake Bunga	Lakes Entrance – Lake Tyers Coastal Reserve	Crown Land (Reserves) Act 1978	Parks Victoria, East Gippsland Shire Council

Table 3: Lead management agencies and their key responsibilities (BMT WBM 2010a).

Agency	Overarching responsibility	Responsibility to Gippsland Lakes
Parks Victoria	Manage parks and reserves.	Manage areas including The Lakes National Park, Gippsland Lakes Reserve, Macleod Morass, The Sale Common, Heart, Dowd and Clydebank Morasses.
Department of Environment, Land Water and Planning (DELWP)	Strategic direction for park and reserve management; flora and fauna management and implementation of the Ramsar Convention in Victoria; catchment and water management, forest management, coastal and port management; leasing, licensing and management of public land, strategic and statutory land use planning including the administration of the Victorian Planning Provisions.	Policy advice for the management of the Gippsland Lakes Ramsar Site. Management of hunting at the Gippsland Lakes Ramsar Site. Management of waterbody lake beds.
Department of Economic Development, Jobs, Transport and Resources	Provides strategic direction for fisheries management and research, agricultural services and sustainable development of Victoria's energy and mineral resources.	Manage commercial and recreational fishing for the Ramsar site in accordance with *Fisheries Act 1995*. Strategic and operational catchment management services e.g. soil conservation, vegetation management, salinity management, water quality monitoring and management.
East Gippsland Shire and Wellington Shire	Manage foreshores adjoining urban areas. Ensure orderly, sustainable development within the catchment to and within the boundary of the Ramsar site, through strategic land-use planning, improvement to the Planning Scheme and administration of the Planning Scheme.	Administer the planning scheme.
Southern Rural Water	Provide irrigation, drainage and water supply services and manage specific water supply catchments.	Supply rural water across southern Victoria including bulk supply to non-metropolitan urban water authorities and La Trobe Valley electricity generators.
East Gippsland Water and Gippsland Water	Provide urban water supplies and wastewater disposal services.	Provide water and sewerage services to townships neighbouring the Ramsar site. Manage water supply catchments and sewage treatment plants.
East and West Gippsland CMAs	Advise State Government on catchment management, and land and water resource issues and priorities. Encourage cooperation between land and water managers. Promote community awareness on catchment management issues.	Develop and implement Regional Catchment Management Strategies. Prepare and implement Action Plans. Manage surrounding catchment and inflowing streams and drainage.
Environment Protection Authority (EPA East Region)	Responsibility for and coordination of all activities relating to the discharge of waste into the environment and the generation, storage, treatment, transport and disposal of industrial waste and the emission of noise and for preventing or controlling pollution and noise and protecting and improving the quality of the environment.	Licence sewage and other discharges. Report on environmental quality as required under SEPP (Waters of Victoria).
Victorian Coastal Council (VCC) and the Gippsland Coastal Board (GCB)	VCC: Strategic Statewide coastal planning; preparation and implementation of the Victorian Coastal Strategy; advise the Minister on coastal issues. GCB: principal role is to implement the Victorian Coastal Strategy, provide advice to the Minister and the Victorian Coastal Council, and prepare and implement coastal action plans. Another key activity is facilitating improved coastal management through liaison with industry, government and the community.	Develop the Gippsland Region Coastal Plan and coastal action plans and guidelines for coastal planning and management within the region; provide advice to Minister and Council on coastal development within the region; and implementation of, and facilitating public awareness of the Victorian Coastal Strategy, Coastal Action Plans and coastal guidelines.
Gippsland Ports (GP)	GP is the manager of five local ports and two waterways in Gippsland. GP is responsible for the effective management and development of local ports and the safe use of waterways throughout the Gippsland region.	Operation of local port of Gippsland Lakes as per overarching responsibilities including specifically maintenance of ocean and port and waterway access.

2.3 Criteria met

At the time that Gippsland Lakes were first nominated as a Wetland of International Importance, the criteria for identifying wetlands of international importance were the "Cagliari criteria", adopted at the first conference of contracting parties in Cagliari in 1980. The original nomination documentation for the Ramsar site considered that the site met three of these criteria as shown in (Table 4). However, no specific justification for these criteria was provided.

Table 4: Criteria for Identifying Wetlands of International Importance as at listing date, 1982. Criteria for which Gippsland Lakes were listed are highlighted in green (Forests Commission 1983).

Basis	Number	Description
Criteria for waterfowl	1a	it regularly supports 10,000 ducks, geese and swans; or 10,000 coots or 20,000 waders
	1b	it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl
	1c	it regularly supports 1% of the breeding pairs in a population of one species or subspecies of waterfowl
Criteria based on plants and animals	2a	it supports an appreciable number of rare, vulnerable or endangered species or subspecies of plant or animal
	2b	it is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna
	2c	it is of special value as the habitat of plants or animals at a critical stage of their biological cycle
	2d	it is of special value for one or more endemic plant or animal species or communities.
Criterion based on representative wetlands	3	it is a particularly good example of a specific type of wetland characteristic of its region.

The criteria under which a Ramsar site can be designated have gone through a series of changes, with the most recent major revisions occurring at the 9th Ramsar Conference in Uganda 2005, when a ninth criterion was added. The most recent assessment of the site against Ramsar criteria indicated that at the time of listing in 1982, the site would have met six of the nine criteria as follows (BMT WBM 2010a):

Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.
The appropriate bioregion for the site is the south-east coast drainage division (Department of the Environment, Water, Heritage and the Arts 2008) and the site contains two waterbodies considered to be in near-natural state (Lake Tyers and Lake Reeve) as well as the Mitchell River Delta, which is considered one of the most outstanding examples of this wetland type (Rosengren 1984).

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.
This criterion is only applied to aquatic flora and fauna, and the site regularly supports five fauna and three flora species listed under the EPBC Act and or IUCN Red List (DELWP Flora and Fauna database extract):

- Fairy tern (*Sternula nereis nereis*)
- Green and golden bell frog (*Litoria aurea*) – Vulnerable;
- Growling grass frog (*Litoria raniformis*) – Vulnerable;
- Australian grayling (*Prototroctes maraena*) – Vulnerable
- Australasian bittern (*Botaurus poiciloptilus*) – Endangered
- Dwarf kerrawang (*Commersonia prostrate*) – Endangered
- Swamp everlasting (*Xerochrysum palustre*) - Vulnerable
- Metallic sun-orchid (*Thelymitra epipactoides*) – Endangered

Since the drafting of the ECD, Coastal Saltmarsh has been listed as vulnerable under the EPCB Act. The site supports substantial areas of this ecological community, which would now be considered to contribute to this criterion.

Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their lifecycles, or provides refuge during adverse conditions.
The basic description of this criterion implies a number of common functions/roles that wetlands provide including supporting fauna during migration, providing drought refuge, supporting breeding and moulting in waterfowl. The Gippsland Lakes supports breeding of waterbirds, is a recognised site for moulting waterfowl and the freshwater fringing wetlands are considered important drought refuges (BMT WBM 2010a).

Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.
Assessment of this criterion is hampered by a lack of comprehensive waterbird counts across the Gippsland Lakes Ramsar Site. However, there is strong evidence to suggest that the site "regularly" supports (i.e. in three out of five years) more than 20,000 waterbirds (BMT WBM 2010a, Wright and Wright 2012, Healey 2013).

Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.
Assessment of this criterion must be made using the most recent official population estimates (Wetlands International 2013). Data presented in BMT WBM (2010a) indicate that two species meet this criterion: little tern (*Sternula albifrons*) and fairy tern (*Sternula nereis nereis*) both of which regularly breed within the Ramsar site (Faye Bedford, biodiversity officer, DELWP, personal communication).

Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.
The Gippsland Lakes is a recognised important commercial and recreational fishery and supports the largest commercial fishery of black bream in the State, accounting for 90 percent of the total catch (Department of Primary Industries 2011). The seagrass and other habitats within the lakes act as important nursery habitat for a range of fish and crustacean species (Warry and Hindell 2012).

Since the development of the ECD, there has been additional data collected that strongly suggests that the site may meet an additional criterion as follows:

Criterion 9: A wetland should be considered internationally important if it regularly supports one percent of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.
In 2011 a new species of dolphin, the Burrunan dolphin (*Tursiops australis*), was described from south-eastern Australia (Charlton-Robb et al. 2011). There are only two known resident populations of this species, one from Port Phillip Bay and one from the Gippsland Lakes, with estimated population sizes of just 80-100 and 50 respectively (Charlton-Robb et al. 2014). Although the male dolphins that form part of the Gippsland Lakes population travel distances along the coast and to Tasmania, there is evidence from genetic studies that the Gippsland Lakes population is distinct and does not breed with other populations of this species (Charlton-Robb et al. 2014). The size of the Gippsland resident population suggests that this criterion may be met.

The formal process of reviewing and updating the criteria under which a site is listed occurs through the updating of the Ramsar Information Sheet (RIS). It is expected that consideration of Criterion 9 will be formally assessed at this time.

2.4 Critical components, processes and services

The Gippsland Lakes Ecological Character Description (ECD) identifies eight components, two processes and two services that are critical to the ecological character of the Ramsar site. These are described briefly below in terms of their benchmark condition, at the time of listing (BMT WBM 2010a).

Establishing the benchmark: "At the time of listing"

The Ramsar Convention establishes the benchmark for the ecological character of listed wetlands as:

"*at the time of designation as a Ramsar Wetland of International Importance*" (Resolution VI.1 Annex Para 2.1).

This is an important concept in terms of obligations to maintain ecological character, especially in systems such as the Gippsland Lakes, which had undergone significant ecological change prior to designation. The opening of the permanent entrance to the Southern Ocean in 1889 had two significant effects (Boon et al. 2014):

- immediate changes to decrease the variability in water level; and
- progressive increases in salinity.

The ecological effects of these physical changes were probably evident within the first few decades, and by the time of designation as a Ramsar site in 1982, Lakes King and Victoria were estuarine / marine in character. Similarly, although there have been significant historical changes in fringing vegetation at Lake Wellington and its fringing wetlands, with a loss of the submerged freshwater plant species *Vallisneria australis* and a decline in the extent of emergent common reed (*Phragmites australis*) fringing the waterbody (see images below), the vast majority of these changes occurred prior to 1982 (Boon et al. 2014).

Extent of common reed at Lake Wellington in the 1950s (left) and 2010 (right). The arrow indicates two comparable areas (Boon et al. 2014).

Aquatic ecosystems are rarely static and stable, and the Gippsland Lakes are no exception. There are ongoing changes, many of which commenced prior to designation, with a continuing trajectory of change. Establishing a benchmark, against which change in ecological character can be assessed, is a task for the Ecological Character Description, using Limits of Acceptable Change (see section 2.5 below). Maintaining the site to maintain ecological character in a changing environment is a challenge for Ramsar site management.

Component 1 Marine subtidal aquatic beds (seagrass / aquatic plants)
Seagrass covers an area of approximately 4000 - 5000 hectares within the Gippsland Lakes Ramsar Site (BMT WBM 2010a), although there is a high degree of variability over time (Roob and Ball 1997). Sub-tidal aquatic beds are dominated by the seagrass species *Zostera nigricaulis* (formerly *Heterozostera tasmanica*) and *Zostera muelleri* with some patches of *Ruppia* spp. (Roob and Ball 1997, Warry and Hindell 2012).

Seagrass predominantly occurs in sub-tidal beds at depths from 0.5 to 2 m, with very little seagrass in intertidal zones (Warry and Hindell 2012). Condition and density of seagrass varies significantly between years (Roob and Ball 1997, Warry and Hindell 2012) most likely in response to changes in salinity and water clarity related to climate variables and freshwater inflows (Webster et al. 2001, Holland and Cook 2009, Ladson 2012).

Component 2 Coastal brackish or saline lagoons (open water phytoplankton dominated habitats)
Planktonic food webs are an important part of the Gippsland Lakes trophic structure and the large lagoons that are dominated by phytoplankton drive the energy dynamics of the system (Grigg et al. 2004, Cook et al. 2008, Holland et al. 2009). Generally the phytoplankton community is dominated by dinoflagellates and diatoms, typical of estuaries and coastal waters in temperate Australia (Day et al. 2011). Biomass (as indicated by chlorophyll-a) is most often in the range of 1 – 2 μg/L (Cook et al. 2008, Holland et al. 2009).

The system experiences periodic algal blooms with seven diatom / dinoflagette blooms recorded between 1985 and 2012 (Day et al. 2011). Post 1997, a number blooms of the cyanobacterium (blue-green algae) *Nodularia spumigena* were recorded across Lake King and Lake Victoria (Webster et al. 2001, Beardall 2008, Day et al. 2011) and in 2007, for the first time a bloom of the cyanobacterium *Synechococcus* spp. extended across large areas of the Ramsar site for over five months (Beardall 2008, Day et al. 2011). In 2011 *N. spumigena* again bloomed across the site from December 2011 to April 2012 causing the closure of fisheries, a second bloom occurred the following summer, but lasted a shorter period of time (Holland et al. 2013b).

Extensive work has been conducted on the algal blooms and phytoplankton dynamics of the Gippsland Lakes (Webster et al. 2001, Grigg et al. 2004, Beardall 2008, Cook et al. 2008, Holland and Cook 2009, Holland et al. 2009, 2013a, 2013b, Day et al. 2011 among others). Conditions that lead to algal blooms are now well understood and include: low salinity (9 to 20 ppt); high nutrient concentrations, with an increased phosphorus to nitrogen ratio and elevated temperatures (Day et al. 2011, Cook and Holland 2012).

Component 3 Freshwater wetlands
Freshwater wetlands within the site at the time of listing were limited to Sale Common and Macleod Morass covering an area of approximately 400 hectares (BMT WBM 2010a). At the time of listing it is thought that these wetlands were dominated by giant rush (*Juncus ingens*) and in 1980 the sites were classified as deep freshwater marsh (Corrick and Norman 1980).

Currently, these systems are still dominated by freshwater emergent vegetation but there has been an expansion of common reed (*Phragmites australis*) and cumbungi (*Typha orientalis*) at the expense of giant rush (Parks Victoria 2005, 2007, BMT WBM 2010a, Ethos NRM 2011). This has been largely attributed to increased nutrient inflows and altered hydrological regimes at the two sites (Tilleard and Ladson 2010).

Component 4 Brackish wetlands
The brackish fringing wetlands within the Ramsar site fringe the open water areas of Lake Wellington and comprise Dowd, Heart and Clydebank Morasses, Lake Coleman and Tucker Swamp; covering an area of approximately 500 hectares (BMT WBM 2010a). They are dominated by swamp paperbark (*Melaleuca ericifolia*) woodland and common reed (*Phragmites australis*) emergent macrophyte beds (Boon et al. 2007).

There is evidence of change in the extent and distribution of these plant communities since listing. There has been a marked decline in the extent of common reed and an expansion of swamp paperbark from 1982 (around the time of listing) to 2003 (Boon et al. 2007, 2008). This has been attributed to alerted water regimes (a decline in freshwater inflows) increased tidal exchange and increases in salinity (Boon et al. 2008).

Component 5 Saltmarsh wetlands
Saltmarsh communities are the dominant vegetation community in the long shallow coastal lagoon of Lake Reeve. Dominant species include *Sarcocornia quinqueflora*, *Tecticornia pergranulata* and *Gahnia filum* (Boon et al. 2011). There is little information on the extent of saltmarsh habitat at the time of listing. The ECD for the site states that there approximately 5000 hectares of saltflat, saltpan and salt meadow (BMT WBM 2010a). More recent mapping suggests approximately 2200 hectares of saltmarsh vegetation community, excluding unvegetated habitats (Boon et al. 2011).

Component 6 Abundance and diversity of waterbirds
The Gippsland Lakes Ramsar Site is known to support over 86 species of waterbird with periodic counts exceeding 20,000 individuals (BMT WBM 2010a). The majority of the significant waterbird habitat is in the margins and fringing wetlands. Satlmarsh and saltflats such as those found at Lake Reeve are important feeding grounds for waders, including migratory species, with significant numbers of red-necked stint (*Calidris ruficollis*) recorded on a number of occasions (Barter 1995, Clemens et al. 2009). Lake Tyers supports breeding of significant numbers of little tern (*Sternula albifrons*) and fairy tern (*Sternula nereis nereis*), which then move to other areas in the site such as Jones Bay and adjacent swamps to feed (Faye Bedford, biodiversity officer, DELWP, personal communication).

The freshwater and brackish habitats support significant numbers of waterfowl including black swan (*Cygnus atratus*), chestnut teal (*Anas castanea*) and musk duck (*Biziura lobata*) and larger resident wading bird species (Corrick and Norman 1980). The large expanses of open water in Lakes Wellington, King and Victoria are considered less important as bird habitat, although may be important foraging areas for fish eating birds such as pelicans and cormorants (Coutin et al. 2003).

Component 7 Presence of threatened frog species
There are intermittent records for two threatened frog species from the Gippsland Lakes Ramsar Site; the green and golden bell frog (*Litoria aurea*) and growling grass frog (*Litoria raniformis*) (BMT WBM 2010a). Despite intensive surveys, there is insufficient data to assess population sizes or determine trends in abundance from the Ramsar site (Gillespie 1996). Records from the site are from vegetated freshwater habitats (BMT WBM 2010a), and both species are known to prefer sites with a large proportion of emergent vegetation and slow moving or ponded water (Clemann and Gillespie 2012). BMT WBM (2010a) suggested that Sale Common, Tucker Swamp, Lake Coleman, Heart and Macleod Morasses would be the most suitable habitat within the Ramsar site for the species.

Component 8 Presence of threatened wetland flora species
Three species of aquatic ecosystem dependent threatened flora have been recorded within the Gippsland Lakes Ramsar Site: dwarf kerrawang (*Commersonia prostrate*); swamp everlasting (*Xerochrysum palustre*); and metallic sun-orchid (*Thelymitra epipactoides*). Populations of all three species are located on the fringes of Lake Victoria in Blond Bay Nature Reserve (Calder et al. 1989, Carter and Walsh 2010a, 2010b) and dwarf kerrawang is also found at Sale Common. The three species inhabit a gradient of wetland habitats from the swamp everlasting, which prefers permanent wetland habitats, through the dwarf kerrawang which inhabits seasonally inundated wetlands, to the metallic sun orchid which grows in seasonally water logged soil (Calder et al. 1989, Carter and Walsh 2010a, 2010b).

Process 1 Hydrological regime
The hydrology of the site is driven by freshwater inflows from the major river systems and the incursion of seawater through the entrance, with groundwater and direct rainfall contributing in a small way to the water budget (McMastera et al. 2003, Grayson et al. 2004, Tilleard and Ladson 2010). Water flows into the Gippsland Lakes from six major river basins with a

combined catchment of approximately 20,000 square kilometres (Grayson et al. 2004). There is a high degree of variability in river inflows to the system, with total inflow volume varying from less than 1000 GL/ year to over 7000 GL / year. In addition, flood flows can be 10,000 times greater than non-flood flows (Tilleard et al. 2009). Adequate freshwater riverine inflows has identified as being particularly important for maintaining the freshwater fringing wetlands in the system (BMT WBM 2010a, Tilleard and Ladson 2010).

The connection to Bass Strait has been permanent since 1889, but is very constricted. Due to restricted flows through the entrance, water levels and salinity in the Lakes fluctuate with freshwater inflows. For example during large flood events, water cannot pass through the entrance at the same rate that it flows into the Lakes and as a consequence, water levels rise by up to two metres and salinity decreases across a gradient from the entrance to Lake Wellington (Tilleard et al. 2009). In contrast, tidal influences are minor and essentially smoothed out by the narrow nature of the entrance. Diurnal tide in Bass Strait is in the order of one metre, but this is modulated to just a few centimetres in Lake Wellington (McMaster et al. 2003, Grayson et al. 2004, Tilleard and Ladson 2010).

Since the construction and maintenance of the permanent entrance, the system has operated as an estuary with salinity fluctuating in response to freshwater inflows. During periods of drought, when freshwater inflows are low, salinity rises across the system. Conversely during flood periods, such as occurred in 1978, salinity across all surface waters dropped to near fresh (Fryer and Easton 1980). As with many estuaries, there is stratification or layering of the water column with denser more saline water underneath a freshwater layer (Figure 5). Tilleard et al. (2009) considered that the entrance was responsible for the spatial pattern in salinity and freshwater inflows principally responsible for temporal variation in salinity.

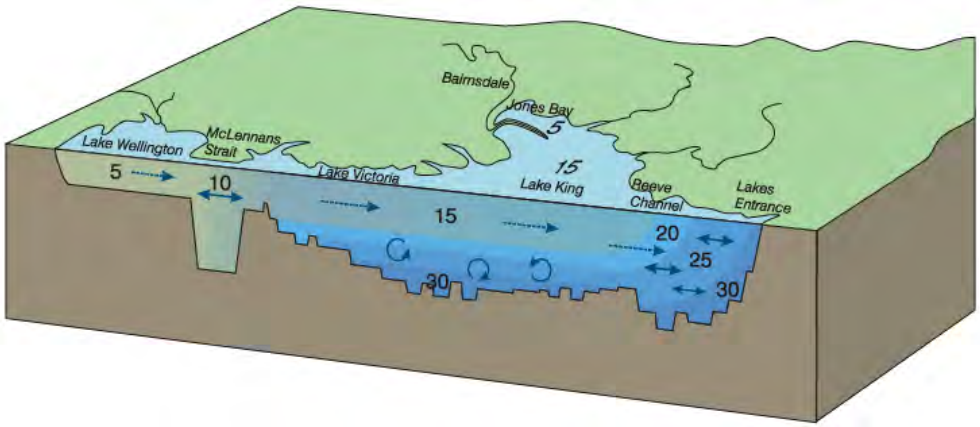


Figure 5: Conceptual model of salinity and stratification in the Gippsland Lakes (Webster et al. 2001).

Freshwater inflows from the catchments bring with them high loads of nutrients and sediments with an estimated average of over 200,000 tonnes / year of sediment, 3000 tonnes / year of phosphorus and 2800 tonnes / year of nitrogen entering the lakes (Webster et al. 2001, Grayson et al. 2004). The entrance performs an important function to the Lakes in exporting sediments and nutrients to the ocean. During periods of low river flow this process is driven largely by oceanic water level fluctuations and flushing times are in the order of six months (Webster et al. 2001). During flood events the residence time is greatly reduced and large plumes of sediment are visible discharging from the entrance (Figure 6).

Figure 6: Discharge plume of fresh, turbid water following a large flood event in July 2007 (image provided courtesy of GP).

Process 2 Waterbird breeding

The Gippsland Lakes Ramsar Site supports breeding of a number of waterbird species across a variety of habitats. The ECD indicates that breeding of the following waterbird species within the Ramsar site is critical to the ecological character (BMT WBM 2010a):

- Australian pelican (*Pelecanus conspicillatus*) at Lake Coleman, Tucker Swamp and Crescent Island;
- Little tern (*Sternula albifrons*) and fairy tern (*Sternula nereis nereis*) at mud islands and Lake Tyers; and
- Black swan (*Cygnus atratus*), Australian white ibis (*Threskiornis molucca*), straw-necked ibis (*Threskiornis spinicollis*) and little black cormorant (*Phalacrocorax sulcirostris*) at Macleod Morass, Sale Common and Dowd Morass.

Service 1 Maintaining threatened species

This service relates to the critical components C7 (threatened frog species) and C8 (threated flora species), but also includes a threatened fish species: Australasian grayling (*Prototroctes maraena*). Although there are no records of this species from within the Ramsar site boundary, it is known to occur in all six river basins that drain into the site (Berra 1982, BMT WBM 2010a) and it has an obligate estuarine marine phase as part of it's breeding cycle (Berra 1982, Crook et al. 2006) and so must spawn in the lakes or pass through the estuarine areas of the site to spawn in the ocean and on its return journey to freshwater habitats.

Service 2 Fisheries resource value

The Gippsland Lakes Ramsar Site is an important commercial and recreational fishery as well as providing nursery habitat for a range of fish that form part of the Bass Strait commercial fishery (Hindell et al. 2008, Warry and Hindell 2012, GLMAC 2013). Over 170 species of fish have been recorded within the site boundary, the vast majority estuarine or marine species, with a number of diadromous species that move between fresh, estuarine and marine environments (Ramm 1986). Commercially and recreationally important native fish species include black bream (*Acanthopagrus butcheri*), yelloweye mullet (*Aldrichetta forsteri*), tailor (*Pomatomus saltatrix*) and Australian salmon (*Arripis* spp.) (Department of Environment and Primary Industries 2014). The introduced common carp (*Cyprinus carpio*) was also, at the time of listing a significant commercial fish within the freshwater areas of the Ramsar site, often accounting for over half the total commercial catch (Department of Environment and Primary Industries 2014).

2.5 Ecological character status and Limits of Acceptable Change (LAC)

The mechanism against which change in ecological character is assessed is via comparison with Limits of Acceptable Change (LAC). LAC are defined by Phillips (2006) as:

"…the variation that is considered acceptable in a particular measure or feature of the ecological character of the wetland. This may include population measures, hectares covered by a particular wetland type, the range of certain water quality parameter, etc. The inference is that if the particular measure or parameter moves outside the 'limits of acceptable change' this may indicate a change in ecological character that could lead to a reduction or loss of the values for which the site was Ramsar listed. In most cases, change is considered in a negative context, leading to a reduction in the values for which a site was listed".

The following should be considered when developing and assessing LAC:

- LAC are a tool by which ecological change can be measured. However, LAC do not constitute a management regime for the Ramsar site.
- Exceeding or not meeting LAC does not necessarily indicate that there has been a change in ecological character within the meaning of the Ramsar Convention. However, exceeding or not meeting LAC may require investigation to determine whether there has been a change in ecological character.
- While the best available information was used to prepare the ECD and define LAC for the site, a comprehensive understanding of site character may not be possible as in many cases only limited information and data is available for these purposes. The LAC may not accurately represent the variability of the critical components, processes, benefits or services under the management regime and natural conditions that prevailed at the time the site was listed as a Ramsar wetland.
- LAC can be updated as new information becomes available to ensure they more accurately reflect the natural variability (or normal range for artificial sites) of critical components, processes, benefits or services of the Ramsar wetland. The formal process for this is via the Ramsar Rolling Review, which is a three yearly assessment of ecological character at each Ramsar site (Butcher et al. 2011).

The LAC for the Gippsland Lakes Ramsar Site were established in the ECD for critical components, processes and services (BMT WBM 2010a). These are described briefly below together with the most current information related to the condition of the Lakes. Note that although a full assessment of the status of ecological character occurs through the Ramsar Rolling review, there is no evidence from the information below of an exceedence of a LAC in the Gippsland Lakes Ramsar site.

Critical CPS	Limit of Acceptable Change	Current condition
C1 Marine subtidal aquatic beds (seagrass / aquatic plants)	• Total seagrass extent will not decline by greater than 50 percent of the baseline value of Roob and Ball 1997 (that is, by more than 2165 hectares) in two successive decades at a whole of site scale. • Total mapped extent of dense and moderate *Zostera* will not decline by greater than 80 percent of the baseline values determined by Roob and Ball (1997) in two successive decades at any of the following locations: o Fraser Island o Point Fullerton, Lake King o Point King, Raymond Island, Lake King o Gorcrow Point – Steel Bay, Lake Victoria o Waddy Island, Lake Victoria	The most recent Ramsar Rolling Review (Butcher et al. 2011) indicated that there was insufficient data to assess against this LAC, with no comprehensive mapping of seagrass since that undertaken by Roob and Ball in 1997. Video footage collected in 2008 suggested a decline in seagrass extent at 75 percent of sites compared to the 1997 mapping, although this could not be quantified (Warry and Hindell 2012). Until the next scheduled assessment of seagrass is in 2015/16 it is not possible to determine if there is a decline in seagrass extent beyond natural variability and whether or not the LAC has been exceeded.

Critical CPS	Limit of Acceptable Change	Current condition
C2 Coastal brackish or saline lagoons (open water phytoplankton dominated habitats)	• Long-term: A long-term change in ecosystem state at Lake King, Lake Victoria or Lake Tyers from relatively clear, seagrass dominated estuarine lagoons to turbid, algae dominated system (characteristic of Lake Wellington) will represent a change in ecological character. • Short-term: No single cyanobacteria algal bloom event will cover greater than 10 percent of the combined area of coastal brackish/saline lagoons (that is, Lake King, Victoria, Wellington and Tyers) in two successive years.	While the Ramsar Rolling Review indicated that there was an increasing trend in algal blooms, they concluded that the LAC at the time (2011) had not been exceeded (Butcher et al. 2011). There were successive blooms in 2011 and 2012. While the 2011 bloom definitely covered more than 10 percent of the lakes, the 2012 bloom covered a smaller area. There were no widespread toxic algal blooms in the lakes in 2013/14 and 2014/15.
C3 Freshwater wetlands	• Long-term: The total mapped area of freshwater marshes (shrubs and reed wetland types) at Sale Common and Macleod Morass will not decline by greater than 50 percent of the baseline value for 1980 (that is, 50 percent of 402 hectares = 201 hectares) in two successive decades. • Short-term: In existing freshwater wetland areas, the annual median salinity should not be > 1 ppt in two successive years.	There is insufficient data to assess against the long and short-term LAC (Butcher et al. 2011). There is anecdotal evidence of increased salinity, but no quantitative data upon which to base an assessment (Parks Victoria 2005, 2007, Butcher et al. 2011).
C4 Brackish wetlands	• Long-term: The total area of common reed at Dowd Morass will not decline by greater than 50 percent of the 1982 baseline value (that is not less than 245 hectares) in two successive decades. • Short-term: The annual median salinity will be < 4 ppt in five successive years.	There is evidence of change in the extent and distribution of these plant communities since listing. There has been a marked decline in the extent of common reed and an expansion of swamp paperbark from 1982 (around the time of listing) to 2003 (Boon et al. 2007, 2008). This has been attributed to altered water regimes (a decline in freshwater inflows) increased tidal exchange and increases in salinity in the fringing wetlands (Boon et al. 2008).
C5 Saltmarsh	• Medium-term: The total mapped area of salt flat, saltpan and salt meadow habitat at Lake Reeve Reserve will not decline by greater than 50 percent of the baseline value outlined in VMCS for 1980 (that is, 50 percent of 5035 hectares = 2517 hectares) in two successive decades.	There is no evidence to suggest that the saltmarsh habitats within the site have changed in the past two decades.

<table>
<tr><th>Critical CPS</th><th>Limit of Acceptable Change</th><th>Current condition</th></tr>
<tr><td>C6 Abundance & diversity of waterbirds:</td><td>• The number of standard 20 minute searches (within any ten year period) where waterbird abundance is less than 50 individuals will not fall below 50 per cent of the ‘baseline’ value (based on Birds Australia count data – 1987-2010), for the following species:
○ black swan = 15 percent of surveys
○ chestnut teal = 10 percent of surveys
○ Eurasian coot = 11 percent of surveys.
• The absence of records in any of the following species in five successive years will represent a change in character: red-necked stint, sharp-tailed sandpiper, black swan, chestnut teal, fairy tern, little tern, musk duck, Australasian grebe, grey teal, Eurasian coot, great cormorant, red knot, curlew sandpiper.</td><td>There is little data upon which the LAC can be assessed as complete counts for the site are mostly lacking. However, data contained in volunteer bird group newsletters and from the Australian Bird Atlas (Clemens et al. 2009, Wright and Wright 2012, Healey 2013) indicate that the target species have all been observed in the site in the last five years. A recent review of bird abundance and diversity in the Gippsland Lakes indicated a long-term stability in total diversity, but a very high inter-annual variation (Healey 2013). Short-term declines in waterbird abundance and diversity in the system have been associated with bushfires, floods and algal blooms (Healey 2013).</td></tr>
<tr><td>C7 Threatened frog species</td><td>Insufficient data to develop a LAC for this critical component, nor to assess changes in populations over time.</td><td>Population data is available for Dutson Downs and Macleod Morass, with evidence that growling grass frog and southern bell frog are still breeding within the site (Jim Reside, personal communication).</td></tr>
<tr><td>C8 Threatened wetland flora species</td><td>The three threatened flora species (Rulingia prostrata, Thelymitra epipactoides and Xerochrysum palustre) continue to be supported within the boundaries of the Gippsland Lakes Ramsar Site.</td><td>The most recent published surveys for these species are from 2008 and all were still present within the Ramsar site at that time (DSE Flora and Fauna Database), indicating that the LAC is still met. However, population data for the swamp everlasting shows a decline from 500 plants to just 150 within the Ramsar site from 2005 to 2008 (Carter and Walsh 2010a). Whereas the dwarf kerrawang populations within the Ramsar site have increased following a fire in 2004 which may have stimulated germination (Carter and Walsh 2010b). No trend data for the sun-orchid could be sourced.</td></tr>
<tr><td>P1 Hydrologcal regime</td><td>Wetland wetting frequency, flushing frequency and flushing volume are maintained as follows:<table><tr><th>Wetland</th><th>Wetting Frequency</th><th>Flushing Frequency</th><th>Required Flushing Volume</th></tr><tr><td>Sale Common</td><td>Annual with 100 per cent reliability</td><td>2-3 times/decade</td><td>4 GL</td></tr><tr><td>Dowd Morass</td><td>5-7 times/decade</td><td>2-3 times/decade</td><td>15GL</td></tr><tr><td>The Heart Morass</td><td>5-7 times/decade</td><td>2-3 times/decade</td><td>15GL</td></tr></table></td><td>There is no doubt that altered hydrological regimes have affected the Gippsland Lakes (Webster et al. 2001, Tilleard et al. 2009, Tilleard and Ladson 2010). However, the vast majority of these impacts occurred prior to the site being listed as a Ramsar site, with the benchmark set at 1982. For example, water extraction from rivers and the construction of the Thomson Dam all began prior to listing. However, there is some evidence of a decline in freshwater inflows in the past three decades (Boon et al. 2007, 2008, Tilleard and Ladson 2010); but no evidence that the LAC has been exceeded (BMT WBM 2010a, Butcher et al. 2011).</td></tr>
<tr><td>P2 Waterbird breeding</td><td>Abandonment or significant decline (greater than 50 per cent) in the productivity of two or more representative</td><td>Insufficient data to assess the LAC.</td></tr>
</table>

Critical CPS	Limit of Acceptable Change	Current condition
	breeding sites (based on two sampling episodes over a five year period) within any of the following site groupings: • Lake Coleman, Tucker Swamp and Albifrons Island - Australian pelican. • Bunga Arm and Lake Tyers – little tern and fairy tern. • Macleod Morass, Sale Common and Dowd Morass – black swan, Australian white ibis, straw-necked ibis, and little black cormorant.	
S1 Maintaining threatened species	No LAC are proposed for painted snipe and Australasian bittern at the current time until greater information is available about patterns of usage and populations in the Ramsar site. Other threatened species are dealt with in the critical components above. Australian grayling continues to be supported in one or more of the catchments draining into the Gippsland Lakes.	Insufficient data to assess the LAC.
S2 Fisheries resource value	Total annual black bream commercial fishing catch per unit effort will not fall below 6.1 tonnes in a successive five-year period. Sub-optimal black bream spawning conditions should not occur in any successive five-year period within key spawning grounds (that is, mid-lower estuaries and adjacent waters of main lakes) during the peak spawning period (October to December). Optimal conditions are as follows: • Water column salinity is maintained in brackish condition (for example, between 17-21 ppt median value) in the middle of the water column in the mid-lower estuaries and adjacent waters of the main lakes • The salt wedge is located within the mid-lower section of the estuarine river reaches or just out into the main lakes as opposed to far upstream or well-out into the Gippsland Lakes.	The most recent commercial catch data (Department of Environment and Primary Industries 2014) indicates that the annual catch of black bream over the past decade years has ranged from 26 to 148 tonnes, well above the LAC of 6 tonnes. Although the salinity portion of the LAC is difficult to assess, water quality data from Lakes Wellington, Victoria and King (as provided by EPA Victoria) indicate that salinity largely remained within the 17 to 21 ppt threshold October to December for the past decade; with the exception of flood years (e.g. 2008, 2011) when salinity was lower.

3 Risk assessment

3.1 Method

The risk assessment process adopted for this project is consistent with the Australian/New Zealand Standard: Risk Management (AS/NZS 4360:2004; Standards Australia and Standards New Zealand 2004) and the Standards Australia Handbook: Environmental risk management - principles and process (HB 203-2000; Standards Australia and Standards New Zealand 2006). The risk assessment approach follows a structured and iterative process, with the following steps:

1. Establish the context – existing values and environmental conditions;
2. Identify risks – threats and associated potential impacts; and
3. Analyse risks – assign likelihoods and consequences to determine level of risk

3.1.1 Establishing the context

A review of existing published and unpublished information relevant to the Gippsland Lakes was undertaken to identify and summarise the important ecological, social and economic values (see section 4); current condition and potential threats to ecological character (see section 5). The spatial scale of the risk assessment was established as mega-habitat, with separate risk assessments completed for each habitat type.

The purpose of the risk assessment was to identify priority values and threats as the basis for identifying strategic actions in the Gippsland Lakes Ramsar Site Management Plan. The ECD (BMT WBM 2010) provided a benchmark for values and threats, which was augmented by local knowledge. The risk assessment was underpinned by both local knowledge and expert opinion and provided the input to a multi-criteria analysis to identify priority values and threats (se sections 4 and 5). The process of prioritising values and threats and how the risk assessment contributed to this is illustrated in Figure 7.

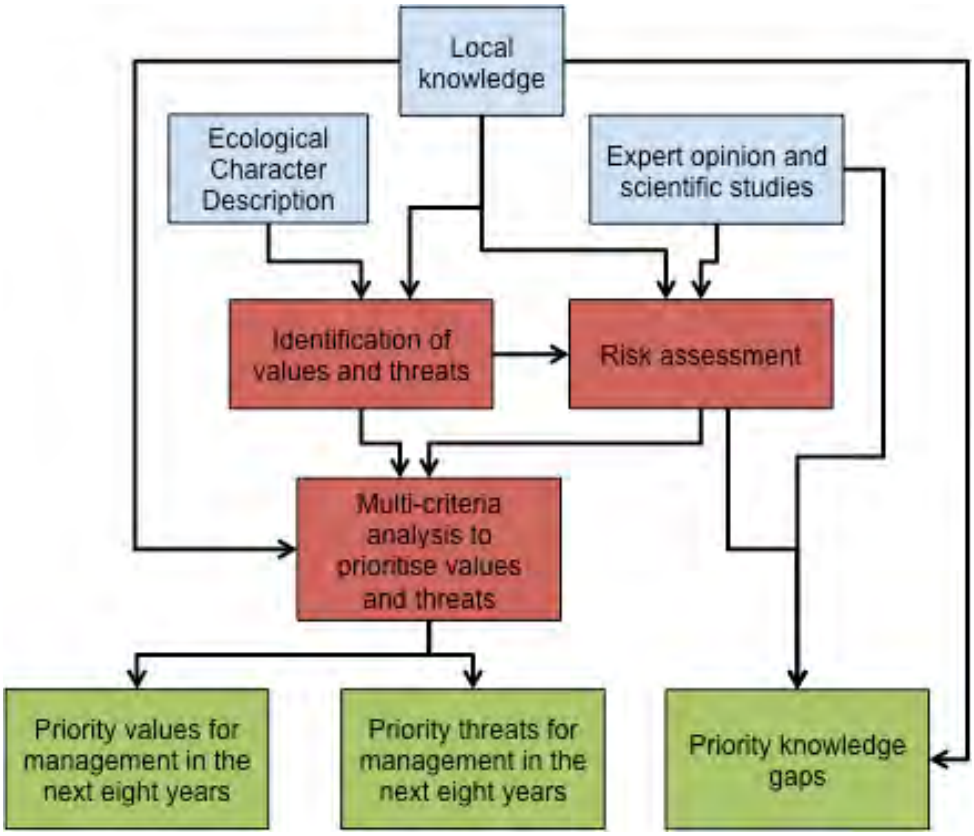


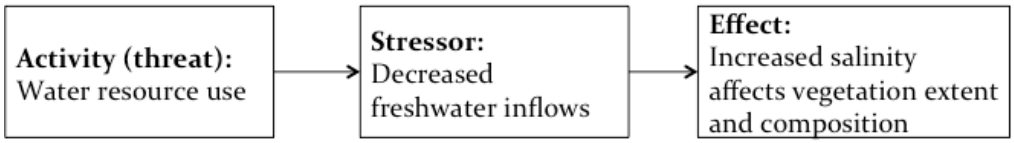
Figure 7: Process of prioritising values and threats and the role of the risk assessment.

3.1.2 Identifying risks

An impact pathway approach was adopted for identifying and analysing risks. This uses a hierarchical process to identify potential risks as follows:

Threats (threatening activities) – actions in the Ramsar site or catchment that could affect ecological character;
Stressors – the physical or chemical changes that could arise as a result of an activity;
Effects – the potential responses caused by the stressors.

This allows for clear identification of the underlying causes of risks and threats to ecological character of the Ramsar site, separating the threat from the impact. An example of an impact pathway is provided below.



Ecological risk assessment processes have limited mechanisms for dealing with cumulative and synergistic effects (Lawrence 2013). One method of considering and illustrating potential interactions of multiple stressors is through the use of conceptual stressor models (Gross 2003, Davis and Brock 2008). Stressor models were developed for each mega-habitat to illustrate he impact pathways and the potential effects of multiple pathways on critical components, processes and services.

The conceptual models and expert / local knowledge were used to identify all plausible impact pathways of relevance to the ecological character of the Gippsland Lakes.

3.1.3 Analyse risks

The impact pathways formed the basis of a formal risk analysis process. Likelihood and consequence were assigned to each **impact pathway** in its entirety; integrating each of the levels in the hierarchy. An example of an impact pathway is:

Threats	Stressors	Impact pathway
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and a decline in seagrass health

The questions were: what is the likelihood that agricultural practices in the catchment will result in increased nutrients, algal blooms and that this will result in a decline in seagrass health? What are the consequences of this with respect to the ecological character of the Gippsland Lakes Ramsar Site?

Likelihood and consequence were guided by Table 5 and Table 6, with the risk matrix (Table 7) determining the overall risk.

Table 5: Likelihood

Almost certain	Likely	Possible	Unlikely	Rare
Is expected to occur in most circumstances	Will probably occur in most circumstances	Could occur	Could occur but not expected	Occurs only in exceptional circumstances

Table 6: Consequence

Category	Negligible	Minor	Moderate	Major	Extreme
Ecosystem Function (need to consider resilience and resistance)	Alteration or disturbance to ecosystem within natural variability. Ecosystem interactions may have changed but it is unlikely that there would be any detectable change outside natural variation / occurrence.	Localised measurable changes to the ecosystem components without a major change in function (no loss of components or introduction of new species that affects ecosystem function). Recovery (if relevant) in less than 1 year.	Widespread measurable changes to the ecosystem components without a major change in function (no loss of components or introduction of new species that affects ecosystem function). Recovery (if relevant) in 1 to 2 years.	Widespread measureable changes to the ecosystem components with a major change in function. Recovery (ie within historic natural variability) in 3 to 10.	Long term and possibly irreversible damage to one or more ecosystem function. Recovery, if at all, greater than 10 years.
Habitat and communities	Alteration or disturbance to habitat within natural variability. Less than 1% of the area of habitat affected or removed.	1 to 5% of the area of habitat affected in a major way or removed.	5 to 30% of the area of habitat affected in a major way or removed.	30 to 90% of the area of habitat affected in a major way or removed.	Greater than 90% of the area of habitat affected in a major way or removed.
Species	Population size or behaviour may have changed but it is unlikely that there would be any detectable change outside natural variation / occurrence.	Detectable change to population size and / or behaviour, with no detectable impact on population viability (recruitment, breeding, recovery) or dynamics.	Detectable change to population size and / or behaviour, with no impact on population viability (recruitment, breeding, recovery) or dynamics.	Detectable change to population size and / or behaviour, with an impact on population viability and or dynamics.	Local extinctions are imminent / immediate or population no longer viable.
Social	Short-term interruptions in recreational use (days) and perception as a high amenity place to live unaltered.	Recreational activities restricted and perceptions of amenity altered in a localised area for short-term (< 1 year)	Recreational activities restricted and perceptions of amenity altered in a localised area for > 1 year.	Long-term disruption to recreational activities and perceptions of amenity altered at a regional scale for 1 to 5 years.	Long-term disruption to recreational activities and perceptions of amenity altered for a regional scale for > 10 years.
Economic	No measurable reduction in commercial fishing beyond historical variability. No effect on local and regional businesses.	Measureable reduction (<5 percent) in local commercial fishery and or local economy. Effects lasting < 1 year	Significant reduction (5 - 30 percent) in commercial fishery or local economy, effects lasting < 1 year.	Significant reduction (5 - 30 percent) in commercial fishery or local economy, effects lasting 1 - 5 years.	Significant reduction > 30 percent) in commercial fishery or regional economy, with effects lasting > 5 years.

Table 7: Risk matrix (adapted from AS/NZS 2006).

Likelihood	Consequence					
		Negligible	**Minor**	**Moderate**	**Major**	**Extreme**
	Almost certain	Negligible	Medium	High	Extreme	Extreme
	Likely	Negligible	Medium	Medium	High	Extreme
	Possible	Negligible	Low	Medium	High	High
	Unlikely	Negligible	Low	Low	Medium	Medium
	Rare	Negligible	Negligible	Negligible	Low	Medium

3.1.4 Stakeholder involvement

A draft risk assessment for each mega-habitat was developed based on best available information by a team of wetland scientists in consultation with experts on various aspects of the Gippsland Lakes. This draft risk assessment was provided to the project steering committee (PSC) and technical advisory group (TAG) members for review. A one day workshop was held in Traralgon on September 16, 2014. Workshop participants were asked to review the impact pathways, likelihood and consequence ratings for each impact pathway in their area of interest or expertise. At the workshop, the risk assessment was systematically worked through with discussion on the rankings and identified pathways until agreement was reached. Critical knowledge gaps were identified and documented for inclusion in the management plan. A number of risk rankings were deferred at the workshop for consultation with relevant scientific experts.

It should be noted that a small number of potential impact pathways were raised by stakeholders in the risk assessment workshop, which were excluded following discussion and direction by the Project Steering Committee. These comprised:

- Impacts from increased seismic activity in the region – plausible impact pathways for the Gippsland Lakes from this potential threat could not be identified.
- Hunting and fishing (potential exceedence of bag limits) impacting on flora and fauna – these activities are currently managed through a defined and implemented DELWP processes. It is not a priority threat for the Ramsar site management plan. Addressing the knowledge gap on recruitment and movement of native fish will cover the potential impacts of this threat.
- Unconventional Gas Mining (including Coal Seam Gas) – it was recognised that this may represent a threat to the ecological character of the Ramsar site. However, the impacts of Unconventional Gas Mining are being dealt with at State and Federal Levels by a separate, rigorous process that is currently underway. This Ramsar plan is deferring to this more detailed process.

Following the workshop, relevant experts from universities and research organisations were contacted to provide input to the risk assessment in their respective fields. The results of these conversations, together with the outputs of the workshop were used to produce a revised risk assessment for each mega-habitat.

The revised risk assessment was circulated to PSC and TAG members for any further comments, prior to finalisation. The following was posted on the Gippsland Lakes E-engagement website informing the community about the process:

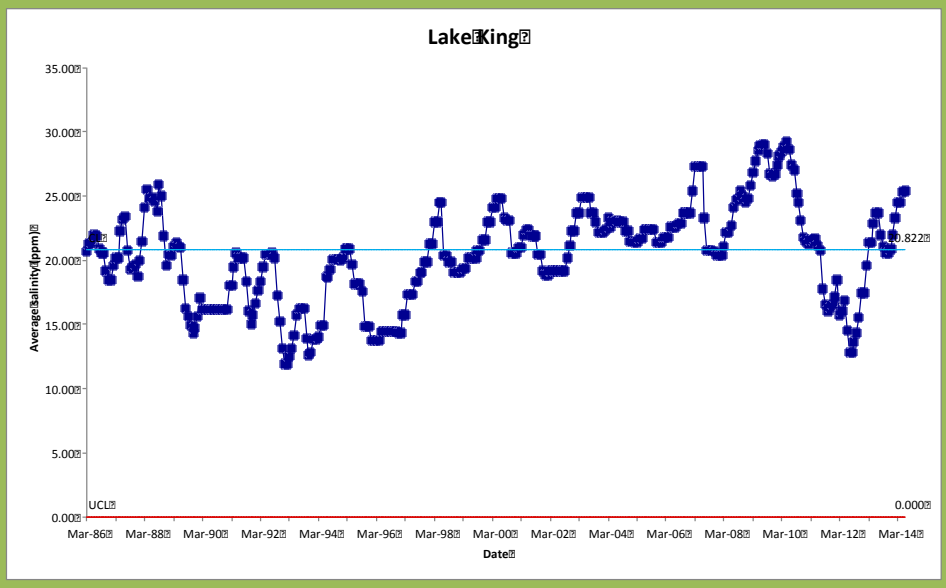
"*The renewal of the Gippsland Lakes Ramsar Site Management Plan is well underway. A group of scientists, local and State agency staff and locals with expertise about the Lakes' environment met this week. Together they worked to review a wide range of threats to the environment and the birds, animals and fish it supports and assess the impact of those threats. The outcome was a rigorous and transparent ranking of risks, which will inform the next step in the development of the plan - identifying priority threats and values for management."*

Using an evidence-based approach to inform the risk assessment: Changed entrance conditions and salinity in the main lakes

The permanent connection to the ocean was in place for almost a century prior to the Gippsland Lakes being listed as a Ramsar site, so the benchmark for ecological character is as an estuary, with many of the values of the site and the majority of the critical components, processes and services reliant on estuarine conditions. The issue to be explored is that of changed conditions since 1982, specifically changes associated with dredging of the entrance following the switch to a Trailer Suction Hopper Dredge (TSHD) in 2008. A study by Water Technology (Reynolds et al. 2011) reviewed all the available information and is the most comprehensive review of this specific issue. Their conclusions were that the change in dredge method has not had an effect on salinity in the system. Specifically:

- Despite ongoing dredging, there has been a build-up of sediments in the navigation channel (Wheeler et al. 2010a, 2010b, 2010c). This was attributed to decreased freshwater inflows, particularly during the Millennium drought.
- Small changes in the volume of water that enters the Gippsland Lakes (called the tidal prism) have very little effect on salinity in the Gippsland Lakes. This is based on the CSIRO research (Webster et al. 2001) which modelled the effects of increasing the entrance channel such that tidal exchange was increased by 1.5 times, and decreasing the channel capacity to limit tidal exchange to 0.6 times current. The result was a negligible change in the salinity in the main basins, and a moderate change in salinity in Reeve Channel. This is due to the large attenuation of tide through the Entrance, which severely restricts tidal exchange between the Gippsland Lakes and Bass Strait. Any impacts to tidal exchange and salinity due to the adopted channel design will be considerably smaller than those modelled by Webster et al. (2001) with Reynolds et al. (2011) citing a potential increase of just 16 percent in tidal exchange at Lakes Entrance post 2008 (three times less than that modelled by CSIRO that indicated no change in salinity).
- "*Changes observed in the salinity concentration of the Gippsland Lakes over recent years can be predominantly attributed to the reduction in freshwater inflows through the inflowing river systems which is associated with lower rainfall conditions and water abstraction*"

There is no sustained increase in salinity in Lakes King and Victoria, using EPA water quality data. The graph below shows an Exponentially Weighted Moving Average (EWMA) of surface salinity in Lake King. It shows a rise in salinity in 2008 – 2009; followed by a fall during the wet years of 2010, 2011 and a minor rise again.



Entrance management is guided by the Gippsland Lakes Ocean Access Long Term Monitoring and Management Plan – Maintenance Dredging with Ocean Disposal 2013-2023"
http://www.gippslandports.vic.gov.au/pdfs/reports/gippslandport_30.pdf

3.2 Risk assessment for the deep lakes mega-habitat

The deep lakes mega-habitat comprises the main lakes of Victoria and King as well as Lake Tyers (Figure 8). A stressor model for the site, was developed to guide the risk assessment, and illustrates the potential impacts of multiple stressors on the values of the site (Figure 9).

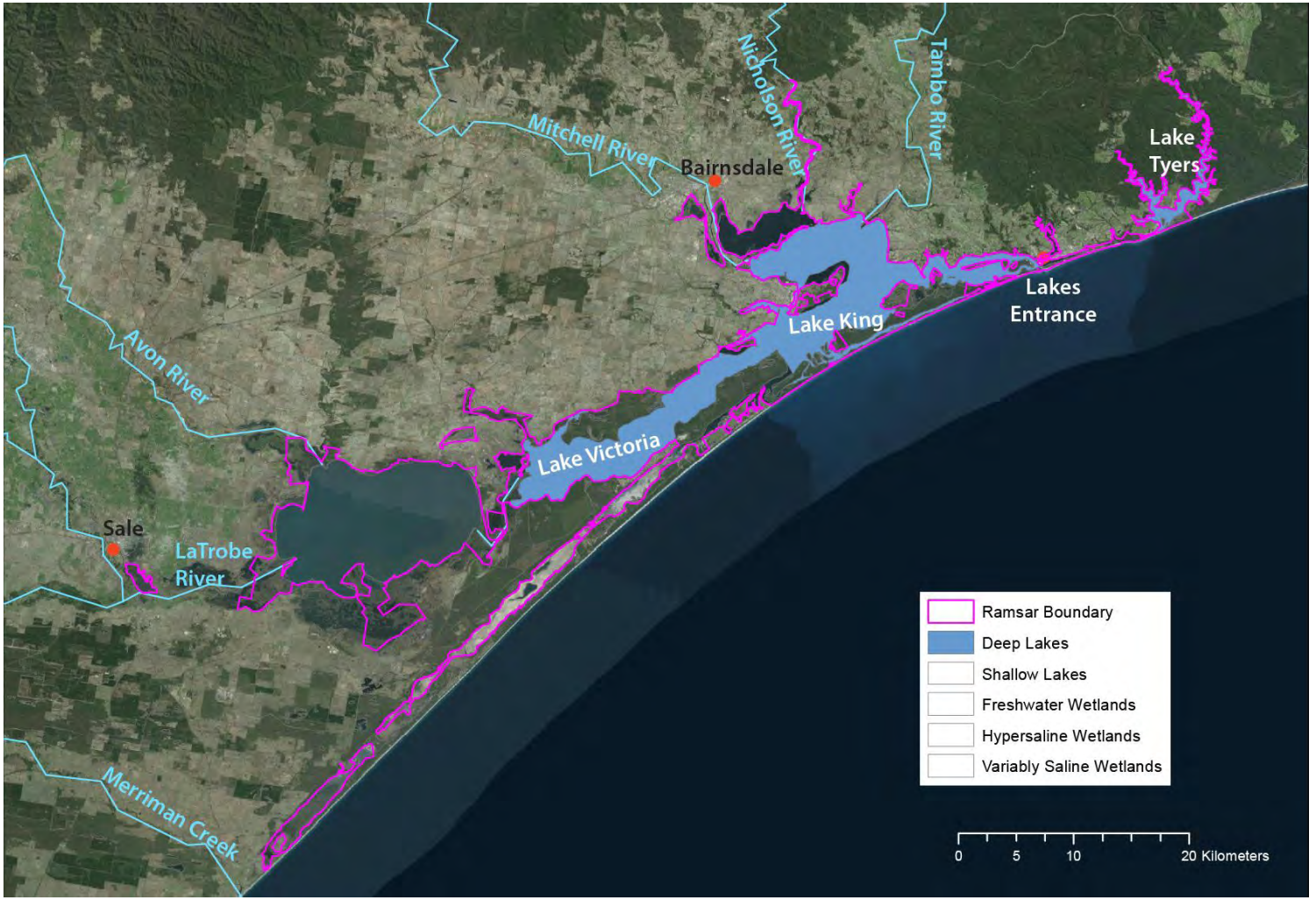


Figure 8: Location of the deep lakes mega-habitat within the Gippsland Lakes Ramsar Site.

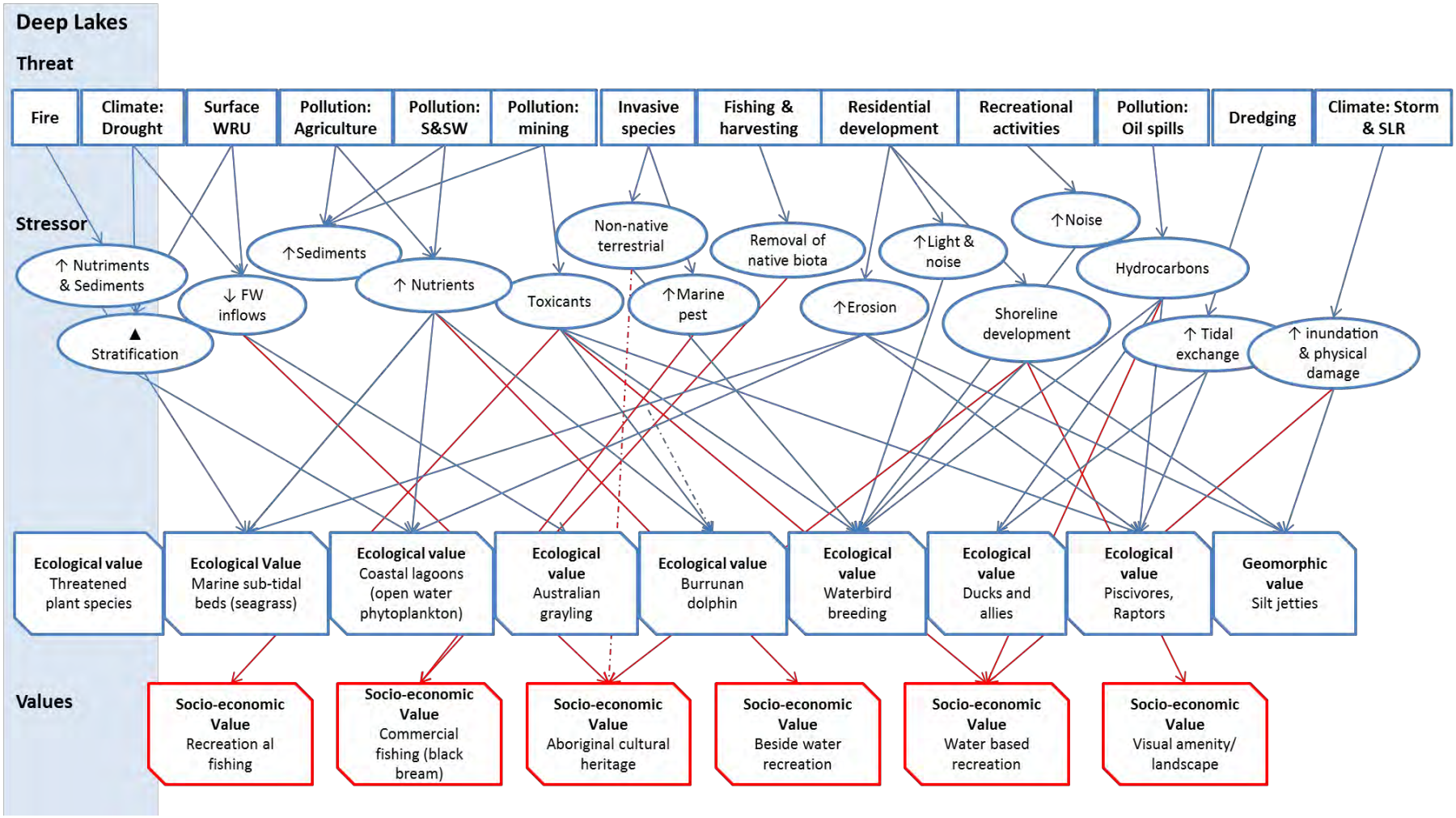


Figure 9: Stressor model for the deep lakes mega-habitat (red lines join stressors to socio-economic values, blue to ecological values).

One hundred and six impact pathways were identified and assessed for the Deep Lakes mega-habitat. The high and extreme risks are associated with residential and commercial development, nutrient inflows from the catchment, invasive species and climate change. The complete risk assessment is provided in Appendix C. The identified high and extreme risks associated with this habitat are provided in Table 8.

Table 8: Identified high and extreme risks to ecological character for the deep lakes mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Residential and commercial development	Presence of development on lake shores	Affects visual amenity	Almost certain	Moderate	High	Commercial and residential development along the shorelines of the lakes has been identified as a community concern (GLMAC 2013)
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding (general)	Almost certain	Moderate	High	The pathway includes piscivores and ducks and swans feeding on submerged vegetation. Also includes the movement of birds onto adjacent lands and possible ramifications (e.g. swan cull in 2007).
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding (threatened species: little terns and fairy terns)	Likely	Major	High	Risk is considered high, due to the increased energy requirements by nesting terns from having to forage further; resulting in decreased recruitment success.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects visual amenity	Almost certain	Moderate	High	Previous algal blooms have elicited negative responses from residents and visitors. However, the impact does not extend for long after the bloom is no longer visible.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth that affects water based recreation and tourism	Almost certain	Moderate	High	An assessment of the economic impact of the 2008 algal bloom estimated a 15 % decline in business activity, with a 6% reduction in visitors (Connolly and Brain 2009).
Wildfire	Increased nutrients and sediment	Affects seagrass	Likely	Major	High	Assumption that this impact pathway is for a large fire followed by heavy rain / significant flow as that which occurred in 2006/7. This event resulted in three times the average annual load of phosphorus and over twice the average annual load of nitrogen entered the lakes after intense rainfall fell on burned catchments mobilising large amounts of sediment and associated nutrients

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
						(SKM 2008). All likelihood and consequences for these pathways have been adjusted from those assessed for agricultural effluents to reflect the increased magnitude.
Wildfire	Increased nutrients and sediment	Affects aquatic biota (fish)	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Affects dolphins	Likely	Major	High	Increased dolphin deaths and disease recorded during 2006/7 event (Kate Charleton-Robb, personal communication).
Wildfire	Increased nutrients and sediment	Affects waterbirds	Likely	Major	High	Swan cull from feeding in agricultural lands, following loss of feeding habitat in the 2006/7 event (Chris Healey personal communication). Plus effect on nesting terns (Faye Bedford personal communication).
Wildfire	Increased nutrients and sediment	Affects visual amenity	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Affects water based recreation	Likely	Major	High	
Water resource use	Altered freshwater inflows	Disrupts stratification and internal nutrient cycling; promoting algal blooms	Possible	Major	High	Based on current understanding of the factors that effect bloom formation and the importance of internal nutrient cycling (Cook and Holland 2012, Holland et al. 2013a).
Invasive species	Introduced marine pests (European shore crab)	Increased competition and predation results in a decline in native species extent, diversity and abundance	Almost certain	Major	Extreme	Based on anecdotal reports of tonnes of crabs harvested monthly. Described as a voracious predator with the following potential impacts "In Australia they may have a great impact including direct impacts on prey species, indirect effects on species competing for the same prey, and indirect impacts on nutrient availability (by removing bivalves which filter algae and larvae) http://www.mesa.edu.au/marine_pests/marine_pests04.asp. Risk based on presence of species in the Lakes and preliminary risk assessment by Nathan Bott for the GLMAC.
Invasive species	Non-native terrestrial animals (foxes and cats)	Predation on nesting, feeding and roosting waterbirds	Almost certain	Moderate	High	Based on the presence of nesting little terns and fairy terns at Lake Tyers and Rigby Island, which are in this mega-habitat.
Invasive species	Non-native terrestrial plants (sea spurge)	Reduction in habitat for nesting terns	Almost certain	Moderate	High	Observations that terns will not nest in parts of the shoreline covered by the weed (Faye Bedford personal communication).

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Climate change and severe weather: Drought	Altered freshwater inflows	Disrupts stratification and internal nutrient cycling; promoting algal blooms	Possible	Major	High	Based on the most recent climate change predictions (Grose et al. 2015) and known algal bloom dynamics (Cook et al. 2008, Cook and Holland 2012).
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Damages the silt jetties	Possible	Extreme	High	Based on the most recent climate change predictions (Grose et al. 2015) and predictions of water level changes in the Gippsland Lakes (McInnes et al. 2013).
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects Aboriginal cultural heritage including significant sites	Possible	Major	High	Based on the most recent climate change predictions (Grose et al. 2015) and predictions of water level changes in the Gippsland Lakes (McInnes et al. 2013).
Recreational activities	Increased boat traffic	Impacts to dolphins	Almost certain	Moderate	High	Based on discussions with dolphin researcher Kate Charlton-Robb.

3.3 Risk assessment for the shallow lakes mega-habitat

The shallow lakes mega-habitat comprises Lake Wellington and Jones Bay (Figure 10). A stressor model for the site, was developed to guide the risk assessment, and illustrates the potential impacts of multiple stressors on the values of the site (Figure 11).

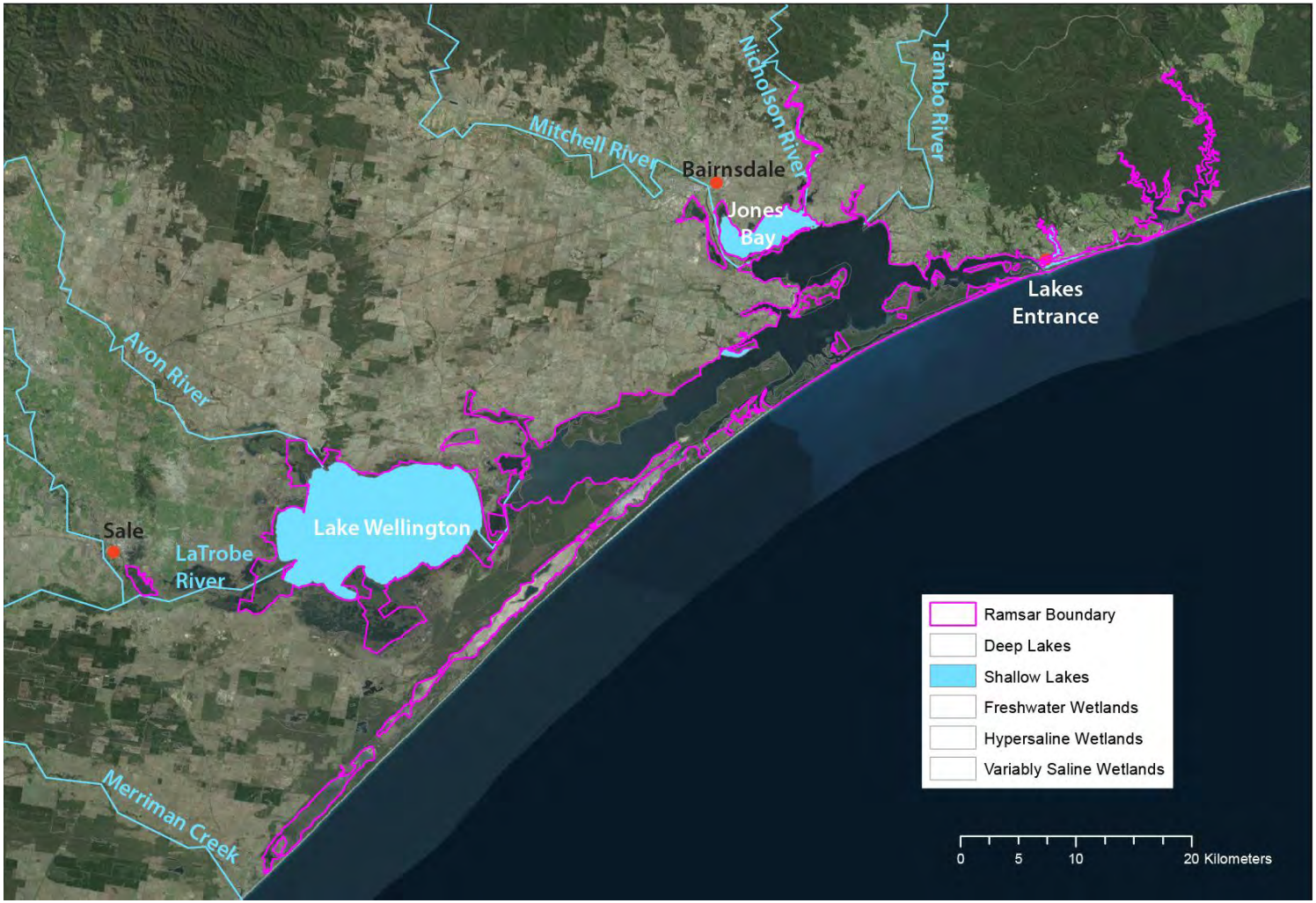


Figure 10: Location of the shallow lakes mega-habitat within the Gippsland Lakes Ramsar Site.

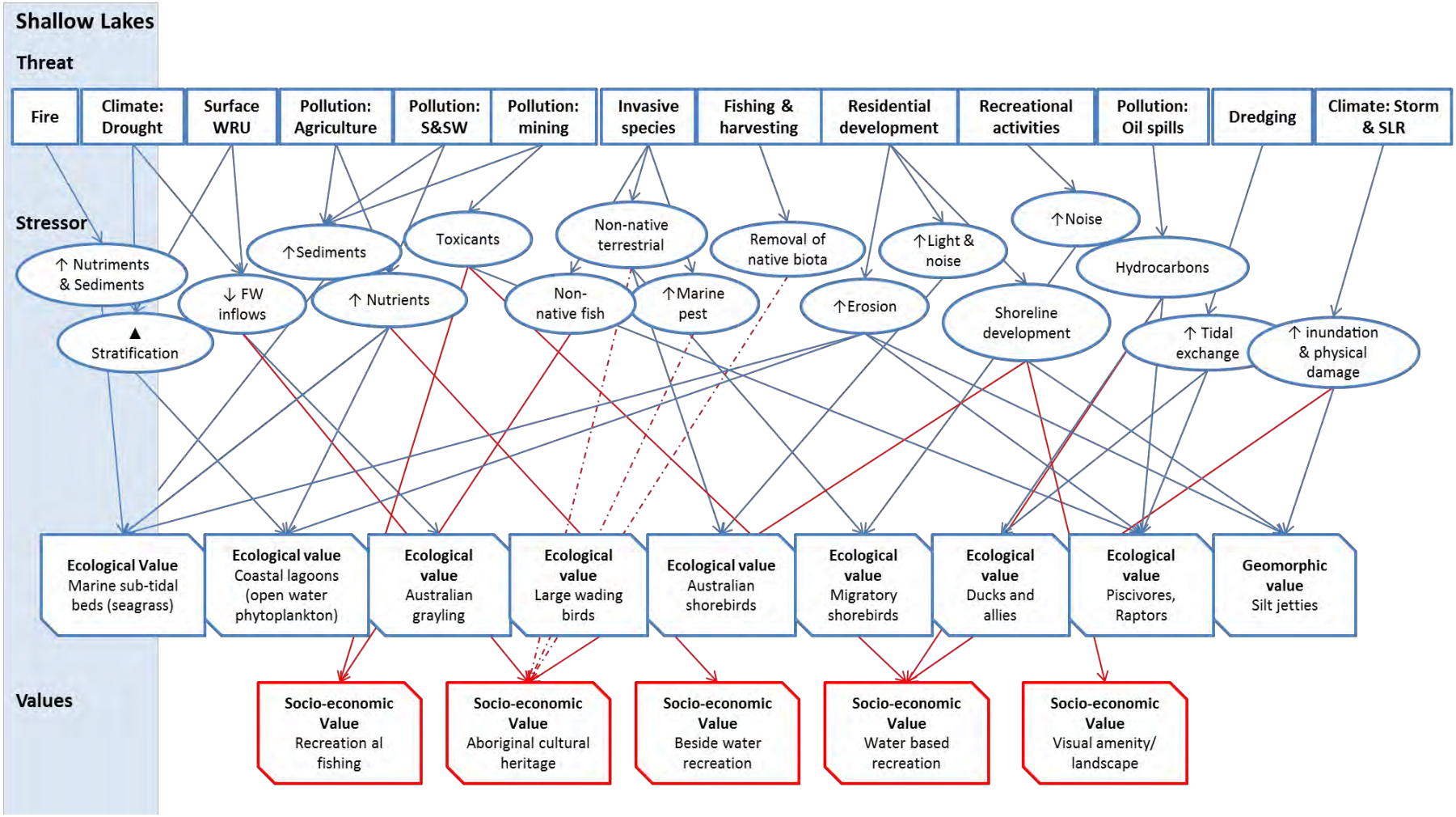


Figure 11: Stressor model for the shallow lakes mega-habitat (red lines join stressors to socio-economic values, blue to ecological values).

One hundred and four impact pathways were identified and assessed for the shallow lakes mega-habitat. The high and extreme risks are similar to those identified for the deep lakes mega-habitat and are associated with residential and commercial development, nutrient inflows from the catchment, water resource use, invasive species and climate change. The complete risk assessment is provided in Appendix C. The identified high and extreme risks associated with this habitat are provided in Table 9.

Table 9: Identified high and extreme risks to ecological character for the shallow lakes mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Residential and commercial development	Presence of development on lake shores	Affects visual amenity	Almost certain	Moderate	High	Commercial and residential development along the shorelines of the lakes has been identified as a community concern (GLMAC 2013). This would include Jones Bay.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding	Almost certain	Moderate	High	The pathway includes piscivores, large wading birds and ducks and swans. Jones Bay is a significant area for waterbirds within the Ramsar site, particularly for herbivores such as coots and swans. Past events have resulted in a loss of feeding habitat and the movement of birds to agricultural lands, instigating culls.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects visual amenity	Almost certain	Moderate	High	Previous algal blooms have elicited negative responses from residents and visitors. However, the impact does not extend for long after the bloom is no longer visible.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects waterbased recreation and tourism	Almost certain	Moderate	High	An assessment of the economic impact of the 2008 algal bloom estimated a 15 % decline in business activity, with a 6% reduction in visitors (Connolly and Brain 2009). How much of this is relevant to the shallow lakes habitat is not known.
Wildfire	Increased nutrients and sediment	Effects on seagrass	Likely	Major	High	Assumption that this impact pathway is for a large fire followed by heavy rain / significant flow as that which occurred in 2006/7. This event resulted in three times the average annual load of phosphorus and over twice the average annual load of nitrogen entered the lakes after intense rainfall fell on burned catchments mobilising large amounts of sediment and associated nutrients (SKM 2008). All likelihood and consequences for these pathways have been adjusted from those assessed for agricultural effluents to reflect the increased magnitude.
Wildfire	Increased nutrients and sediment	Effects aquatic biota (fish)	Likely	Major	High	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Wildfire	Increased nutrients and sediment	Effects dolphins	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Effects waterbirds	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Effects visual amenity	Likely	Major	High	
Water resource use	Decreased connectivity	Affects migratory routes of fish including threatened Australasian grayling	Possible	Major	High	The Australian Grayling migrates from fresh to marine waters as part of its lifecycle, with the return of juveniles to the rivers in spring (November) the most vulnerable phase (Koehn and O'Connor 1990). Recent research suggests that the fish migrate out to the open ocean in the juvenile phase (Schmidt et al. 2011) which would mean passing through the Lakes system and out to Bass Strait at Lakes Entrance. As this mega habitat includes the estuarine reaches of the Mitchell, Nicholson and Tambo Rivers, this impact pathway has been included. Australian Grayling and other diadromous fish require low flow freshes in spring and summer to complete their lifecycles. Recruitment failures in 3 to 4 years would represent a high risk to short lived species (Tilleard and Ladson 2010).
Invasive species	Introduced marine pests (European shore crab)	Increased competition and predation results in a decline in native species extent, diversity and abundance	Almost certain	Major	Extreme	Based on anecdotal reports of tonnes of crabs harvested monthly. Described as a voracious predator with the following potential impacts "In Australia they may have a great impact including direct impacts on prey species, indirect effects on species competing for the same prey, and indirect impacts on nutrient availability (by removing bivalves which filter algae and larvae) http://www.mesa.edu.au/marine_pests/marine_pests04.asp. Risk based on presence of species in the Lakes and preliminary risk assessment by Nathan Bott for the GLMAC.
Invasive species	Non-native fish (carp)	Increase in turbidity affecting flora and fauna	Almost certain	Moderate	High	Carp are known to occur in Lake Wellington and have been identified as a cause for loss of vegetation and increased turbidity (Harris et al. 1998).
Invasive species	Non-native fish (carp)	Competition and predation affect native fish abundance and diversity	Almost certain	Moderate	High	See above

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects breeding triggers for black bream and other estuarine fish (in estuarine reaches), reducing fish populations	Likely	Major	High	Based on same evidence and assumptions as "decreased freshwater flows from water resource use". An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013). This was considered to be a significantly increased risk to the ecology of the system than from water resource use alone.
Climate change and severe weather: Drought	Decreased connectivity	Affects migratory routes of fish including threatened Australasian grayling	Likely	Extreme	Extreme	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects littoral vegetation	Likely	Major	High	Extensive climate modelling and impact assessments have indicated a likely increase in sea level coupled with an increase in the frequency and intensity of storms (DSE 2013, McInnes et al. 2013). Potential impacts include physical damage to shorelines, vegetation and assets; as well as increased inundation. Recent studies indicate that there is significant risk of erosion around the shores of Lake Wellington and Jones Bay.
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects intertidal and sub-tidal seagrass condition and extent	Likely	Major	High	Based on the most recent climate change predictions (Grose et al. 2015) and predictions of water level changes in the Gippsland Lakes (McInnes et al. 2013).
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Damages the silt jetties	Possible	Extreme	High	Based on the most recent climate change predictions (Grose et al. 2015) and predictions of water level changes in the Gippsland Lakes (McInnes et al. 2013).
Recreational activities	Increased boat traffic	Impacts to dolphins	Almost certain	Moderate	High	Based on discussions with dolphin researcher Kate Charlton-Robb.

3.4 Risk assessment for the freshwater wetland mega-habitat

The freshwater wetland mega-habitat within the Ramsar site comprises just two of the fringing wetlands: Sale Common and Macleod Morass (Figure 12). A stressor model for the site, was developed to guide the risk assessment, and illustrates the potential impacts of multiple stressors on the values of the site (Figure 13).

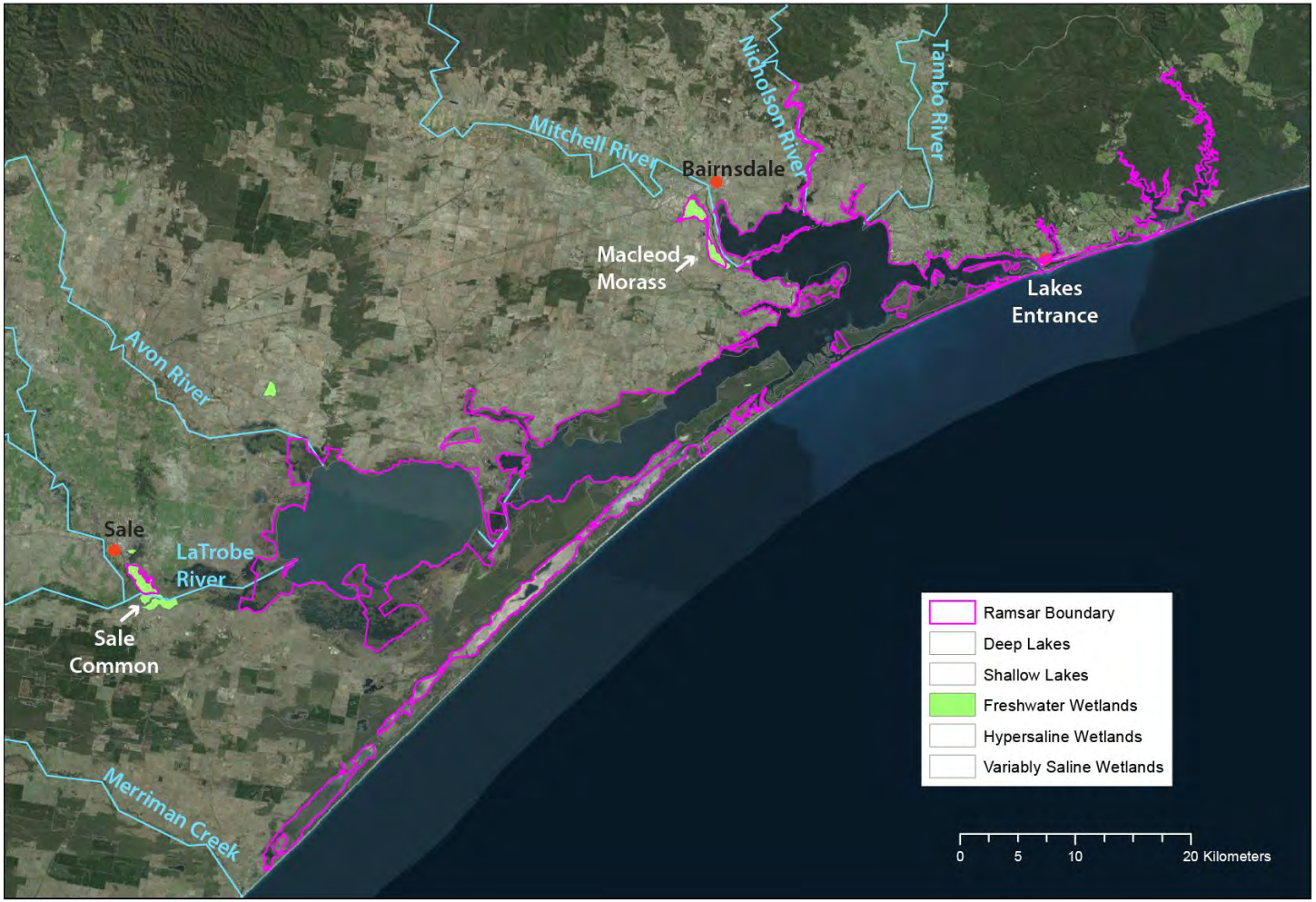


Figure 12: Location of the freshwater wetland mega-habitat within the Gippsland Lakes Ramsar Site.

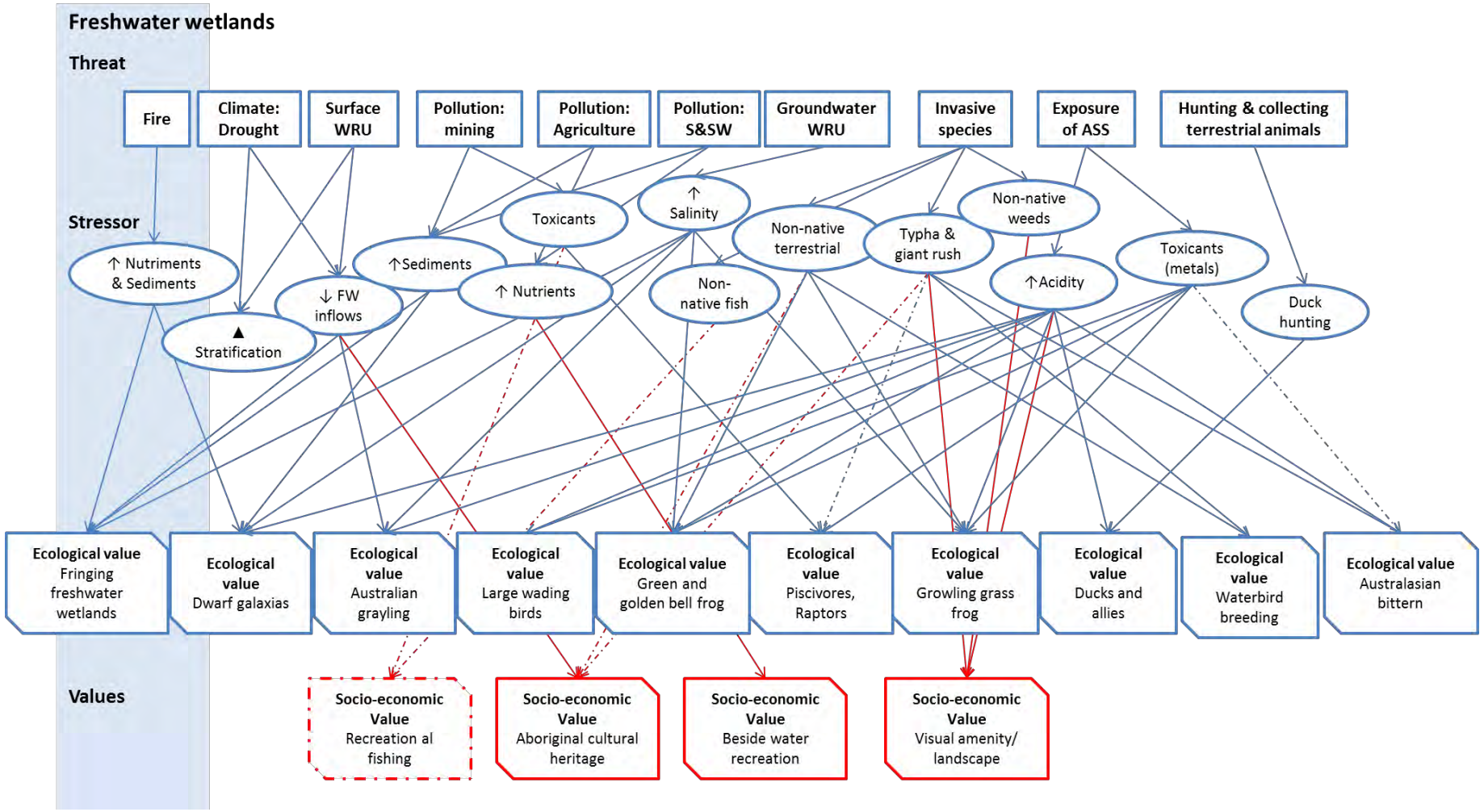


Figure 13: Stressor model for the freshwater wetland mega-habitat (red lines join stressors to socio-economic values, blue to ecological values).

Eighty-eight pathways were identified and assessed for the freshwater wetland mega-habitat. The highest risks were identified for water resource use and associated change in water regimes and salinity, invasive native plant species such as Typha, and climate change. The complete risk assessment is provided in Appendix C. The identified high and extreme risks associated with this habitat are provided in Table 10.

Table 10: Identified high and extreme risks to ecological character for the freshwater wetland mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Water resource use	Decreased freshwater inflows	Altered water regime affects native vegetation diversity, community composition and extent	Almost certain	Major	Extreme	Approximately one-third of average annual flow in the Latrobe, Thomson and Macalister Rivers is diverted, affecting all but large floods (Tilleard and Ladson 2010). Altered water regimes have been identified as a significant threat to these freshwater systems (Parks Victoria 2005, 2007), with altered flows suggested as mechanisms for changes to vegetation community composition and extent (BMT WBM 2010).
Water resource use	Decreased freshwater inflows	Altered water regimes affect threatened plant species	Possible	Major	High	Dwarf kerrawang is known from Sale Common (BMT WBM 2010) and is known to require periodic / seasonal inundation with freshwater (Carter and Walsh 2010). Alteration to wetting and drying regimes is a serious threat.
Water resource use	Decreased freshwater inflows	Altered water regimes affect threatened frog species	Likely	Major	High	Growling grass frog (*Litoria raniformis*) has been recorded in Sale Common (Urlus and Ricciardello 2012) which is reliant on freshwater habitat for feeding and breeding (Gillespie 1996). Recent reviews have indicated that altered water regimes and reduced complexity of aquatic vegetation are probably causes of current localised extinctions, and predictors of future extinctions in growling grass frog (Wassens et al. 2010).
Invasive species	Native species (Typha and giant rush)	Increased competition displaces native vegetation species, reducing diversity of native wetland flora	Almost certain	Moderate	High	Expansion of Typha has been identified as an ongoing problem in Macleod Morass (Parks Victoria 2005) and Sale Common (BMT WBM 2010)
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regime affects native vegetation diversity, community composition and extent	Almost certain	Moderate	High	Based on same evidence and assumptions as “decreased freshwater flows from water resource use”. An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013). This was considered to be a significantly increased risk to the ecology of the system than from water resource use alone and is supported by the most recent climate change assessments for the region (Grose et al. 2015).
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect threatened plant species	Likely	Major	High	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect threatened frog species	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects native vegetation	Almost certain	Moderate	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects threatened plant species	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects threatened frog species	Likely	Major	High	
Recreational activities (illegal 4WD)	Physical damage	Affects vegetation and habitat for biota	Almost certain	Moderate	High	Based on the expert knowledge of stakeholders attending the workshop.

3.5 Risk assessment for the variably saline wetlands mega-habitat

The variably saline wetland mega-habitat comprises a large number of fringing wetlands such as Dowd's and Heart Morass that have fluctuating salinity regimes (Figure 14). A stressor model for the site, was developed to guide the risk assessment, and illustrates the potential impacts of multiple stressors on the values of the site (Figure 15).

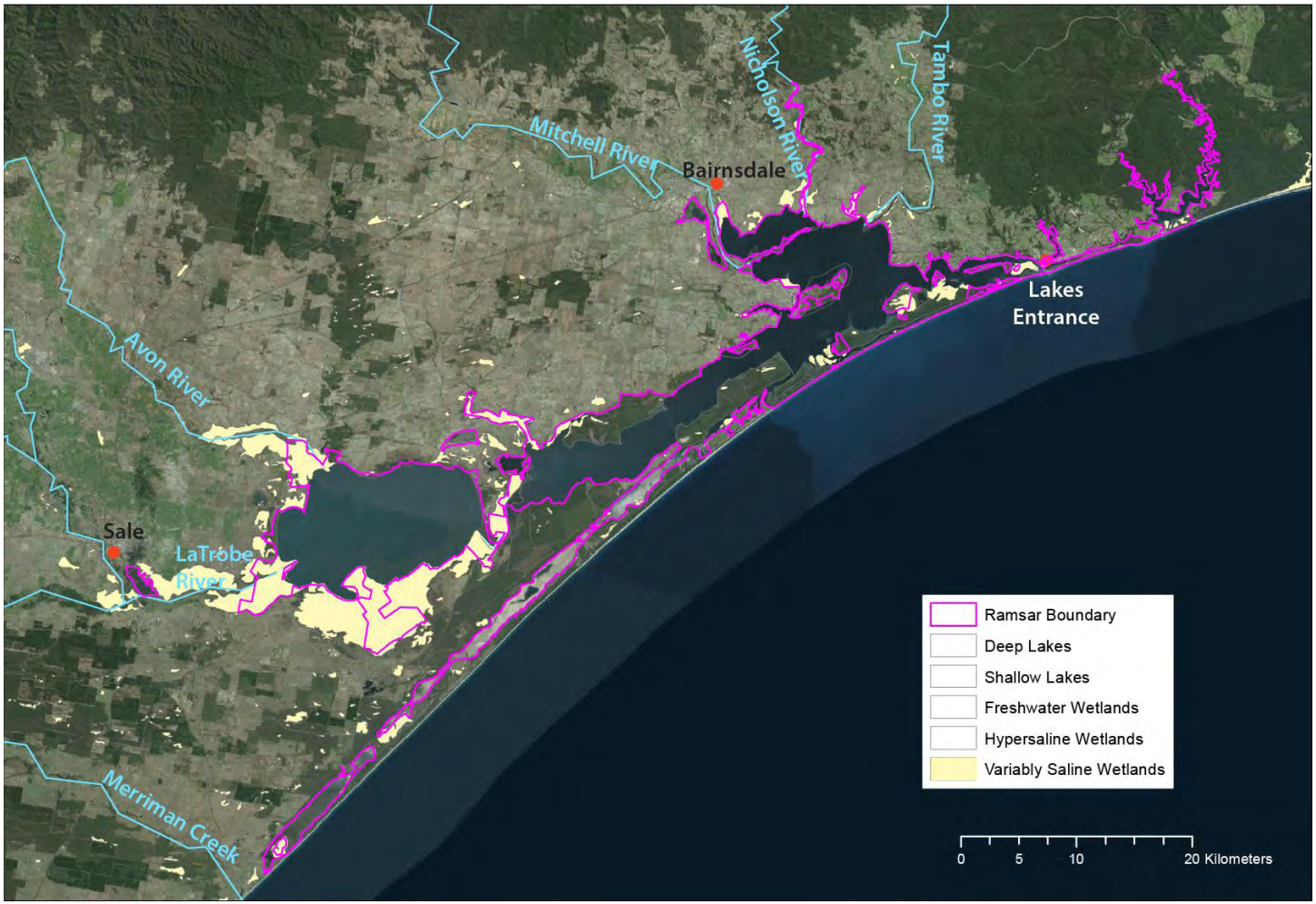


Figure 14: Location of the variably saline wetland mega-habitat within and surrounding the Gippsland Lakes Ramsar Site.

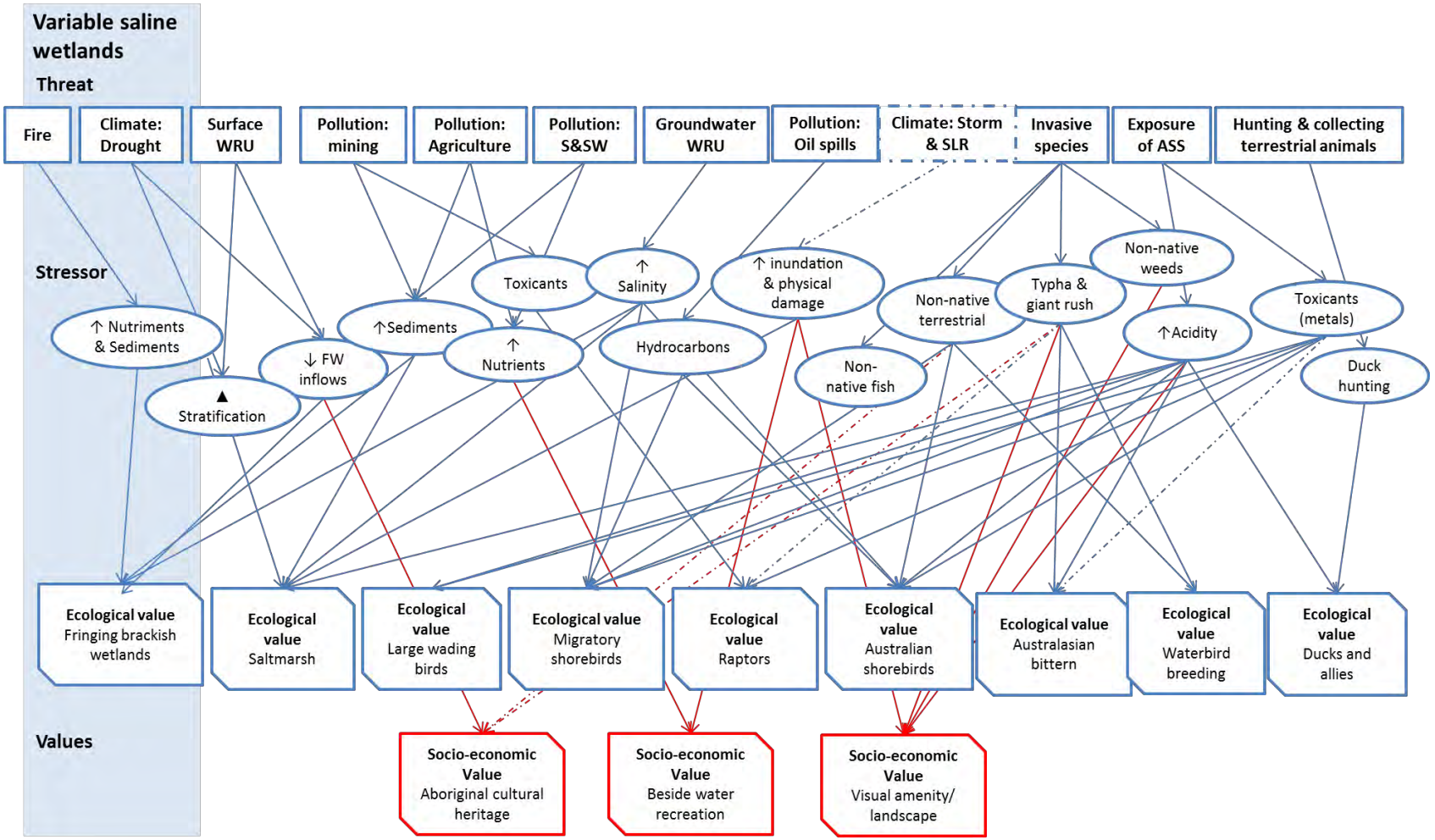


Figure 15: Stressor model for the variably saline wetland mega-habitat (red lines join stressors to socio-economic values, blue to ecological values).

Eighty-eight pathways were identified and assessed for the variably saline wetland mega-habitat. The highest risks were identified for toxicants (steroid hormones), exposure of acid sulfate soils (ASS), water resource use impacts on water regimes and salinity, invasive fish species, climate change and recreational vehicle damage to vegetation and habitat. The complete risk assessment is provided in Appendix C. The identified high and extreme risks associated with this habitat are provided in Table 11.

Table 11: Identified high and extreme risks to ecological character for the variably saline wetland mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Agricultural effluents	Toxicants (steroid hormones)	Affects fish	Possible	Major	High	Risk assessment on chemicals in the Gippsland Lakes identified the highest risk from steroid hormones from the dairy industry and concluded (Allinson 2009): "Extremely high profile environmental issue; very highly plausible threat in lower reaches of rivers servicing GLRS (dairy and beef farming); could affect amphibian reproduction and development via endocrine disrupting chemicals (EDC) mechanisms; could affect fish reproduction and development through EDC mechanisms; potential population effects." Threatened fish species Dwarf galaxias has been recorded in Dowd Morass (SKM 2001).
Pollution: Agricultural effluents	Toxicants (steroid hormones)	Affects frogs (including threatened species)	Possible	Major	High	See above, and the growling grass frog was recently recorded in Heart Morass (Urlus and Ricciardello 2012).
Exposure of ASS	Increased acidity	Impacts flora and fauna (including threatened species)	Almost certain	Major	Extreme	ASS are known from the fringing wetlands (Boon et al. 2007), and recent studies indicate that at Dowd and Heart Morass, there are active ASS that have resulted in very low pH levels < 3 (Unland 2009, Taylor 2011).
Exposure of ASS	Toxicants	Toxicants in the sediments are mobilised impacting flora and fauna	Likely	Major	High	Recent studies indicated that the ASS in both Dowd and Heart Morass have lead to the mobilisation of metals at concentrations that are likely to cause biological effects (Unland 2009, Taylor 2011).
Water resource use	Decreased freshwater inflows	Altered water regime affects native vegetation diversity, community composition and extent	Almost certain	Major	Extreme	Approximately one-third of average annual flow in the Latrobe, Thomson and Macalister Rivers is diverted, affecting all but large floods (Tilleard and Ladson 2010). Altered water regimes have been identified as a significant threat to the fringing wetlands (Parks Victoria 2005, 2007), with altered flows suggested as mechanisms for changes to vegetation community composition and extent (BMT WBM 2010).
Water resource use	Decreased freshwater inflows	Altered water regimes affect threatened plant species (dwarf kerrawang; metallic sun orchid and swamp everlasting)	Possible	Major	High	The three threatened flora species within the Ramsar site dwarf kerrawang (Commersonia prostrate); swamp everlasting (Xerochrysum palustre); and metallic sun-orchid (Thelymitra epipactoides) are present in the fringing wetlands near Blond Bay Nature Reserve (BMT WBM 2010) and all require freshwater inundation to varying degrees (Carter and Walsh 2010a, 2010b).

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
						Altered hydrology is considered threatening process for the species
Water resource use	Decreased freshwater inflows	Altered water regimes affect waterbird feeding through habitat alteration	Almost certain	Moderate	High	Many species of waterbird have specific water depth requirements for feeding habitats. For example, shorebirds have bills that are adapted to different water depths and altered water depths can result in decreased feeding opportunities (Cole et al. 2002).
Water resource use	Decreased freshwater inflows	Altered water regimes affect threatened frog species	Likely	Major	High	Growling grass frog (*Litoria raniformis*) has been recorded in Heart Morass (Urlus and Ricciardello 2012) which is reliant on freshwater habitat for feeding and breeding (Gillespie 1996). Recent reviews have indicated that altered water regimes and reduced complexity of aquatic vegetation are probably causes of current localised extinctions, and predictors of future extinctions in growling grass frog (Wassens et al. 2010).
Water resource use	Decreased freshwater inflows	Increased salinity affects native vegetation	Almost certain	Moderate	High	Increased salinity has been identified as a critical threat to a large number of the fringing wetlands (SKM 2001, 2004a, Boon et al. 2007, Tilleard et al. 2009). Limited data suggested that increased salinity has occurred and continues to occur resulting in significant ecological shifts (Borg and Savage 2005).
Water resource use	Decreased freshwater inflows	Increased salinity affect threatened plant species (dwarf kerrawang; metallic sun orchid and swamp everlasting)	Possible	Major	High	The three threatened flora species within the Ramsar site dwarf kerrawang (*Commersonia prostrate*); swamp everlasting (*Xerochrysum palustre*); and metallic sun-orchid (*Thelymitra epipactoides*) are present in the fringing wetlands near Blond Bay Nature Reserve (BMT WBM 2010a) and all require freshwater inundation to varying degrees (Carter and Walsh 2010a, 2010b). Salinisation could result in a decline in the species
Water resource use	Decreased freshwater inflows	Increased salinity affects threatened frog species	Almost certain	Moderate	High	Growling grass frog (*Litoria raniformis*) has been recorded in Heart Morass (Urlus and Ricciardello 2012) which is reliant on freshwater habitat for feeding and breeding (Gillespie 1996). Salinisation would reduce suitable habitat for the species.
Invasive species	Non-native fish (carp and gambusia)	Predation and competition affect diversity and abundance of native fish	Almost certain	Moderate	High	Carp are known from a number of the fringing wetlands, but *Gambusia holbrooki*, is not presently known to be a key threat to the site (BMT WBM 2010).
Invasive species	Non-native fish (carp and gambusia)	Habitat alteration results in impacts to aquatic macrophytes	Almost certain	Moderate	High	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regime affects native vegetation diversity, community composition and extent	Almost certain	Moderate	High	Based on same evidence and assumptions as "decreased freshwater flows from water resource use". An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013). This was considered to be a significantly increased risk to the ecology of the system than from water resource use alone and is supported by the most recent climate change assessments for the region (Grose et al. 2015).
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect threatened plant species (dwarf kerrawang; metallic sun orchid and swamp everlasting)	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect threatened frog species	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects native vegetation	Almost certain	Moderate	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affect threatened plant species (dwarf kerrawang; metallic sun orchid and swamp everlasting)	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects threatened frog species	Likely	Major	High	
Recreational activities (illegal 4WD)	Physical damage	Affects vegetation and habitat for biota	Almost certain	Moderate	High	Based on the expert knowledge of stakeholders attending the workshop.

3.6 Risk assessment for the hypersaline wetlands mega-habitat

The hypersaline saline wetland mega-habitat comprises Lake Reeve and a small number of fringing wetlands around Lake Victoria that have fluctuating salinity regimes (Figure 15). A stressor model for the site, was developed to guide the risk assessment, and illustrates the potential impacts of multiple stressors on the values of the site (Figure 16).

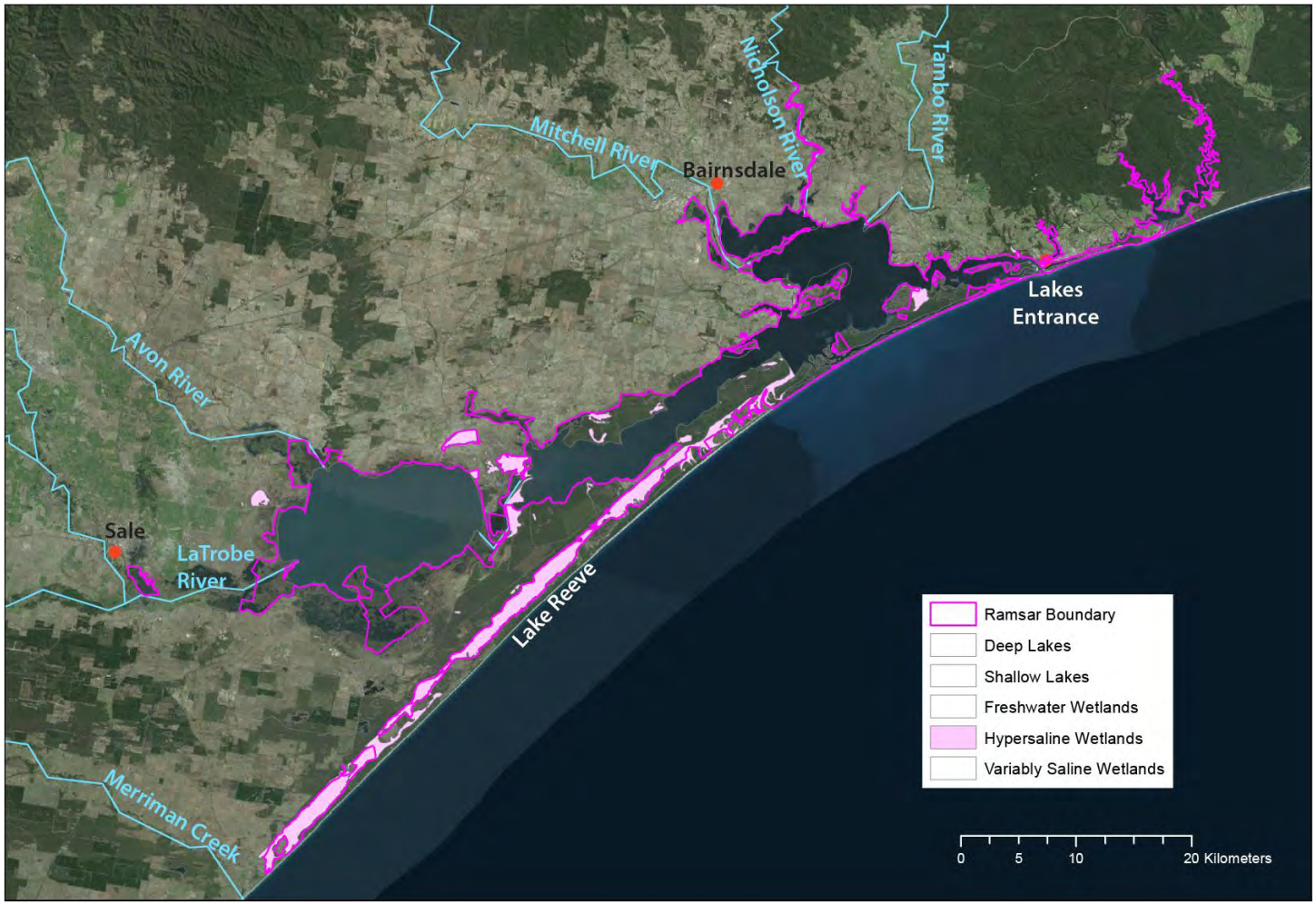


Figure 16: Location of the hypersaline wetland mega-habitat within and surrounding the Gippsland Lakes Ramsar Site.

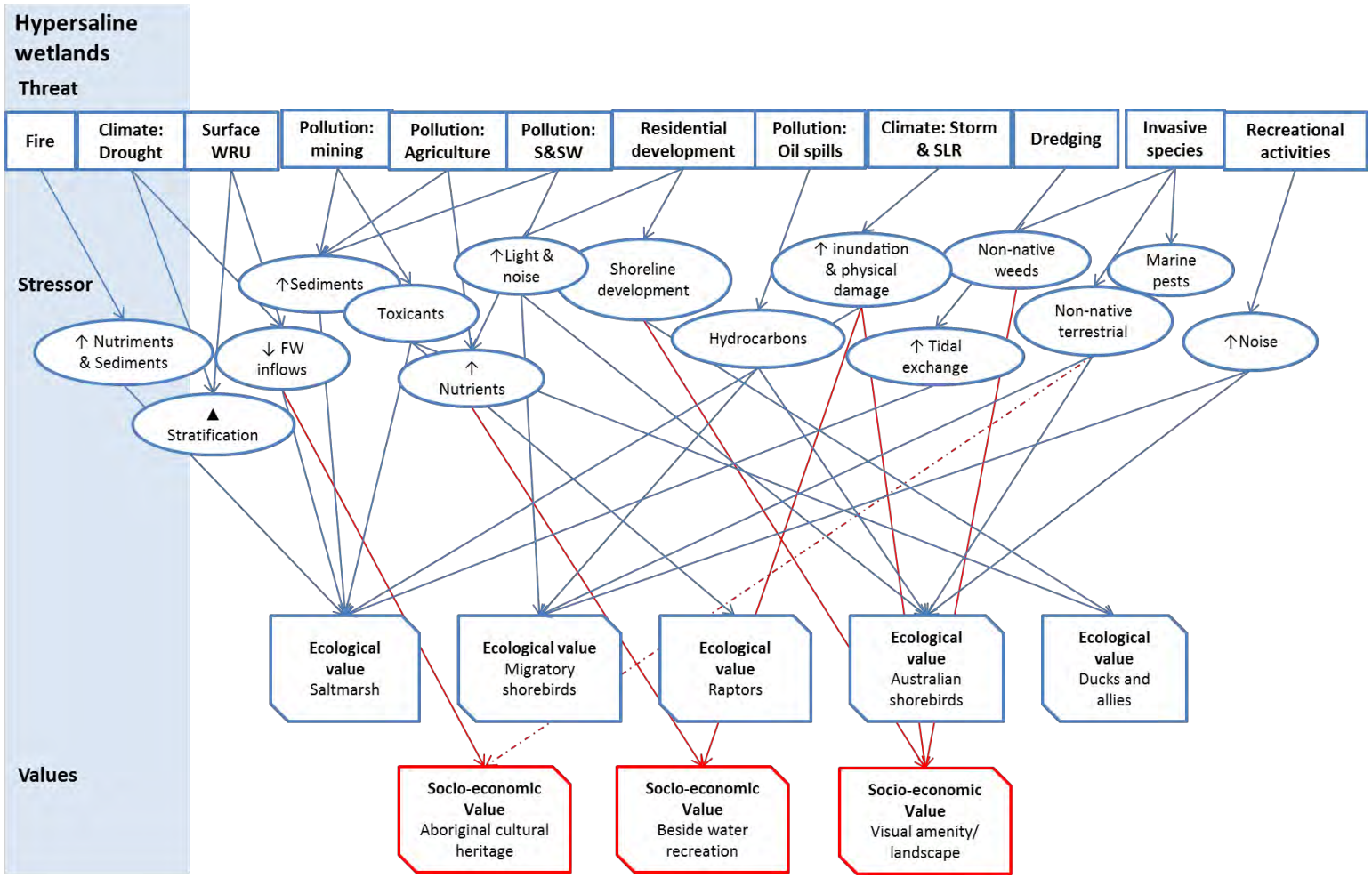


Figure 17: Stressor model for the hypersaline wetland mega-habitat (red lines join stressors to socio-economic values, blue to ecological values).

Forty-five pathways were identified and assessed for the hypersaline wetland mega-habitat. Only a single high risk was identified, relating to erosion and other damage due to sea level rise and climate change (Table 12). The hypersaline wetlands are not well researched and a number of knowledge gaps were identified (see Table 14). The complete risk assessment is provided in Appendix C.

Table 12: Identified high and extreme risks to ecological character for the hypersaline wetland mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects saltmarsh extent, community composition and health	Likely	Major	High	Extensive climate modelling and impact assessments have indicated a likely increase in sea level coupled with an increase in the frequency and intensity of storms (DSE 2013, McInnes et al. 2013; Grose et al. 2015). Potential impacts include physical damage to shorelines, vegetation and assets; as well as increased inundation. Recent studies indicate that there is a high likelihood of a major increase in inundation for Lake Reeve and potential erosion of the shoreline (Sjerp et al. 2002).

3.7 Risk assessment for the estuarine reaches mega-habitat

The estuarine reaches mega-habitat is located mostly outside the Ramsar site boundary; with the exception of a large stretch of the Nicholson River estuarine reach (Figure 18). As a part of the stakeholder consultation process, the estuarine reaches were included in this Ramsar management plan as they are important in maintaining the character of the site and add significant ecological value.

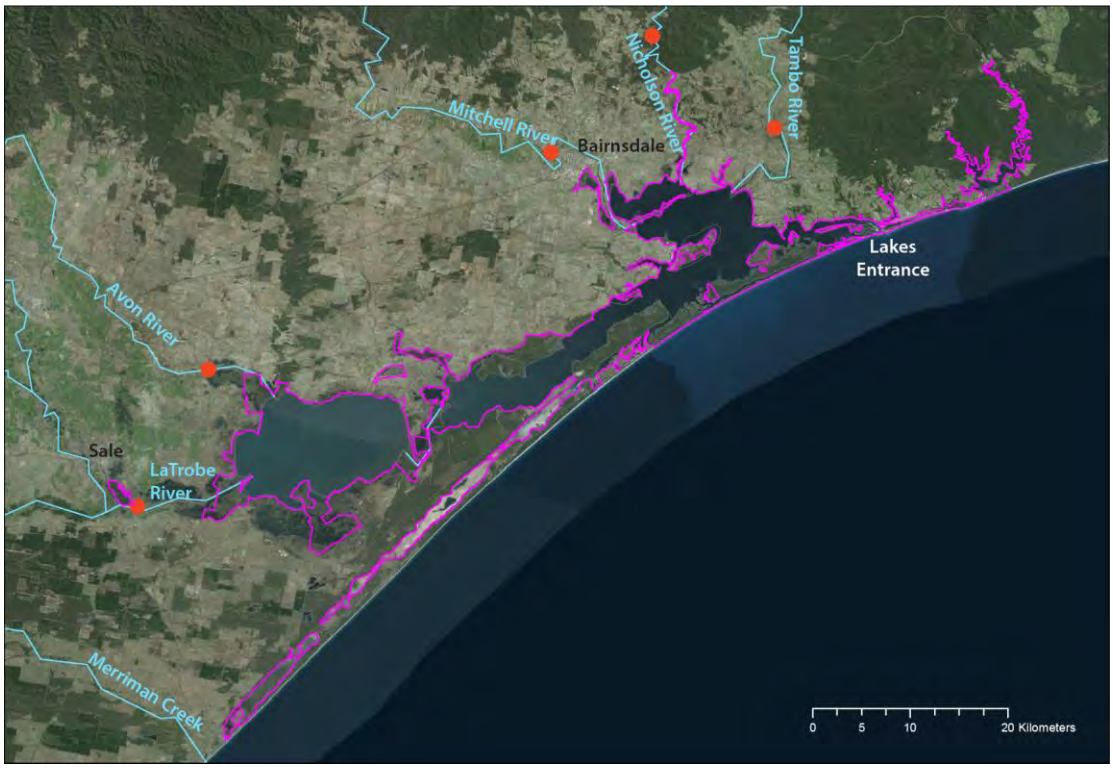


Figure 18: Extent of estuarine reaches (red dots) of the five main rivers (Tilleard et al. 2009) and the Ramsar site boundary.

The process for identifying risks in the estuarine reaches was different than that for the other mega-habitats. The estuarine reaches had already been through a risk assessment process in the development of the Regional Waterway Strategies for East and West Gippsland (East Gippsland CMA 2014, West Gippsland CMA 2014) and there was general agreement that this Ramsar plan should be consistent with these two key documents. As such the identified high risks in the two Regional Waterway Strategies were reviewed by stakeholders and aligned with the impact pathway approach. The resulting identified high risks for the estuarine reaches are described in Table 13.

Table 13: Identified high risks to ecological character for the estuarine mega-habitat (adapted from East Gippsland CMA 2014, West Gippsland CMA 2014 with input from stakeholders).

Threats	Stressors	Impact pathway
Pollution: Agricultural effluents	Increased nutrients	Affects aquatic biota
Exposure of Acid Sulphate Soils	Increased acidity	Impacts flora and fauna
Water resource use	Decreased freshwater inflows	Altered water and salinity regime affects native fish breeding and migration cues
Water resource use	Decreased freshwater inflows	Altered water regimes affects instream and riparian vegetation
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water and salinity regime affects native fish breeding and migration cues
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affects instream and riparian vegetation
Recreational activities (illegal 4WD)	Physical damage	Affects vegetation and habitat for biota (riparian and instream)
Recreational activities (boat launching)	Physical damage	Affects vegetation and habitat for biota (riparian and instream)
Invasive species	Non-native plants	Increased competition displaces native vegetation species, reducing diversity of native instream and riparian flora
Invasive species	Deer and rabbits	Impacts riparian vegetation
Residential and commercial development	Development on estuarine banks	Affects visual amenity
Wildfire	Increased nutrients and sediments	Impacts aquatic biota
Invasive species	Non-native fish (carp)	Competition and predation affect native fish abundance and diversity
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Damages the silt jetties

3.8 Identified knowledge gaps from the risk assessment process

Through the risk assessment process, stakeholders identified a number of critical knowledge gaps relevant to the management of the Gippsland Lakes Ramsar Site. These are listed in Table 14, with relevant mega-habitats associated with each.

Table 14: Knowledge gaps and associated mega-habitats.

Knowledge gap	Mega-habitats					
	Deep lakes	Shallow lakes	Freshwater wetlands	Variable saline wetlands	Hypersaline wetlands	Estuarine reaches
1. Mercury (and other toxicants): bioavailability in sediments and bioaccumulation through the food chain.	X	X				X
2. Risks and mitigation strategies for endocrine disruptors in dairy, urban, and human waste from the wastewater treatment plant in Macleod Morass.			X	X		
3. Groundwater relationships with freshwater and variably saline wetlands, status, effects, potential causes of groundwater fluctuation.			X	X	X	
4. Wetland hydrology, current condition and potential impacts associated with altered water and salinity regimes.			X	X	X	
5. Environmental water requirements and setting realistic management goals for Macleod Morass and Jones Bay.		X	X	X		
6. Cues for migration and recruitment of native fish.	X	X	X	X		X
7. Impacts of blue-green algae on waterbirds and recruitment success.	X	X				
8. Impacts of reduced freshwater inflows on stratification and nutrient cycling in the deep lakes mega habitat.	X					
9. Effects of fire in the catchment on freshwater and variably saline wetlands.			X	X		
10. Productivity changes from altered water regimes and thresholds for change.			X	X	X	
11. Seagrass – reasons for fluctuations and possible management interventions, including thresholds.	X	X				
12. Water quality in the freshwater wetlands.			X			
13. Water quality and water regime in the freshwater and variably saline wetlands.				X	X	
14. Waterbird breeding: species and important breeding habitats / locations.	X	X	X	X	X	
15. Important habitats and populations of the threatened Australasian bittern in the Ramsar site.			X	X		
16. The populations and movement of native fish (including threatened species) in the freshwater wetlands and estuarine river reaches.			X			X
17. Habitat use by the Australian grayling within the site.	X	X	X			X
18. Vegetation extent and community composition in the fresh and variably saline wetlands and estuarine river reaches and drivers of change.			X	X		X
19. Importance of the estuarine river reaches to water dependent reptiles and mammals.						X
20. Feasibility of and options to improve the ecological condition of Lake Wellington.		X				
21. Implications of climate change for the ecological character of the Ramsar site.	X	X	X	X	X	X
22. Refuge for green and golden bell frog and growling grass frog during out of breeding season habitat requirements.			X	X		X
23. Migratory wader refuge: species and locations of important habitats; impact of recreational activities on migratory waders at these locations.	X	X	X	X	X	X

4 Values

4.1 Method

4.1.1 Approach

A multi-criteria analysis was used to prioritise values for the Gippsland Lakes Ramsar Site management plan. The objective of the prioritisation was to identify the highest priorities for management for the next eight years (i.e. the life of the plan). Therefore criteria for prioritising values are related to (Table 15):

- Meeting Ramsar site management planning obligations to maintain ecological character (criteria 1 and 2);
- Importance to the broader community (criterion 3); and
- Values that are currently in decline or have been identified as being at risk from threats at the site or in the catchment (criteria 4 and 5).

Values were identified for each mega-habitat based on those acknowledged as being critical to the ecological character of the Ramsar site in the ECD (BMT WBM 2010a); together with additional values identified through a search of recent literature and research; consistent with the methods described in the Victorian Waterway Management Strategy (Department of Environment and Primary Industries 2013). Attribution of values to each mega-habitat relied on both data and local knowledge and was reviewed by TAG and PSC members.

The prioritisation criteria were applied to each value relevant to each mega-habitat and scores summed to rank values in order of priority for management. A sensitivity analysis that weighted criteria was undertaken, but revealed no redundancies, and no significant changes in the ranking. Final scores were derived into "high, medium and low" priorities to allow for easy comparison across mega-habitats.

Table 15: Criteria for prioritisation of values (and descriptions of low (1), medium (2) and high (3) rankings).

Criteria	Description	Score
1. Critical to the ecological character of the Gippsland Lakes Ramsar Site	**Low priority:** Not an identified critical CPS[1], nor related to priority species / ecological communities.	1
	Medium priority: Value relates to one or more state listed and/or one or more items listed under international agreements; regional management priorities included in regional planning frameworks, management plans etc., but were not identified as a critical CPS in the ECD.	2
	High priority: Value is a critical component, process or service and present in the mega-habitat.	3
2. Supports ecological character	**Low priority:** Value regularly present at site but not directly involved in supporting a critical CPS.	1
	Medium priority: Value is not identified as a critical CPS but is considered important in supporting a critical CPS of the Ramsar site.	2
	High priority: Value is considered influential on two or more of the critical CPS and / or other values.	3
3. Community priority	**Low priority:** Not identified of concern by general community.	1
	Medium priority: Value identified as of moderate interest/concern for the community.	2
	High priority: Value identified as a high priority by the community	3
4. Risk (from risk assessment)	**Low priority:** No high or extreme risks identified for the value.	1
	Medium priority: One high risk identified for the value.	2
	High priority: An "extreme" risk and / or two or more "high" risks identified for the value.	3
5. Current condition	**Low priority:** No qualitative or quantitative evidence of a decline in condition (against 1982 benchmark)	1
	Medium priority: Qualitative evidence of a decline in condition and / or a localised or non-sustained change in condition reported for the value.	2

[1] Critical components, processes and services (CPS) – as identified in the ecological character description for the Ramsar site.

Criteria	Description	Score
	High priority: Quantitative evidence of a sustained decline in condition associated with the value.	3

4.1.2 Stakeholder involvement

A draft prioritisation of values for each mega-habitat was developed based on best available information by a team of wetland scientists in consultation with experts on various aspects of the Gippsland Lakes. This draft prioritisation of values was provided to the project steering committee (PSC) and technical advisory group (TAG) members for review. A one day workshop was held in Traralgon on October 29, 2014. Workshop participants were asked to review the application of criteria and scoring for each value in each mega-habitat in their area of interest or expertise. At the workshop, the prioritisation was systematically worked through with discussion on scoring until agreement was reached. A number of values and scores were deferred at the workshop for consultation with relevant scientific experts.

It should be noted that a small number of values were raised by stakeholders in the workshop, which were excluded following discussion and direction by the Project Steering Committee. These comprised:

- Platypus in the estuarine river reaches – advice from the Australian Platypus Conservancy (Geoff Williams, personal communication) indicated that platypus are rarely observed in the Lakes proper, presumably because both water depth and salinity are generally too high to support efficient foraging. The few that are observed are most likely to be displaced (or possibly dispersing) individuals originating in nearby river systems.
- Littoral rainforest communities – were located predominantly outside the Ramsar site boundary and are not considered inundation dependent.

Following the workshop, relevant experts from universities and research organisations were contacted to provide input to the prioritisation in their respective fields. The results of these conversations, together with the outputs of the workshop were used to produce a revised prioritisation of values for each mega-habitat. The revised prioritisation of values was circulated to PSC and TAG members for any further comments, prior to finalisation.

4.2 High priority values for management

The prioritisation of values identified thirteen high priority values for management in the next eight years across the mega-habitats (Table 16). The complete prioritisation with the scoring for each criterion is provided in Appendix D.

Table 16: Priority values and mega-habitats of the Gippsland Lakes Ramsar Site (H = high priority for management; M = Moderate priority; L = Lower priority, as identified in the prioritisation process).

Value	Mega-habitats					
	Deep lakes	Shallow lakes	Freshwater wetlands	Variably saline wetlands	Hypersaline wetlands	Estuarine reaches
Marine sub-tidal beds (seagrass)	H	H				
Coastal lagoons (open water phytoplankton)	H	H				
Fringing freshwater wetlands			H			
Fringing brackish wetlands				H		
Saltmarsh				M	H	
Abundance & diversity of waterbirds: Ducks and allies	H	H	M	M	H	L
Abundance & diversity of waterbirds: Piscivores	M	M	M	M		M
Abundance & diversity of waterbirds: Large wading birds	M	M	M	M	M	L
Abundance & diversity of waterbirds: Migratory shorebirds	M	H	M	M	H	
Abundance & diversity of waterbirds: Australian shorebirds	M	M	M	M	H	
Abundance & diversity of waterbirds: Raptors	M	M	M	M	M	L
Threatened species: Little tern and fairy tern	H	M				
Threatened species: Green and golden bell frog (*Litoria aurea*)			M	M		L
Threatened species: Growling grass frog (*Litoria raniformis*)			M	M		L
Abundance and diversity of native fish	M	M		L		H
Threatened species: Australian grayling (*Prototroctes maraena*)	L	L				M
Threatened species: Dwarf galaxias (*Galaxiella pusilla*)			L	M		
Threatened species: Australasian bittern (*Botaurus poiciloptilus*)			L	M		
Threatened species: Dwarf kerrawang (*Rulingia prostrata*)			M	M		
Threatened species: Swamp everlasting (*Xerochrysum palustre*)				M		
Threatened species: Metallic sun-orchid (*Thelymitra epipactoides*)				M		
Threatened ecological community: Gippsland Red Gum (*Eucalyptus tereticornis* sub spp. *mediana*) Grassy Woodland.			L			H
Swamp scrub			L	L		L
Plains grassy woodland		L				L
Waterbird breeding	H		H	H		M
Burrunan dolphin (*Tursiops australis*)	H	H				H
Geomorphic features (silt jetties)	M	M				H
Visual amenity / landscape	M	M	L	L	L	M
Recreational fishing	L	L				L
Commercial fishing (black bream; eels)	L	L	L	L		L
Water based recreation (swimming, boating)	M	M				M
Beside water recreation (camping, bushwalking, nature observation)	M	M	L	L	L	M
Aboriginal cultural heritage	Assessed through a separate consultation process see section 6.8					
European cultural heritage	L				L	
Game hunting	L	L	L	L	L	L

* Note that water quality has been considered as a stressor / threat, with the above values maintained by maintaining good water quality.

5 Threats

5.1 Method

5.1.1 Approach

A multi-criteria analysis was used to identify priority threats for each mega-habitat. The objective of the prioritisation is to identify the highest priorities for management in the next eight years (i.e. the life of the plan). Therefore criteria for the multi-criteria analysis for identifying high priority threats are related to:

- Risks;
- Feasibility of management;
- Cost of implementing management actions; and
- Community priorities.

Unlike the prioritisation of values, the threats assessment adopts a rules based approach, followed by a scoring system. In the first instance all threats, associated stressors and impact pathways that resulted in negligible or low risks were considered a low priority, and filtered from the remaining prioritisation process. Then any threats, for which no feasible management action could be identified, were also considered a low priority and filtered from the ranking process[2].

Remaining threats, stressors and impact pathways were scored according to the criteria described in Table 17, to provide a ranking of threats for management in the next eight years. The assessment was undertaken at threat / stressor level unless management interventions were likely to be different for different pathways. For example management of boats to limit impacts to dolphins could require a different management action than management of boats to prevent destruction of seagrass beds, therefore these threats and stressors were ranked at the finer, impact pathway level. However, management of nutrients from the catchment, would likely be the same for all associated impact pathways (seagrass versus fish) and so the ranking was at the threat / stressor level.

Table 17: Criteria for prioritisation of threats (and descriptions of low (1), medium (2) and high (3) rankings).

Criteria	Description	Score
1. Identified as a significant risk to the ecological character of the site	**Low priority:** Risk assessment identified no high risks associated with the threatening activity.	1
	Medium priority: Risk assessment identified one high risk associated with the threatening activity.	2
	High priority: Risk assessment identified two or more high risks and / or an extreme risk associated with the threatening activity.	3
2. Management intervention feasible or a current management focus (effectiveness aspect of cost effectiveness assessment)	**No active management:** Actions will not address the threatening activity nor measurably mitigate the impact.	1
	Some active management: Management activities in the site or catchment may address threat but are not likely to result in a significant and sustained effect on ecological character.	2
	Actively managed: Threatening activity able to be addressed or mitigation of impact is possible through active management.	3
3. Cost (cost aspect of cost effectiveness assessment)	**High cost:** Capital costs and / or ongoing costs are high.	1
	Moderate cost: Moderate capital cost and / or moderate ongoing cost of implementation.	2
	Low cost: Low capital cost and ongoing cost of implementing the option.	3
4. Community priority	**Low priority:** Not identified of concern by general community.	1
	Medium priority: Threat identified as of moderate interest/concern for the community.	2
	High priority: Threat identified as a high priority by the community.	3

[2] Note that criterion 3 (costs) could not be applied to threats / pathways for which there were no possible management actions.

Combined effects of multiple threats: Saltmarsh

Many of the values of the Gippsland Lakes Ramsar Site are impacted by different threats. These threats often do not operate independently, but interact to produce combined effects on biota and ecosystems. These may be greater than the sum of each individual threat.

Coastal saltmarsh is a recognised important vegetation community and is listed as vulnerable under the EPBC Act. Coastal saltmarsh is important in capturing and storing carbon (blue carbon) and is a vital habitat for many invertebrates, fish and waterbirds.

Saltmarsh is a complex community that grows in saline intertidal areas. It has specific requirements to maintain health that are related to water quality (salinity, nutrients, pH) and water depth (elevation). These factors interact to result in distinct zones of layers of vegetation from the sea inland from mangroves (where present), to succulent shrubs like beaded and shrubby glassworts to sea rush and swamp paperbark further inland (see image below).

Zonation of saltmarsh communities (Boon et al. 2014).

Threats that are currently impacting saltmarsh communities in the Gippsland Lakes include altered salinity from water resource use; increased nutrients, invasion by weeds such as *Spartina* spp. and physical damage from 4WD and other recreational vehicles. All of these factors are reducing the resilience of saltmarsh communities. This makes them more vulnerable to other threats and impacts reducing their ability to recover or “bounce back” from events such as storm surges. Added to this is the potential long term effect of sea level rise.

Recent climate modelling (Grose et al. 2015) indicates sea level has risen around Australia at an average rate of 1.6 mm per year between 1966 and 2009; by 2030 sea level is expected to be 70 to 190 mm higher than today. This could have serious effects on saltmarsh diversity and extent, particularly if those communities are already in poor condition from other impacts. Maintaining healthy saltmarsh may allow for migration of communities to higher elevations. In the example above, healthy vegetation that is actively flowering and reproducing may result in a slow movement of mangrove to where beaded glasswort currently is, and the glassworts further inland to the areas currently occupied by sea rush, and so on through the zones.

5.1.2 Stakeholder involvement

A draft risk prioritisation of threats for each mega-habitat was developed based on best available information by a team of wetland scientists in consultation with experts on various aspects of the Gippsland Lakes. This draft prioritisation of threats was provided to the project steering committee (PSC) and technical advisory group (TAG) members for review. A one day workshop was held in Traralgon on October 29, 2014. Workshop participants were asked to review the application of criteria and scoring for each threat in each mage-habitat in their area of interest or expertise. At the workshop, the prioritisation was systematically worked through with discussion on scoring until agreement was reached. A number of threats and scores were deferred at the workshop for consultation with relevant scientific experts.

Following the workshop, relevant experts from universities and research organisations were contacted to provide input to the prioritisation in their respective fields. The results of these conversations, together with the outputs of the workshop were used to produce a revised prioritisation of threats for each mega-habitat. The revised prioritisation of values was circulated to PSC and TAG members for any further comments, prior to finalisation.

5.2 High priority threats for management

The prioritisation of values identified twenty high priority threats for management in the next eight years (Table 18). The complete prioritisation with the scoring for each criterion is provided in Appendix E.

Table 18: Priority threats and mega-habitats of the Gippsland Lakes Ramsar Site.

Threat	Mega-habitats					
	Deep lakes	Shallow lakes	Freshwater wetlands	Variably saline wetlands	Hypersaline wetlands	Estuarine reaches
Nutrient inflows from agricultural activities in the catchment	X	X				X
Development on the shores affecting visual amenity	X	X				X
Foxes and cats predating on waterbirds	X	X	X	X	X	
Climate change (storms and sea level rise) affects silt jetties, exposed islands and sandy spits	X	X				X
Climate change (storms and sea level rise) impacts vegetation	X	X			X	
Artificial opening of the entrance at Lake Tyers affects biota (including nesting terns)	X					
Non-native invasive species (sea spurge) affects terns nesting	X					
Non-native invasive plant species affects native flora and habitat			X			X
Native invasive species (e.g. Typha) affects flora diversity and habitat			X	X		
Introduced marine pests (European shore crab) affects native species	X	X			X	
Introduced marine pests – potential introduction on new species	X	X			X	
Invasive species (carp and gambusia) affect native fish and habitat		X	X	X		X
Decreased freshwater inflows – impacts on breeding triggers for estuarine fish						X
Decreased freshwater inflows – altered water regimes impacts flora and fauna			X	X		X
Decreased freshwater inflows – increased salinity impacts flora and fauna		X	X	X		X
Exposure of acid sulphate soils (ASS)			X	X		X
Disturbance of migratory shorebirds and / or nesting birds by recreational activities (vehicles, people, dogs and noise)	X	X	X	X	X	
Vessels affecting the behaviour and condition of dolphins	X	X				
Recreational vehicles causing physical damage to vegetation and habitat			X	X	X	X
Grazing and trampling on riparian/coastal habitats from deer pigs, goats and rabbits			X	X		X

6 Site management strategies

6.1 Method

6.1.1 Approach

Resource condition targets (RCTs) were developed for priority values to guide the development of appropriate management strategies. RCTs are statements of aspirational condition for each of the identified priority values. How they fit into the planning and the development process is illustrated in Figure 19. As part of Ramsar management planning, Limits of Acceptable Change (LAC) have been developed previously for the site. These are formal instruments against which change in ecological character is assessed and reported to the Convention every three years (see section 2.5 above). RCTs must therefore be set at a level of better condition than LAC. The process for developing the draft RCTs is illustrated in Figure 20.

High level management strategies were developed by the PSC and TAG to meet the RCTs and address critical knowledge gaps (see Table 14 above). Where possible, integration with existing programs was sought, with relevant programs identified. Responsibilities for each management strategies were identified. A cross reference of management strategies with RCTs, priority threats and knowledge gaps was undertaken to ensure that all priority values and threats were included (see Appendix G).

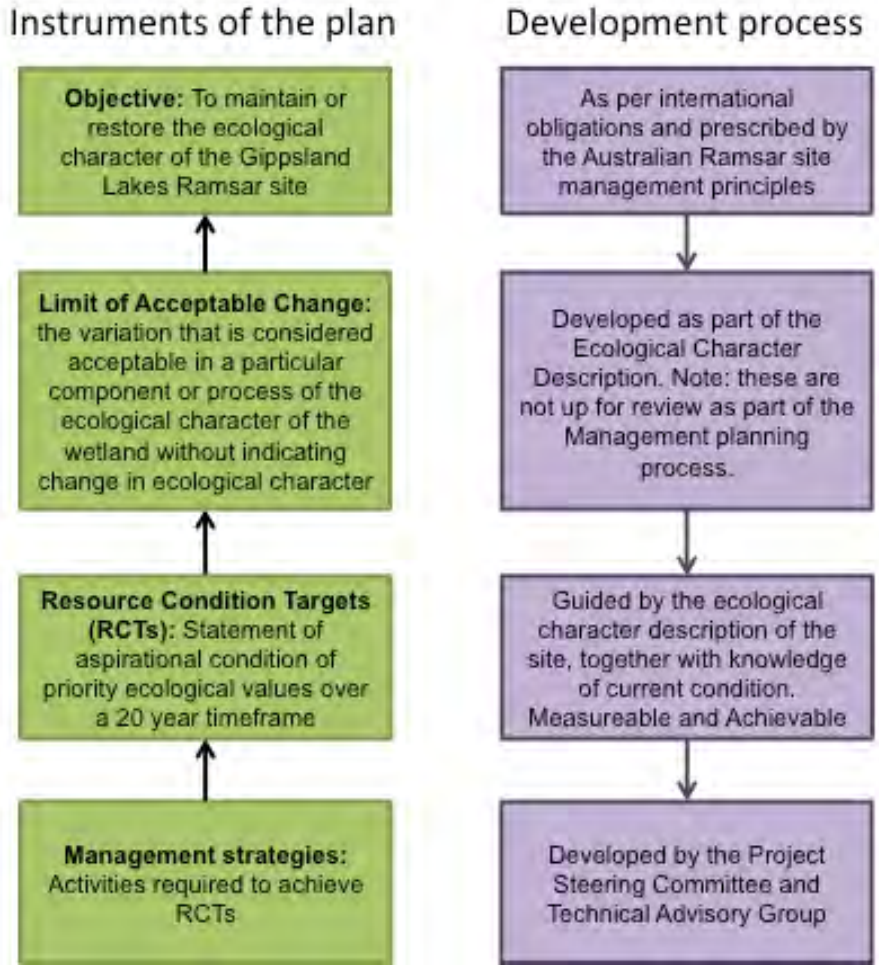


Figure 19: Relationships between the different instruments of the plan and their development process.

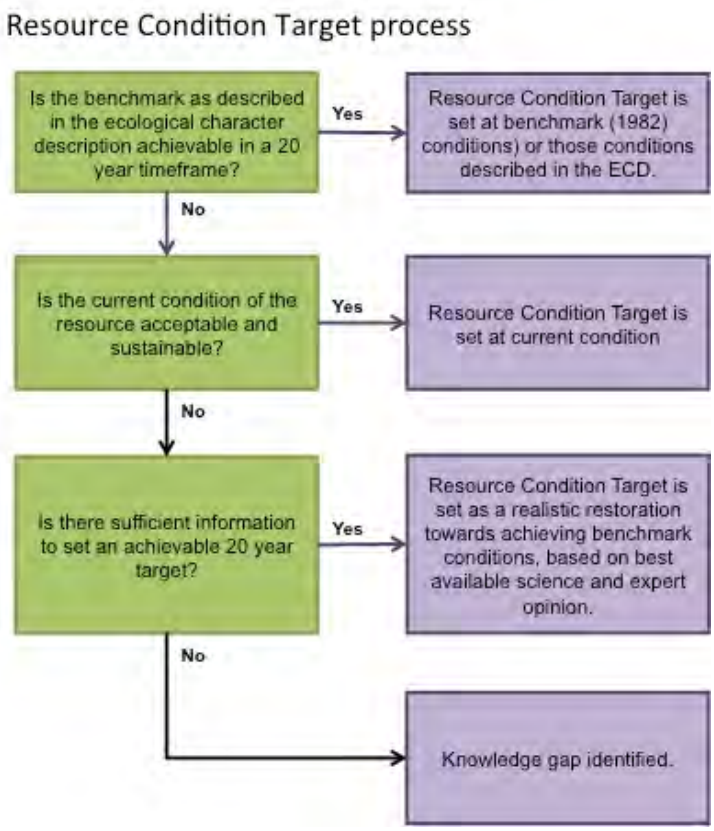


Figure 20: Process for developing RCTs (see Appendix F for baseline descriptions).

6.1.2 Stakeholder involvement

Draft RCTs were developed based on best available information by a team of wetland scientists in consultation with experts on various aspects of the Gippsland Lakes. These draft RCTs were provided to the project steering committee (PSC) and technical advisory group (TAG) members for review. A one day workshop was held in Traralgon on December 9, 2014. Workshop participants were asked to review the RCTs and identify management strategies to meet these targets in their area of interest or expertise. At the workshop, participants worked collaboratively to refine RCTs and identify management strategies.

The outputs of the workshop were used to produce revised RCTs and to assign management strategies to one of five themes:

- Theme 1: Maintaining and restoring habitats
- Theme 2: Protecting fauna
- Theme 3: Managing nutrients and sediments
- Theme 4: Managing water regimes
- Theme 5: Integrating Aboriginal and European knowledge and management
- Theme 6: Improving our understanding.

The indigenous community were provided an opportunity to be involved in the development of the plan via the Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC). A representative of GLaWAC was included n the project steering committee and invited to participate in the workshops. In addition, members of the steering committee met with GLaWAC representatives separately to identify critical values, threats and management actions for indigenous cultural heritage and wise use of the Gippsland Lakes Ramsar Site.

The revised RCTs and management actions were circulated to PSC and TAG members for any further comments, prior to finalisation. The following was posted on the Gippsland Lakes E-engagement website informing the community about the process:

"The renewal of the Gippsland Lakes Ramsar Site Management Plan passed a significant milestone this week with the third and final meeting of the Technical Assessment Group, a collective of scientists, local and State agency staff and locals with expertise about the Lakes' environment. The group has previously identified the threats to the environment and the birds, animals and fish that make the Gippsland Lakes so valuable. The group worked together to identify activities to maintain or improve each aspect of the Lakes' health. The process has identified several areas where there is insufficient knowledge. The draft plan is likely to recommend these for further investigation.

The next step is to collate the material from the workshops, confirm implementation responsibilities and prepare the draft plan. The draft Gippsland Lakes Ramsar Site Management Plan will be available to interested people for comment in Autumn 2015."

6.2 Achievements from the 2003 plan

A large amount of on-ground work and research has been undertaken within the Gippsland Lakes Ramsar Site since the release of the 2003 Ramsar site management plan. A summary of this work, highlighting significant achievements related to maintaining ecological character is provided here for each management agency. Case studies of some key projects demonstrating the breadth of work being undertaken to maintain ecological character are illustrated in Figure 21.

East Gippsland CMA
The East Gippsland CMA has continued to work with other agencies to address key issues in the management of the Gippsland Lakes Ramsar Site. In the term of the Gippsland Lakes Ramsar Site Strategic Management Plan the CMA has implemented and renewed the regional catchment strategy and the regional waterway strategy. As part of the delivery of these strategies, the CMA has been involved in water quality monitoring, maintaining environmental flows, excluding stock, rehabilitating wetlands and improving riparian and shoreline frontages.

West Gippsland CMA
The West Gippsland CMA has formed a number of strategic partnerships to coordinate and maximise effort in works that have contributed significantly to restoring and maintaining the ecological character of the Ramsar site. Specific examples include:

- Together with Wetland Environmental Taskforce (WET) Trust - wetland restoration at Hearth Morass;
- Together with Southern Rural Water, farmers and other partners, developed and implemented the Macalister Nutrient Reduction Program aimed at reducing nutrient and sediment loads to the Gippsland Lakes;
- Together with East Gippsland CMA, led an investigation to improve understanding of the environmental water requirements of the Gippsland Lakes; and
- Secured and delivered environmental water in the Thomson, Macalister and Latrobe river systems; and
- Investigated, designed and delivered on-ground works for environmental water delivery, reinstatement of fish passage, in-stream and bank erosion control and improved in-stream habitat, managing avulsion risk.

Parks Victoria
Parks Victoria has continued on ground actions specifically addressing threats to flora and fauna in parks and reserves in the Ramsar site. This includes ongoing control of significant weeds such as willow, boneseed and blackberry; fencing of reserves and waterways to prevent intrusion by stock; fox baiting in priority areas; forging partnerships with users of parks and reserves (such as hunters) on sustainability and wise use and fire management.

Department of Environment, Land, and Water and Planning
The Department of Environment, Land, and Water and Planning has continued to coordinate the implementation of the Ramsar Convention requirements in Victoria. In 2013, the department released the Victorian Waterway Management Strategy (VWMS), which sets out

Victoria's policy on the management of Ramsar sites, and waterways generally. The Department administered the $10m Gippsland Lakes Environmental Fund, which provided funding to develop and implement the Gippsland Lakes Environmental Strategy by the former Gippsland Lakes Ministerial Advisory Committee from 2011/12 to 2014/15 (inclusive). The Department also developed the Gippsland Region Sustainable Water Strategy in 2011, which set out actions to secure the region's water future. The strategy identifies threats to water availability and policies and actions to help water users, water corporations and catchment management authorities manage and respond to those threats over the next 50 years.

Department of the Environment
The Department of the Environment is responsible for implementing the Ramsar Convention in Australia. Key activities include:

- Developing national guidance on implementing the Convention in Australia
- Providing funds to support the conservation and wise use of Ramsar sites
- Developing Ecological Character Descriptions for all Australian Ramsar sites, including the Gippsland Lakes
- Participating in the Partnership for the Conservation of Migratory Waterbirds in the East Asian – Australasian Flyway
- Participation in international treaties for the protection of migratory birds: Japan-Australia Migratory Bird Agreement, China-Australia Migratory Bird Agreement and the Republic of Korea-Australia Migratory Bird Agreement
- Regularly reviewing Ramsar site condition through the Ramsar Rolling Review
- Working with state and territory governments to promote the conservation Ramsar sites and wise use of all wetlands, and
- Coordinating and facilitating collaboration between the Convention's Oceania member countries.

Former Gippsland Lakes Ministerial Advisory Committee
The Committee operated from 2012 to June 2015. The objectives of the Committee were to:

- Advise the Ministers on matters relating to the health of the Gippsland Lakes and improved decision-making on development within the Lakes region
- Prepare an environmental strategy that considers future development, tourism and fishing; planning processes, research and monitoring, education and community information
- Coordinate government agencies to implement the Strategy and foster better coordinated management of the Lakes

The Committee oversaw the expenditure of the $10 million Gippsland Lakes Environment Fund guided by the Gippsland Lakes Environment Strategy. A large number of projects were funded including on ground works and research to further understanding of the lakes and help maintain ecological character.

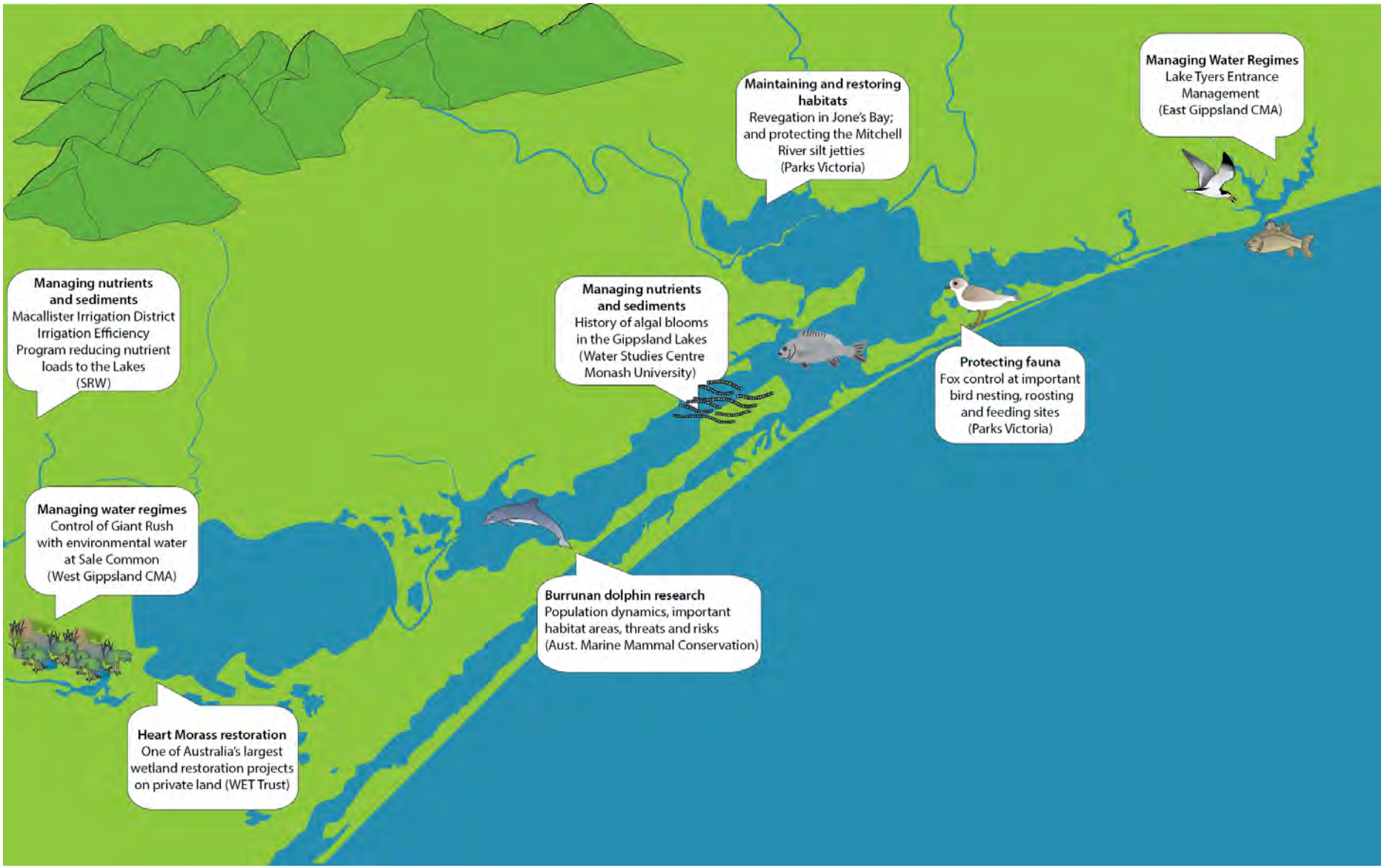


Figure 21: Case studies demonstrating some of the achievements in maintaining ecological character of the Gippsland Lakes Ramsar Site (further details in text boxes in subsequent sections).

6.3 Resource condition targets

A total of 26 Resource Condition Targets have been defined for the Gippsland Lakes Ramsar Site (Table 19). These have helped to guide the identification of management strategies and provide a goal for monitoring the ecological character of the site. Further justification for the development of these RCTs is provided in Appendix F.

Table 19: Resource Condition Targets for the Gippsland Lakes Ramsar Site.

Resource Condition Targets	Associated values
1. The current extent and condition of seagrass in the Gippsland Lakes Ramsar Site will be maintained as indicated by the following: • Maintain extent of seagrass – 4000 to 5000 hectares. • Maintain medium-dense seagrass cover in 25 percent of beds (measured as a long term average over the 20 year timeframe).	Marine sub-tidal beds (seagrass)
2. Lakes Victoria and King remain clear with median secchi depths of > 1 m	Coastal lagoons (open water phytoplankton)
3. A reduction in the number of years in which blue-green algal blooms occur in the lakes to less than five over the 20 years.	
4. Maintain Macleod Morass and Sale Common as freshwater marshes.	Freshwater wetlands
5. Maintain the extent, diversity and condition of freshwater vegetation communities.	
6. Maintain extent of variably saline fringing wetlands.	Brackish wetlands
7. Maintain extent, diversity and condition of native vegetation communities: swamp paperbark (*Melaleuca ericifolia*) woodland and common reed (*Phragmites australis*) emergent macrophyte beds.	
8. Increase the extent and diversity, and improve the condition of native vegetation communities in and around the Heart Morass and other fringing wetlands on private land.	
9. Maintain the extent, diversity and condition of saltmarsh communities	Saltmarsh
10. Total diversity of waterbirds across the site remains above 86.	Abundance and diversity of waterbirds
11. The site supports greater than 20,000 waterbirds in three out of five years.	
12. Maintain successful breeding of little tern and fairy tern, with recruitment of 1.5 chicks per nest.	Threatened species
13. Green and golden bell frog and growling grass frog are recorded at Dutson Downs, Heart Morass, Clydebank Morass, Dowd Morass, Macleod Morass within a 5 year period.	Threatened species
14. Successful breeding of green and golden bell frog and growling grass frog at a minimum of five sites in any five-year period, as evidenced by tadpoles and juveniles.	
15. Maintain native fish species richness, with a minimum of 70 species recorded in the Deep and Shallow lakes over any five-year period (based on Warry and Hindell 2012).	Abundance and diversity of native fish
16. Maintain fish diversity for species within each of the following life history strategy: estuarine dependent, estuarine opportunists, marine migrants, diadromous, and obligate freshwater species.	
17. Maintain sustainable native fish populations of important recreational and commercial fishes.	
18. Maintain hydrological and biotic connectivity between the catchment and the sea.	
19. Maintain populations of dwarf galaxias (*Galaxiella pusilla*).	Threatened species
20. Maintain populations of Australasian bittern (*Botaurus poiciloptilus*)	Threatened species
21. Maintain populations of threatened plant species: dwarf kerrawang (*Commersonia prostrate*); swamp everlasting (*Xerochrysum palustre*); metallic sun-orchid (*Thelymitra epipactoides*), river swamp wallaby grass (*Amphibromus fluitans*).	Threatened species
22. Maintain extent and community composition of Gippsland Red Gum (*Eucalyptus tereticornis* sub spp. *mediana*) Grassy Woodland.	Threatened communities
23. Maintain the existing population of Burrunan dolphins.	Burrunan dolphin
24. Maintain the current (2014) shoreline alignment in priority areas identified in Parks Victoria (2014).	Geomorphic features (silt jetties)
25. Protect regularly used colonial waterbird breeding sites (Pelicans, Darters, Ibis, Pied Cormorants, Little Black Cormorants, Royal Spoonbills)	Waterbird breeding
26. Increase instream habitat (woody debris and in channel vegetation) in the estuarine river reaches	In-stream habitat in riparian reaches

6.4 Theme 1: Maintaining and restoring habitats[3]

6.4.1 Past and current activities

Parks Victoria, DELWP, East and West Gippsland CMAs and Gippsland Ports with partner organisations, community groups and volunteers have been actively involved in a wide range of projects aimed at maintaining and restoring habitats in the Gippsland Lakes. Activities include excluding stock from waterways, improving the condition/health of wetlands, improving riparian and shoreline frontages, active revegetation, weed and invasive native plant species control. Two case studies presented below highlight some of the successes.

Maintaining habitat: The Mitchell River silt jetties

The Mitchell River silt jetties are long, narrow tracts of land that extend almost eight kilometres into Lake King, forming the barrier between Lake King and Jones Bay. They are second in size only to those of Mississippi River that extend into the Gulf of Mexico and are considered significant both nationally and internationally as one of the finest examples of this type of landform in the world (Rosengren 1984).

The origin of the Mitchel River silt jetties has been the subject of scientific debate, with questions raised about how such an extensive formation of sediment could have accumulated from such a relatively small river (Bird 1978). However, the most common theory is that they were formed from the deposition of sediments from the Mitchell River as a type of river delta, with the low wave energy in the waterbodies prior to the permanent opening to the Southern Ocean, accounting for their unusual size (Rosengren 1984).

Since the 1900s, there has been considerable erosion of the silt jetties and surrounding shorelines, with much of the extensive reed beds that once protected these shorelines now gone. In addition, these important features, which provide habitat for a variety of plants and animals, are at risk from sea level rise and climate change (Arrowsmith et al. 2014).

Parks Victoria is leading a collaborative project to protect the silt jetties through a number of on ground management actions.

Shoreline erosion susceptibility (high shown in pink) of the areas around the silt jetties from predicted sea level rise (Arrowsmith et al. 2014).

[3] Restore in this context refers to maintaining ecological character at the time of listing.

Restoring habitat: Revegetation in Jones Bay

Parks Victoria is leading two key projects involving revegetation in the Jones Bay area of the Gippsland Lakes Ramsar Site. These projects complement each other and will provide Jones Bay with buffering protecting from the surrounding private property and industrial estate.

The Jones Bay Wildlife Reserve Revegetation Project

The Jones Wildlife Reserve Revegetation Project is a partnership between Greening Australia and Parks Victoria, funded through Caring For Our Country Grants. The project is based at the northern boundary of the Jones Bay Wildlife reserve area. The objective is to see the currently degraded fringing areas of the reserve enhanced with a diversity of species of native vegetation. This will not only increase the habitat values of the reserve but will also buffer the wetlands from the surrounding land use threats such as nutrient loads and weed seed dispersal. Specifically the project aims to:

- Prioritise the landscape over five years within each work area.
- Revegetate three main vegetation communities (floodplain riparian woodland, estuarine wetland and saltmarsh).

Jones Bay Gippsland Lakes Reserve Revegetation Project EGCMA

The Gippsland Lakes Environment Fund has funded a program of revegetation and habitat protection in the riparian areas of the streams flowing into Jones Bay. The project has provided appropriate financial incentives (in the form of landholder grants) in order to achieve ongoing stock exclusion and weed control on properties adjoining priority riparian areas. To date achievements include:

- 42 hectares protected from livestock
- 20 hectares revegetated
- 6.5 km of fence line constructed
- Revegetation program – 16 550 native seedlings planted throughout 9 protected sites. A further 7 000 seedlings will be planted (in-fill planting where required) within these sites during Autumn 2015.

The revegetation is proving to be very successful at this point –particularly given the challenging planting conditions at some sites. The consistent rainfall throughout spring and summer has been of tremendous benefit.

6.4.2 Management strategies

Many of the habitats of the Gippsland Lakes were identified as priority values for management during the life of this plan on the basis of both their ecological significance, community value and current threats. Direct impacts from physical damage (from erosion or human activities) as well as from introduced plants and animals were identified as critical threats. Twelve management strategies have been developed to meet resource condition targets by maintaining habitat values and addressing priority threats (Table 20). The relationship between management strategies, priority threats and priority values with their associated resource condition targets (RCTs) is provided in Appendix G.

Table 20: Management strategies and responsibilities for maintaining and restoring habitat.

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant mega-habitat(s)
1A. Manage boat and swing moorings to minimize physical damage to seagrass beds.	Gippsland Ports		Deep Lakes Shallow Lakes
1B. Implement island renourishment and re-vegetation.	Gippsland Ports, DELWP, Parks Victoria	On-going active management of sand islands for nesting bird habitat.	Deep Lakes Shallow Lakes
1C. Protect and restore habitat at little tern and fairy tern nesting and post-breeding sites. Manage sea spurge at little tern and fairy tern nesting sites.	DELWP, Parks Victoria	Gippsland Lakes Environment Fund program.	Deep Lakes Shallow Lakes
1D. Improve native vegetation corridors and connectivity within and between all habitat types represented in the Ramsar site.	East and West Gippsland CMAs	East and West Gippsland Regional Waterway Strategies	All
1E. Continue protection and rehabilitation of the Heart Morass.	WET Trust	Heart Morass restoration plan	Variably saline wetlands
1F. Continue strategic protection and rehabilitation of wetlands on private property that contribute to maintaining the ecological character of the Ramsar site.	East and West Gippsland CMAs	Greening Australia Western wetlands protection program	Variably saline wetlands
1G. Implement actions to control invasive native species such as Typha and Giant Rush in freshwater wetlands as required.	Parks Victoria, East and West Gippsland CMAs	DELWP, Parks Victoria Macleod Morass Vegetation Project	Freshwater wetlands
1H. Actively manage priority non-native pest plants.	Parks Victoria	Parks Victoria invasive species strategy	All
1I. Develop and implement instream and riparian habitat protection and/or rehabilitation programs for the estuarine river reaches	East and West Gippsland CMAs	East and West Gippsland Regional Waterway Strategies	Estuarine reaches
1J. Explicitly consider impacts to visual amenity of the landscape when assessing planning applications adjacent to the site	Shire Councils	Gippsland Lakes Sustainable Development Strategy Gippsland Lakes Coastal Action Plan	All
1K. Monitor and where possible control off-road vehicle use at priority locations within the Ramsar site	Parks Victoria		Deep Lakes, Shallow Lakes Hypersaline wetlands
1L. Develop management strategies to maintain and restore the Mitchell River silt jetties	Parks Victoria East Gippsland CMA	Shoreline protection and enhancement of key areas of the Mitchell River Silt Jetties	Deep Lakes

6.5 Theme 2: Protecting fauna

6.5.1 Past and current activities

Protecting fauna in the Gippsland Lakes has been a focus for a number of programs over the past decade. There has been work on controlling introduced animals such as foxes and carp; protection of important nesting sites and raising awareness of the potential harm to shorebirds, nesting birds and dolphins from disturbance and harassment. The case studies presented below illustrate the need for continued protection of the vulnerable fauna of the Gippsland Lakes Ramsar Site.

Protecting fauna: Sea spurge, foxes and nesting terns

Sea Spurge

Sea spurge (*Euphorbia paralias*) is a coastal plant that grows in sandy dunes and is native to southern Europe and northern Africa. It was introduced to Australia via shipping and first recorded in Albany, Western Australia in 1927. The plant is prolific seeder and produces buoyant seeds that were transported by ocean currents spreading east. It was first recorded in Wilsons Promontory in 1982 and in the Gippsland Lakes in 1993 (Heyligers 2002).

Sea spurge spreads quickly across dune areas, displacing the sandy habitat that shore nesting birds such as little tern, fairy tern and hooded plover require for nesting. These birds build a nest in a scrape in the sand and a lack of sandy habitat can reduce breeding success (Mead et al. 2012).

Parks Victoria, the Friends of the Parks and Reserves of the Gippsland Lakes and the Lakes Entrance Community Landcare Group have been working together to control the plant in nesting sites. The timing of the weed control is critical to ensure that nesting birds are not disturbed and the maximum amount of habitat is made available (http://parkweb.vic.gov.au/about-us/news/friends-unite-to-remove-sea-spurge-pest-from-gippsland-lakes).

Gippsland Lakes Coastal Park Fox Control Program

Parks Victoria leads a program of active fox control across 2300 hectares of the Gippsland Lakes Coastal Park taking in Boole Poole Peninsula, Bunga Arm, Rigby Island, Crescent Island, Barton Island and large sections of the 90 Mile Beach from Ocean Grange to Lakes Entrance. This Fox Control program provides protection to native wildlife including the threatened little tern and fairy tern, hooded plover and other significant wetland birds and their breeding habitat. In one form or another the program has been carried out by Parks Victoria and the Department of Environment, Land Water and Planning for more than 15 years.

Photo: Faye Bedford.

Vulnerable fauna: The Burrunan dolphin

In 2011 a new species of dolphin, the Burrunan dolphin (*Tursiops australis*), was described from south-eastern Australia (Charlton-Robb et al. 2011). The Gippsland Lakes is home to one of only two known resident populations of this species, with an estimated resident population size of just 50 individuals (Charlton-Robb et al. 2014). During winter, however, the numbers increase, with over 150 individuals recorded. It is thought that this is due to migration of males between the Gippsland Lakes and Tasmania in a seasonal pattern, arriving in the Gippsland Lakes in winter to breed, then heading south to Tasmania in summer. By contrast, the female population appears to be more sedentary, remaining in the Lakes year round.

The very small population size makes these dolphins vulnerable to human impacts as the loss of only a few dolphins could affect the viability of a population. In February 2014, the species was listed as threatened under the *Flora and Fauna Guarantee Act 1988*.

Of concern are the impacts of tourism and boating on the Burrunan dolphins in the Gippsland Lakes, with the species affected by boat strike and altered behaviour from pursuit. In particular avoidance of boats and tour operators can detract from important activities for dolphins such as feeding and resting and can lead to a decline in their health (Howes et al. 2012, Filby et al. 2014). Managing boating and tourism in the Gippsland Lakes to maintain and improve the condition of the Burrunan dolphin is an important to both maintain dolphin populations and the long term sustainability of dolphin related tourism.

6.5.2 Management strategies

Waterbirds and the Burrunan dolphin were identified as high priority values for management in the next eight years due to their ecological importance and identified high risks (see Table 18). In addition, introduced marine pests were identified as a priority threat in the main lakes with the potential to impact on native fauna through competition and predation. Six management strategies have been identified to protect fauna (Table 21). The relationship between management strategies, priority threats and priority values with their associated resource condition targets (RCTs) is provided in Appendix G.

Table 21: Management strategies and responsibilities for protecting fauna.

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant mega-habitat(s)
2A. Control of introduced predators in priority bird areas	Parks Victoria, DELWP	Biodiversity programs by Parks Victoria and DELWP	All
2B. Increase signs in priority migratory wader and nesting bird habitats to reduce disturbance	Parks Victoria, DELWP	Biodiversity programs by Parks Victoria and DELWP	Deep Lakes Shallow Lakes
2C. Identify key nursery areas for the Burrunan dolphins	DELWP	AMMCF (Australian Marine and Mammal Conservation Foundation)	Deep Lakes, Shallow Lakes, Estuarine reaches
2D. Investigate the risk posed by human disturbance to migratory waders develop and implement feasible actions to address the risks	Parks Victoria, DELWP		Shallow Lakes, Variably saline and hypersaline wetlands
2E. Develop and implement a public awareness campaign to reduce harassment and boating injuries to Burrunan dolphins	DELWP / Gippsland Ports	AMMCF	Deep Lakes, Shallow Lakes, Estuarine reaches
2F. Implement an introduced marine pest strategy for the Gippsland Lakes	DELWP	GLMAC: Introduced marine pest investigation	Deep Lakes, Shallow Lakes

6.6 Theme 3: Managing nutrients and sediments

6.6.1 Past and current activities

Nutrient and sediment inputs to the Gippsland Lakes have been the subject of extensive investigation and committed on-ground management actions. In the past decade, our understanding of the triggers for algal blooms and nutrient and sediment sources has been greatly improved. In addition, agencies such as the West and East Gippsland CMAs have worked with landholders, industry and communities to try and reduce the loads of nutrients and sediments entering the Gippsland Lakes from the catchment. The two case studies reflect both the improvement in our knowledge and the achievements of on ground actions.

The impacts of increased nutrients: the history of algal blooms

A study of the long-term history of algal blooms in the Gippsland Lakes from sediment cores indicates that there are two distinct periods of blue-green algal blooms in the Lakes (Holland et al. 2013a). The first was prior to the permanent opening of the entrance to the Southern Ocean, and it is thought that the intermittently closed and open lagoon system was eutrophic. This is followed by a period immediately post construction of the channel at Lakes Entrance in 1889 of low algal growth, as the system filled and flushed with marine water. The second period of increased algal blooms occurred more recently with seven diatom / dinoflagellate blooms recorded between 1985 and 2012 (Day et al. 2011). Post 1986, a number of blooms of the blue-green algae *Nodularia spumigena* were recorded across Lake King and Lake Victoria (Webster et al. 2001, Beardall 2008, Day et al. 2011) and in 2007, for the first time a bloom of the cyanobacterium *Synechococcus* spp. extended across large areas of the main lakes for over five months (Beardall 2008, Day et al. 2011). In 2011 *N. spumigena* again bloomed across the Lakes from December 2011 to April 2012 causing the closure of fisheries, a second bloom occurred the following summer, but lasted a shorter period of time (Holland et al. 2013b).

Algal blooms are linked to periods of increased nutrients, which arrive in large loads following heavy rainfall and in extreme loads following widespread bushfires in the catchment. Erosion from cleared land and degraded river banks are a significant source of sediment and nutrients (Hancock et al. 2007). The West and East Gippsland CMAs and other agencies such as Southern Rural Water have a number of programs in place to address nutrient and sediment movement from the catchment to the Lakes to help manage algal blooms and protect the ecological character of the Gippsland Lakes Ramsar Site.

Reducing nutrient and sediment inflows to the Gippsland Lakes: Macalister Irrigation District Irrigation Efficiency Incentives Program

The Macalister Irrigation District Nutrient Reduction Plan (MID NRP) was developed in 1998 to reduce the amount of phosphorus leaving the district in drainage water and to lower the likelihood of algal blooms in the Gippsland Lakes. The plan identified more efficient use of irrigation water, fertilisers and dairy waste as the best way to achieve this outcome.

The MID NRP has now been replaced by the Macalister Land and Water Management Plan (MLWMP), which aims to improve not only the health of the Gippsland Lakes, but also the condition of a range of assets including productive farmland, wetlands and native vegetation. The plan recognises that more efficient use of irrigation water remains one of the best ways to minimise offsite impacts of irrigation.

Financial assistance has been available to MID farmers under the incentives program since July 2000 to help irrigators plan and implement improved irrigation practices on farms.

Projects completed to June 2014

Activity	No. of projects completed	Area serviced (hectares)	Estimated water savings (ML)	Estimated phosphorus savings (tonnes)
Irrigation farm planning	404	33,869	na	na
Irrigation re-use systems installed	221	11,127	22,000	84
Flood to spray irrigation conversions	126	4,039	8,000	32

6.6.2 Management strategies

Nutrient and sediment inflows from the catchment to the main lakes were identified as one of the highest priority threats for this Ramsar site management plan (see Table 18). Impact pathways from general agricultural run-off and elevated nutrient and sediment loads following bushfires, were identified as high risks for seagrass, waterbirds (including the threatened species little tern and fairy tern), visual amenity, recreation and tourism (Table 8). A single integrated management strategy has been identified to address this important issue and maintain ecological character (Table 22). The relationship between management strategies, priority threats and priority values with their associated resource condition targets (RCTs) is provided in Appendix G.

Table 22: Management strategies and responsibilities for managing nutrients and sediments.

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant mega-habitat(s)
3A. Reduce nutrient and sediment loads to the Gippsland Lakes through riparian, in-stream and catchment works to improve water quality of river flows to the Gippsland Lakes.	East and West Gippsland CMAs DEDJTR	Riparian, in-stream and catchment works in the East and West Gippsland Regional Catchments Strategies and Regional Waterway Strategies Existing Parks Victoria vegetation management programs CORE 4 program in dryland and irrigated areas of West Gippsland MID extension and incentives program SEPP Waters of Victoria (currently under revision)	Deep Lakes Shallow Lakes

6.7 Theme 4: Managing water regimes

6.7.1 Past and current activities

In the past decade there have been significant developments with respect to environmental water management in the Gippsland Lakes and catchment. Environmental water management arrangements have been established for rivers flowing into the Gippsland Lakes and used to "*preserve environmental values and health of water ecosystems including their biodiversity, ecological functioning and quality of water and other uses that depend on the environmental condition."* East and West Gippsland CMAs have worked with storage operators, water entitlement-holders and land-holders to maximise the environmental benefits from the environmental water and integrate it with other waterway management works and measures. In addition, there has been considerable effort into maintaining connectivity and managing the opening of estuaries, such as Lake Tyers. The two case studies below provide examples of both these functions.

Managing water regimes: Lake Tyers Entrance Management

Lake Tyers is naturally an intermittently open and closed coastal lagoon that remains closed for periods of time due to sand accumulation at the entrance. The system opens naturally following heavy rainfall, or can be opened artificially by excavator.

Extended periods of closure have been known to result in:

- A decline of seagrass health and cover;
- Water quality decline, including low dissolved oxygen leading to fish deaths;
- Loss of connectivity for fish species that migrate from the rivers and estuaries to the sea;
- Potential flooding of beach nesting sites for little tern and fairy tern; and
- If water levels exceed 1.9 m AHD, inundation of assets such as jetties, fish cleaning stations and boat ramps.

Artificially opening of Lake Tyers can have impacts to nesting birds (near the entrance location), and on the feeding opportunities for these birds near their nesting locations.

To maximise the benefits for environmental and social assets at Lake Tyers, East Gippsland CMA has developed and is implementing an Estuary Entrance Management Protocol. This provides a systematic and coordinated approach to entrance opening. The decision to artificially open the estuary entrance will be based on several factors. The main physical factors considered are staff and contractor safety, the level of the water in the estuary, the predicted tide levels at sea, the forecast weather conditions and the distance of the sand between the beach and the estuary. These factors determine whether there is a safe worksite and suitable gradient across the sand so that the entrance will scour sufficiently for the entrance to have the best chance to stay open.

The main environmental factors considered are the oxygen levels in the estuary at the time of the proposed opening. Low levels of oxygen have the potential to impact fish after opening if the oxygenated water drains from the top layers and forces fish into the deeper oxygen depleted water.

Managing water regimes: Sale Common

Dense stands of the native plant Giant Rush (*Juncus ingens*) colonised large areas of previously open water in Sale Common in early 2009. This dramatic vegetation change occurred during a prolonged dry period that extended from the summer of 2008 to spring 2010. The species grows best in shallowly flooded or waterlogged sediments over summer, and so was able to take advantage of the lower water levels over this period. Vandalism of the Sale Common water control structure that connects the wetland to the Latrobe River in spring 2009 is thought to have further encouraged the growth and spread of the rush. Initially water levels rose rapidly to almost fill the wetland. Water levels subsequently receded as water flowed back into the falling river, leaving shallow water across the wetland and creating optimal conditions for Giant Rush to thrive.

Giant Rush can provide excellent habitat for cryptic waterbird species such as bitterns, crakes and rails, and some colonial nesting species such as ibis. It can also become invasive however, creating tall dense stands that reduce overall habitat diversity. There was some concern that Giant Rush could permanently dominate much of the previously 'open' water areas of Sale Common without management intervention. Such a major shift in plant communities is undesirable because it has the potential to decrease the ecological value of the wetland.

The West Gippsland CMA, in collaboration with Parks Victoria, responded to the vegetation change by developing a management strategy aimed at reducing the extent and density of Giant Rush. The strategy was to 'drown' the rush as the seedlings and young plants are thought to be intolerant of long-term submergence. This was to be done by artificially filling the wetland using the Latrobe River regulator in spring 2010, and maintaining high water levels for approximately three years. Nature assisted the chosen watering strategy by completely filling Sale Common in September 2010 and maintaining high water levels through rainfall and natural over-bank flooding for the majority of the last four years. Natural inundation was supplemented with artificial watering in autumn 2013. West Gippsland CMA and Parks Victoria worked closely with VicRoads during the realignment of the South Gippsland Highway in 2010-2011 to ensure that water was retained in the wetland whilst de-watering of the footings for the new road bridges occurred adjacent to the Common.

The water management strategy has achieved the result it sought: a reduction in the extent and density of Giant Rush across Sale Common, in order to restore the mosaic of different vegetation types.

6.7.2 Management strategies

Altered water regimes in the fringing wetlands and the estuarine river reaches of the Gippsland Lakes Ramsar Site were identified as a priority threat for this Ramsar site management plan, with the potential to impact ecological character through changes in salinity, vegetation diversity and extent, disruption of bird breeding cycles and a loss of breeding triggers for estuarine fish (Table 18). Four management strategies have been identified in this plan to address this issue, supporting the existing work that is currently being undertaken in the Ramsar site (Table 23).

Table 23: Management strategies and responsibilities for managing water regimes.

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant mega-habitat(s)
4A. Undertake regular planning, delivery, monitoring and evaluation of the use of environmental water entitlements in the lower Latrobe wetlands (Sale Common, Heart Morass, Dowd Morass) and the Latrobe River estuary.	West Gippsland CMA Parks Victoria Victorian Environmental Water Holder	West Gippsland CMA environmental water program. Gippsland Region Sustainable Water Strategy	Fresh and variably saline wetlands Estuarine river reaches
4B. Investigate, and where feasible and cost effective, implement actions that enable and facilitate effective management of the water and salt regimes of priority fringing wetlands, including Sale Common, Heart Morass, Dowd Morass, Lake Reeve and Macleod Morass. For example: technical studies, management plans and/or agreements, water entitlements, on-ground works, operational management and monitoring.	East and West Gippsland CMA Parks Victoria Victorian Environmental Water Holder Wellington Shire Council East Gippsland Water, Department of Environment, Land, Water and Planning	West Gippsland CMA environmental water program Gippsland Region Sustainable Water Strategy	Fresh, variably saline and hypersaline wetlands
4C. Maintain and where necessary improve hydrological connectivity and freshwater inflows to the Gippsland Lakes for fish migration and breeding.	East and West Gippsland CMAs	East and West Gippsland Regional Waterway Strategies	Deep Lakes, Shallow Lakes, Estuarine river reaches
4D. Develop and implement a procedure for the management of estuary mouth closures for Lake Tyers and Merriman Creek	West and East Gippsland CMAs	East Gippsland CMA estuary opening strategy for Lake Tyers West Gippsland Regional Waterway Strategy	Deep Lakes Estuarine river reaches

6.8 Theme 5: Integrating Aboriginal and European knowledge and management

6.8.1 Aboriginal cultural values of the Gippsland Lakes

The Gunaikurnai people have been custodians of the waterways in the Gippsland region, including the wetlands and rivers of the Ramsar site, for thousands of years. Waterways were, and remain important to Aboriginal people, providing the following values (Leggett 2013):

- **Food** - fishing, collecting mussels, catching eels, hunting animals, collecting swan eggs, and gathering of various plants for food and medicine;
- **Implements** – materials for basket weaving, grinding stones in river beds, ochre for ceremony, bark for canoes;
- **Culture** - Water bodies are important places for our people to come together for cultural, social and recreational activities. In the past, these sites were important meeting places for different clans to conduct business such as trade; and
- **Travel and boundaries** – Rivers provided the tribal boundaries for our region, they were where our people waited to be welcomed on to neighbouring country, they were also an important means of travel both by foot and on water.

Aboriginal values of the Gippsland Lakes: The Dreaming

Creation story of the Gunaikurnai people

The father of the Gunaikurnai people was Borun the pelican, he came down from the mountains in the North West of Victoria carrying his canoe on his head, he crossed over what is now known as the Thompson River at Sale, and walked on to Tara Warackel (Port Albert) in the west. While walking he heard a constant tapping sound but did not know what it was. When he reached the deep water of the inlets, Boorun put down his canoe and, much to his surprise, there was a woman in it. She was Tuk the musk duck.

He was very happy to see her and she became his wife and the mother of the Gunaikurnai people – they are the parents of the five Gunaikurnai clans.

Tiddalik the frog

Tiddalik the frog was a giant frog, the largest frog that had ever been, one day he woke up very thirsty, he drank and drank until there was no fresh water left in the region. The creatures and plants were all dying and it seemed that soon Tiddalik would be the only one still alive.

The animals did not know what to do, until a wise old wombat suggested that if they could make Tiddalik laugh then all of the water would flow out of his mouth.

So all of the animals gathered at the frogs resting place, for a long time they tried to make him laugh, but he would not. The kookaburra told his funniest stories, he himself had a good laugh, the kangaroo jumped over the emu, the lizard waddled around on two legs, but the frog did not laugh.

All the animals were reaching the point of despair when the eel, driven from his favourite creek by the drought, slithered up to the frog and began to dance. He started with slow, graceful movements, then moved faster and twisted and turned himself into weird and wonderful shapes, then suddenly Tiddalik the frog's eyes bulged, his body shook, and he began to laugh. As he laughed all of the water escaped from his mouth and caused a big flood which filled up all of the lakes and swamps and rivers.

6.8.2 Threats to Aboriginal cultural values of the Gippsland Lakes

To a large extent, the threats and risks to the ecological character of the Ramsar site are equally applicable to Aboriginal cultural values. Reduced water quality, pollution, pest plants and animals and inappropriate development have all been identified as impacting on the cultural values of the waterways (Leggett 2013).

In additional, there are several other issues of concern particular to the Aboriginal cultural values of the site. These include:

- Physical damage and erosion to burial sites and other physical artefacts / significant sites.
- Unmanaged public access to shell middens and other important sites
- Restricted Aboriginal access to important sites due to private land ownership.

Threats to Aboriginal cultural values: Legend Rock

The Legend Rock, an important part of Gunaikurnai mythology, lies in shallow water by the shore of Bancroft Bay, opposite the Metung Yacht Club in Tatungooloong Country.

One day, some fisherman who had hauled in many fish with their nets, ate their catch around their campfire. The women, guardians of the social law, saw that the men had eaten more than enough but had not fed their dogs. As a punishment for their greed the fishermen were turned to stone.

The Legend Rocks hold great spiritual value to the Gunaikurnai people and the story serves as a great legend for its people to remember the laws of the land.

There were originally three rocks in the formation at Metung, unfortunately two were destroyed during road construction along the shore of Bancroft Bay in the 1960s. The last rock was preserved when community members and Gippsland and East Gippsland Aboriginal Cooperative had an injunction issued. The Legend Rock continues to be protected under the Aboriginal Heritage Act (2006) of Victoria.

http://www.batalukculturaltrail.com.au/legend_rock.php

In October 2010, the Gunaikurnai were granted Native Title over nine national parks and one reserve in the Gippsland region, with joint management overseen by the Traditional Owner Land Management Board (TOLMB). This includes a number that are wholly or partly within the Gippsland Lakes Ramsar Site:

- Gippsland Lakes Coastal Park
- The Lakes National Park
- Lake Tyers State Park
- Raymond Island Gippsland Lakes Reserve

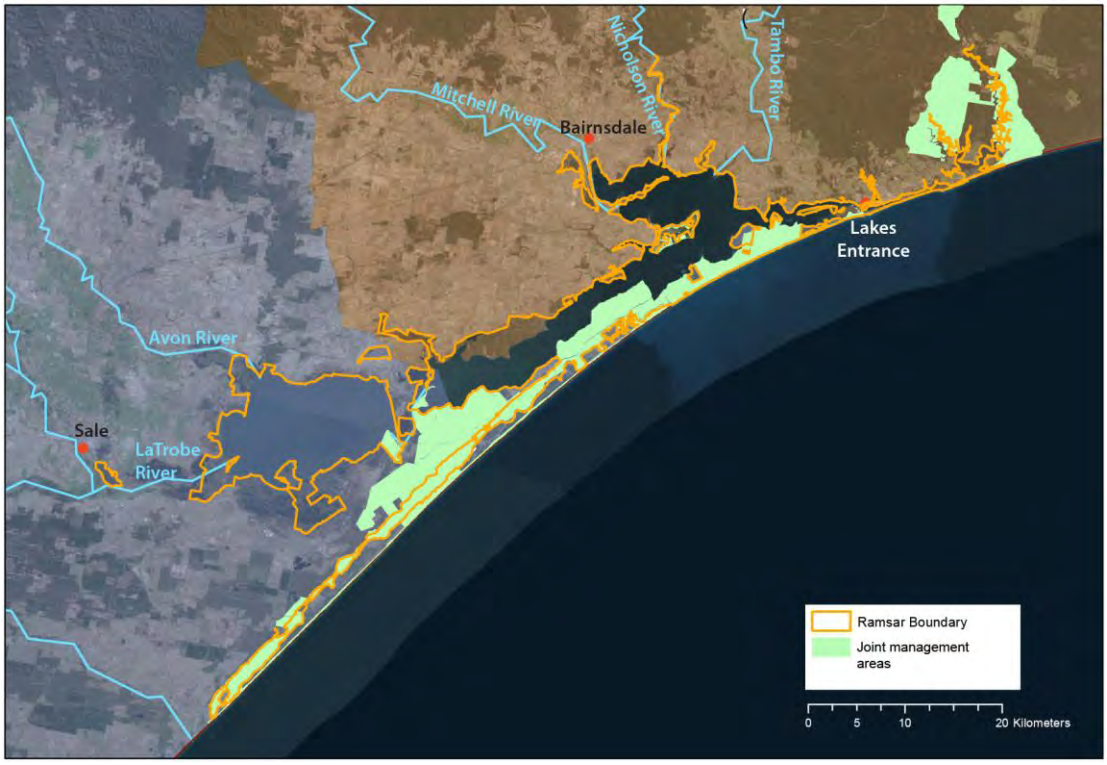


Figure 22: Joint management areas and the Ramsar site boundary.

Joint management benefits both Gunaikurnai and the wider community through recognising Aboriginal culture and knowledge, providing quality tourism experiences, improved public education and by conserving, protecting and enhancing natural and cultural values. Joint

management has enabled increased funding to support joint management and employ Gunaikurnai people to work on country. This will result in healthier parks and better visitor experiences. Currently, Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) has a team of six on-ground rangers undertaking a range of management works in these parks. TOLMB is leading the development of joint management plans for each park to help guide works priorities and actions and is working closely with GLaWAC and Parks Victoria to do this.

6.8.3 Aboriginal priority management strategies

The Gunaikurnai Whole of Country Plan is being developed by GLaWAC with the assistance of Native Title Serves Victoria. The plan will guide the activities of GLaWAC and TOLMB across the region. The plan establishes some guiding principles, which are equally applicable to the management of the Aboriginal cultural values of the Gippsland Lakes Ramsar Site (see text box). Management strategies related to Aboriginal cultural values of the Ramsar site are provided in Table 24.

Table 24: Management strategies and responsibilities for integrating Aboriginal and European knowledge and management.

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant mega-habitat(s)
5A. Implement joint management of the Gippsland Lakes Coastal Park, The Lakes National Park, Lake Tyers State Park and Raymond Island Gippsland Lakes Reserve	GLaWAC Parks Victoria	Whole of Country Plan and Joint Management Plans currently under development	Deep lakes, Shallow Lakes, Hypersaline wetlands
5B. Deliver training and knowledge to increase the capacity of the Aboriginal community to be involved in the management of the Ramsar site	GLaWAC		All
5C. Conduct a comprehensive survey of all waterways in the Ramsar site with respect to cultural significance.	GLaWAC		All
5E. Recognise the cultural value of water bodies, collect data on cultural flows and to take steps to ensure that these values are included in decisions regarding Ramsar site management	GLaWAC		All
5F. Develop and implement traditional ecological knowledge projects within the Ramsar site	GLaWAC		All

Whole of Country Principles

We have cultural obligations
It is our inherent responsibility to look after Country – to heal the damage of the past and protect it for future generations.

Everything is connected
All of our Country is linked. There is no separation between our landscapes, waterways, coasts and oceans, natural and cultural resources. All are linked to our people, law and custom.

Every bit matters
We understand the need to prioritise limited resources to where important values are under threat, but every part of our Country remains important to us. Our values exist even when you can't see them – whether they are under water, deep inside caves, covered with vegetation, they are still important to us.

Don't wait until it is gone
When you lose a site it is gone forever. We need to act now to prevent any further loss of environmental or cultural values.

Look at what was there before
When we are healing and restoring degraded landscapes, we should try and put back the plants and animals that used to be there.

Sustainable use
Our approach to managing Country is to balance resource use with conservation – they are part of the same. Take only what you need – leave some for others.

Seek collective benefits
We use our resources for the benefits of the mob rather than seek individual gain.

We have a right to be on our Country
Traditional Owners should not be restricted in accessing our traditional Country. At the same time, we should have the right to restrict access to others who disrespect and damage our sensitive areas.

Our traditional knowledge is valuable
Our traditional practices and approaches sustained the land for thousands of years. Our Country should be managed in harmony with our traditional ways. We need to take the time to understand what natural and cultural heritage exists out on Country. It can't be managed properly if we don't know what is there.

6.9 Theme 6: Improving our understanding

Twenty-three priority knowledge gaps were identified during the development of the Gippsland Lakes Ramsar Site Management Plan (Table 14). Some of these are addressed through monitoring activities (see section 7) and 15 management strategies have been developed to address the remainder (Table 25).

Table 25: Management strategies to address critical knowledge gaps.

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant mega-habitat(s)
6A. Investigate priority species and locations for waterbird breeding and migratory wader refuges within the Ramsar site. Assess that habitat requirements are being met at priority locations.	DELWP	Oil Spill Response Atlas (OSRA) Gippsland Lakes Hotspots Project – BirdLife East Gippsland	All
6B. Assess the distribution of heavy metals and other contaminants (including mercury) in the Gippsland Lakes and the level of risk (i.e. bioavailability).	EPA Victoria, DHHS	Current EPA desktop review of sources.	Deep Lakes, Shallow Lakes, Estuarine reaches
6C. Investigate the risks of toxicants (steroid hormones) in Macleod Morass.	EPA Victoria, Parks Victoria East Gippsland CMA		Freshwater wetlands
6D. Investigate the cues for migration and recruitment of native fish	DELWP	Current research on black bream in the Latrobe River, including tracking (West Gippsland CMA)	Deep Lakes, Shallow Lakes, Estuarine reaches
6E. Assess the impacts of blue-green algal blooms on waterbird populations and recruitment success	DELWP		Deep Lakes, Shallow Lakes
6F. Assess variability in the extent and condition of seagrass, including environmental thresholds for change	DELWP		Deep Lakes, Shallow Lakes
6G. Investigate the habitat use and requirements for Australian grayling within the Ramsar site	DELWP		Deep Lakes, Shallow Lakes, Estuarine reaches
6H. Assess the importance of estuarine reaches to amphibians, aquatic reptiles and mammals	DELWP		Estuarine River Reaches
6I. Investigate the risk associated with and potential mitigation strategies for climate change impacts to ecological character of the Ramsar site	DELWP East and West Gippsland CMAs		All
6J. Investigate the impacts of altered freshwater inflows on nutrient cycling and productivity in the Deep Lakes, including thresholds for change	DELWP		Deep Lakes
6K. Investigate the impact of high nutrient and sediment loads to fresh and variably saline wetlands following bushfires	DELWP East and West Gippsland CMAs		
6L. Investigate feasible management options for the control of invasive freshwater fish (carp and gambusia)	DELWP		Fresh and variably saline wetlands
6M. Investigate options for improving the ecological condition of Lake Wellington.	DELWP		Shallow Lakes
6N. Investigate the non-breeding habitat requirements of threatened frog species	DELWP		Fresh and variably saline wetlands

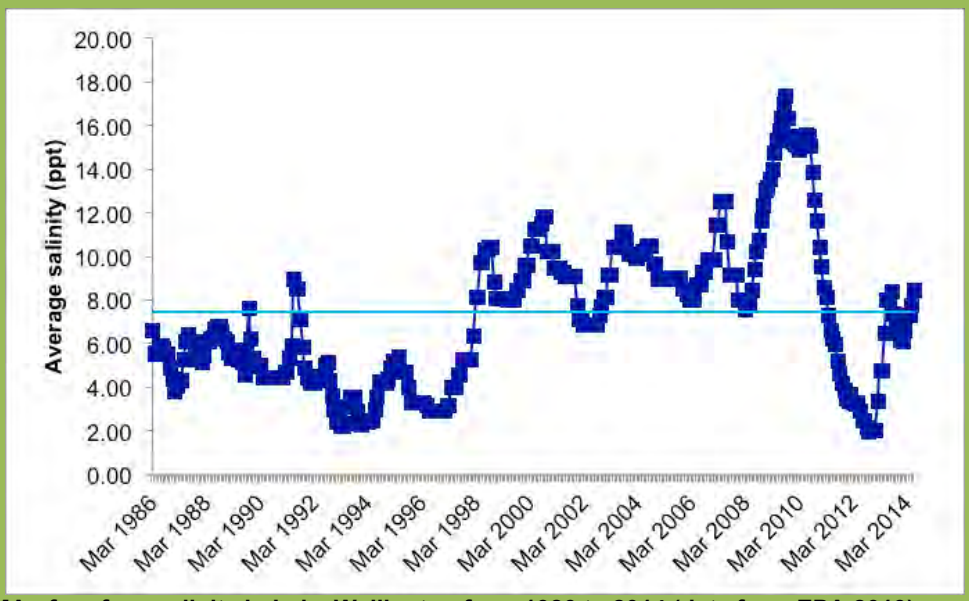
Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant mega-habitat(s)
6O. Awareness raising/education about the Ramsar Convention, the condition of the Gippsland Lakes, environmental impact assessment, management options and implications.	DELWP East and West Gippsland CMAs		All

Improving our understanding: Setting realistic goals for Lake Wellington

Approximately 20 percent of the total average freshwater inflow to the Gippsland Lakes is extracted for consumptive use, particularly from the western rivers (Tilleard and Ladson 2010). Flows in the Latrobe River system are also highly modified by the Thomson, Glenmaggie and Blue Rock Dams. The combined effects of extraction and storage result in a reduction of freshwater inflow into Lake Wellington of more than one third (O'Connor et al. 2009).

This reduction in freshwater inflows has been identified as the critical factor affecting salinity (and the rise of salinity) in Lake Wellington (Tilleard et al. 2009, Ladson et al. 2011). The reduction in freshwater inflows results in increased saline water flowing from Lake Victoria through McLennan Strait into Lake Wellington (Tilleard et al. 2009, SKM 2010). This then has follow-on effects of the back flow of saline water from Lake Wellington into many of the fringing wetlands (Boon et al. 2007).

Salinity in Lake Wellington has risen since the time of listing as evidenced by the Exponentially Weighted Moving Average (EWMA) chart below. This chart highlights trends in salinity, indicating that there was a significant rise starting in the mid to late 1990s, with a reduction in salinity following heavy rains in 2010/2011. Without active management of water, Lake Wellington is likely to continue to increase in salinity, becoming more marine in nature; particularly under future climate scenarios (SKM 2010, Ladson et al. 2011).



EWMA of surface salinity in Lake Wellington from 1986 to 2014 (data from EPA 2013).

Management of salinity in Lake Wellington is complex and it is not likely that the system could be restored to a previous state. To successfully improve the ecological condition of Lake Wellington, careful consideration of the options and setting realistic management goals will be required. A strategic action of this Ramsar Site Management Plan is specifically directed at the issue:

"*Investigate options for improving the ecological condition of Lake Wellington*."

Improving our understanding: the issue of mercury

Information on toxicant concentrations in the waters and sediments of the Gippsland Lakes is limited. However, over the past 30 years, there have been several studies that have indicated that mercury may be of concern in the main lakes (Glover et al. 1980, Harris et al. 1998, Fabris et al. 1999).

There are a number of known sources of mercury in the Gippsland Lakes catchment. This includes:

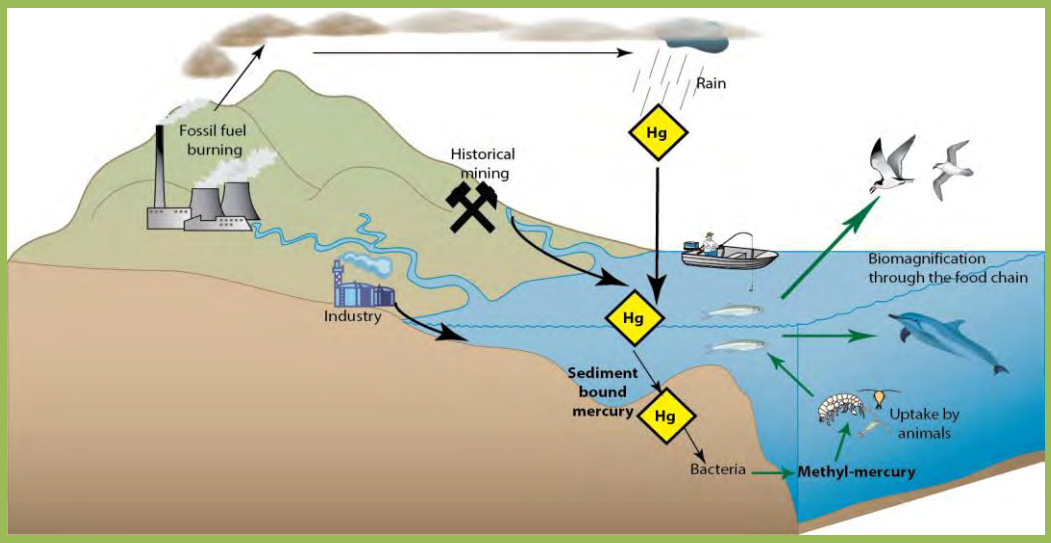
1. Gold mining in the 19th and 20th Centuries - Mercury was used to extract the gold from the crushed ore. The waste crushed rock, containing small amounts of mercury, was often discharged directly to waterways. This mercury could have remained in streams, but a portion at least has probably been washed into the sediments of the Lakes.
2. Coal-fired power stations - Reports from China (Wang et al. 2000) and the USA (USEPA 2008) indicate that coal-fired power stations are the single largest known source of mercury emissions. Although the amount of mercury in coal is very small, the large amount of coal burned each year (currently over 30 million tonnes annually in the Latrobe Valley) could mean a significant amount of mercury in the atmosphere. This can be washed into the Lakes with rain.
3. Mercury may naturally occur in bedrocks and sediments of the catchment.

Metal and organic toxicants are usually transported in aquatic system attached to sediment particles. Sediment particles transported down rivers and streams will ultimately settle out in lakes, estuaries and embayments. The Gippsland Lakes may therefore contain contaminants that have been transported down the rivers in its catchment.

Measures of mercury in the sediments of the Gippsland Lakes were made in 1979 and these indicated very high concentrations; with a mean of 43 mg/kg (dry weight) and a maximum of 100 mg/kg (Glover 1980). More recent studies indicated low, but possibly increasing concentrations of mercury in fish (Fabris et al. 1999). Elevated concentrations of mercury have also been recorded in the tissues of the Burrunan dolphin from Port Phillip Bay and the Gippsland Lakes (Monk et al. 2014).

The high concentration in the sediment does not necessarily mean that there is an impact on human health or the health of plants and animals that live in the Gippsland Lakes. Most of the mercury in the sediment will be in solid form, bound to sediment particles. In this form, mercury is not readily bio-available. Under certain conditions (like low oxygen levels) bacteria in the sediment can convert the mercury from the solid form to methyl mercury, which is very fat soluble and can be absorbed by animal cells. In addition, mercury is known to bioaccumulate, with concentrations increasing as animals up the food chain consume animals containing mercury.

There are currently information gaps regarding what form the mercury is in in the sediment and under what circumstances it could be released. An action has been proposed in Table 26 to address this information gap.



7 Monitoring, evaluation, reporting and improvement

7.1 Framework

Consistent with the *Victorian Waterway Management Strategy* (VWMS), the Ramsar Convention and the Australian Ramsar Management Principles, this Gippsland Lakes Ramsar Site Management Plan adopts an adaptive management approach. The Gippsland Lakes Ramsar Site Management Plan sits within the broader framework of the VWMS (Department of Environment and Primary Industries 2013) as a component of regional waterway management planning (Figure 23). The Gippsland Lakes Ramsar Site Management Plan will be renewed every eight years and is underpinned by a monitoring program that reports on the condition of the system with respect to change in ecological character and progress towards meeting resource condition targets.

Figure 23: The eight-year adaptive management cycle of the Victorian Waterway Management Program, noting that this Ramsar management plan is a part of the regional waterway management planning process (adapted from Department of Environment and Primary Industries 2013).

7.2 Monitoring programs

Monitoring recommendations to assess progress towards resource condition targets and change in ecological character (i.e. evaluate critical components, processes and services against LAC) are provided in Table 26. Consistent with the principles of the Gippsland Lakes Ramsar Site Management Plan, responsible agencies have been identified, as have linkages to existing, relevant programs. Linkages with resource condition targets, knowledge gaps and relevant mega habitats are provided in Appendix G. Full monitoring programs, together with monitoring targeted at assessing the implementation of the plan will be required in the next phase of implementation planning (see section 8). It should be noted that many of the existing programs have limited funding and timelines and a full assessment of ongoing monitoring against monitoring needs will be required as part of implementation planning.

Table 26: Monitoring program for the Gippsland Lakes Ramsar Site.

Recommended monitoring				Linkages to existing programs / activities
Program	**Indicators and method**	**Frequency**	**Responsibility**	
Seagrass	Extent (mapping consistent with Roob and Ball 1997) and condition (consistent with recent programs e.g. Warry and Hindell 2012).	Mapping every five years. Condition every two years.	DELWP	Proposed mapping to be undertaken in 2015 by Monash University, DELWP (Arthur Rylah Institute).
Water quality monitoring in priority lakes and wetlands	Salinity, dissolved oxygen, water clarity, nutrients (dissolved and total) and chlorophyll-a Algal species and enumeration	Monthly and event based (i.e. more frequent sampling during, algal blooms)	EPA Victoria, DELWP, West Gippsland CMA	Current water quality monitoring by EPA Victoria covers Deep and Shallow Lakes. Suggest expand to include: Sale Common, Macleod Morass, Lake Reeve and priority estuarine reaches.
Sediment quality monitoring in lakes and wetlands	Nutrients, toxicants	Every five years	EPA Victoria, DELWP	Not currently included in any routine monitoring programs.
Mapping of wetland (including saltmarsh) vegetation communities in the Ramsar site.	Mapping of wetland EVCs, consistent with that of Boon (2011) and current WGCMA mapping.	Every ten years	DELWP, Parks Victoria, East and West Gippsland CMAs	Boon et al (2011) mapped saltmarsh communities. Current mapping of wetland Ecological Vegetation Classes in West Gippsland CMA region (lower Latrobe wetlands only). Needs to be expanded to East Gippsland CMA Region.
Condition assessments of priority vegetation communities: Freshwater marshes Swamp paperbark Common reed emergent beds Saltmarsh River Red Gum grassy woodland Riparian vegetation	A purpose built condition assessment that measures: Species composition and abundance (cover); Invasive species Structure Recruitment	Every ten years	DELWP, Parks Victoria, East and West Gippsland CMAs	No current programs in place.
Monitoring of threatened plant species: dwarf kerrawang (*Commersonia prostrate*); swamp everlasting (*Xerochrysum palustre*); and metallic sun-orchid (*Thelymitra epipactoides*), River swamp wallaby grass (*Amphibromus fluitans*).	Extent and condition	Annual	DELWP, Parks Victoria	Existing monitoring and protection programs for a selected group of threatened plants are in place by DELWP and Parks Victoria.

Recommended monitoring				Linkages to existing programs / activities
Program	**Indicators and method**	**Frequency**	**Responsibility**	
Waterbird counts and breeding records (including for cryptic species such as the Australasian bittern).	Abundance of each species, and evidence of breeding. Build on existing programs, but with a preference for a total wetland / site count at priority locations (can use a combination of aerial survey, with ground / boat surveys).	Annual	DELWP, Parks Victoria	Current: Shorebirds 2020; Waterfowl annual counts (game species); nesting tern monitoring; and DELWP Hotspot program. Needs to be expanded to include an annual count at all priority locations in the site and targeted to specific species.
Frog monitoring: adults and tadpoles / juveniles	Audio monitoring of calls Fyke net trapping of tadpoles	Annual	DELWP, Parks Victoria	DELWP Hotspot currently monitors adults through calls.
Native fish: abundance and species	Purpose built monitoring program will need to be developed. Different methods will be required for wetland vs open water habitats. At a minimum surveys should measure abundance and community composition. Consideration given to population age structure, perhaps via the use of otolith samples for a subsample of common species.	Annual	DELWP	Current (historic) sampling in the Deep and Shallow Lakes only. Needs to be expanded to include sampling in the freshwater wetlands and estuarine reaches.
Abundance and population structure of Burrunan dolphins	Using the methods developed by Kate Charlton-Robb, for visual surveillance	Annual	DELWP	Current program funded by Gippsland Lakes Environment Fund, but is not on-going.

8 Governance and Implementation

8.1 Governance

The roles and responsibilities for managing Ramsar sites is set out in *Wetlands in Australia – Roles and Responsibilities*. Management of Ramsar sites in Victoria is coordinated by the Victorian Government, through the Department of Environment, Land, Water and Planning (DELWP). Relevant international, national and Victorian state policy and legislation is listed in Section 1.2.

This Gippsland Lakes Ramsar Site Management Plan is an integral component of a continuing program to develop a current management framework for Victoria's Ramsar sites.

8.2 Implementation

The East Gippsland CMA will co-ordinate implementation of this Gippsland Lakes Ramsar Site Management Plan, on behalf of regional agency partners.

A Ramsar Steering Committee (RSC) comprising representatives of the partner agencies primarily responsible for the management of the Ramsar site (East and West Gippsland CMAs, DELWP, Parks Victoria, GLaWAC and DoE) will be convened and co-ordinated by East Gippsland CMA.

8.2.1 Implementation planning

Each of the agency delivery partners (East and West Gippsland CMAs, DELWP, Parks Victoria, GLaWAC and DoE), will prepare agency implementation plans for the actions for which they are identified as responsible in the Gippsland Lakes Ramsar Site Management Plan, by 30 June 2016. Each agency will work within their established legislative, regulatory and administrative arrangements.

The East Gippsland CMA will integrate these agency plans into a single implementation plan for the Gippsland Lakes Ramsar Site Management Plan by December 2016 to ensure that the responsibilities for individual management actions are clearly established, priorities and sequencing is logical, implementation is focused and coordinated, and funding opportunities are identified.

The plan will also establish monitoring, evaluation and reporting (MER) requirements.

The implementation plan will be regularly reviewed to maintain its currency and relevance.

8.2.2 Ramsar Steering Committee

The Ramsar Steering Committee will be convened and co-ordinated by East Gippsland CMA. This integration approach builds on previous and current collaboration practice in the region, evident most recently in the strong participation of delivery partners in the development of the Gippsland Lakes Ramsar Site Management Plan.

The Ramsar Steering Committee will be responsible for coordinating specific aspects of implementation within the themes of the Gippsland Lakes Ramsar Site Management Plan. These responsibilities will include developing:

- implementation targets
- action planning, updated annually
- targeted investment proposals
- integrated delivery arrangements
- coordinated monitoring and evaluation of implementation, including integrated reporting against targets; and
- reviewing Management Plan progress bi-annually.

8.2.3 Targets

The ability to measure progress in implementation of the Gippsland Lakes Ramsar Site Management Plan will be improved by the setting of appropriate targets that express what management actions are intended to achieve over the term of the Gippsland Lakes Ramsar Site Management Plan. East Gippsland CMA will work with the Ramsar Steering Committee to establish implementation targets which are SMART (Specific, Measurable, Agreed, Realistic, and Time-based), and are set over an appropriate timeframe, ranging from three years to the eight year life of the Gippsland Lakes Ramsar Site Management Plan.

Targets will describe the expected cumulative results arising from management activities directed to achievement of the Resource Condition Targets within the Gippsland Lakes Ramsar Site Management Plan. The East Gippsland CMA will co-ordinate reporting against targets to DELWP.

8.2.4 Resourcing implementation

Investment proposals to support actions of the Gippsland Lakes Ramsar Site Management Plan will be developed as investment opportunities arise. Project investment proposals will be prepared through the Ramsar Steering Committee in conjunction with delivery partners and will be structured to reflect the themes within the Gippsland Lakes Ramsar Site Management Plan, and the regional programs of partner managing agencies.

Implementation of the Gippsland Lakes Ramsar Site Management Plan will be influenced by available funding and resources. The implementation approach that will be applied will coordinate the prioritisation of management actions so that maximum benefit is achieved with the resources that are available.

Annual priorities and programs will be developed to best match the funding cycles of investors. Throughout the implementation of the Gippsland Lakes Ramsar Site Management Plan the East Gippsland CMA will work with the Ramsar Steering Committee to use the best available information tools to support the establishment of annual priorities. East Gippsland CMA will also work with the Ramsar Steering Committee to maintain the currency and accuracy of data and information to support implementation.

Partners will seek funding for implementation of this plan through the:

- Victorian Waterway Management Program;
- Relevant initiatives of the State and Federal Governments;
- Existing agency budgets; and
- Contributions of industries and communities.

8.3 Communication

The East Gippsland CMA will co-ordinate communications and engagement for the Ramsar site as part of its role in co-ordinating implementation of the Gippsland Lakes Ramsar Site Management Plan.

8.4 Ramsar Administration

The development of the plan identified a number of administrative matters to resolve. These are described, with a brief rationale in Table 27.

Table 27: Matters related to the administering of the Ramsar Convention and the Gippsland Lakes Ramsar Site.

Management Strategies	Responsibility	Rationale
7A. Review the Ramsar site boundary	DELWP DoE Ramsar Steering Committee	The Ramsar site boundary was delineated at the time of listing in 1982 and more recently described in detail (DEPI 2013). Since 1982, there have been some changes to land management and an increased understanding of the aquatic ecosystems in the region and their values. A review of the boundary to consider adjoining areas based on ecological function in a changing climate is proposed.
7B. Update the Ramsar Information Sheet	DELWP DoE Ramsar Steering Committee	Ramsar information sheets (RIS) are scheduled for review and updating every six years. The most recent RIS for the Gippsland Lakes Ramsar Site is 1999, making it past due for review. There is significant additional data, and updated criteria for which the site should be assessed.
7C. Review and where necessary update Limits of Acceptable Change, in particular for areas that are currently not covered by current LAC such as Lake Tyers.	DELWP DoE Ramsar Steering Committee	Since the development of the ECD, there has been further research and information available for the site. Some of this data may prove useful in informing LAC for the site. It is anticipated that this review could be considered in the next Ramsar Rolling Review for the Gippsland Lakes Ramsar Site.
7D. Apply the appropriate State and Commonwealth environmental impact assessment processes for activities that have the potential to impact on the Ramsar site and Matters of National Environmental Significance (MNES).	DELWP DoE Ramsar Steering Committee	Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), actions that have, or are likely to have, a significant impact on a matter of national environmental significance require approval from the Australian Government Minister for the Environment (the Minister). The responsibility for referral of an action lies with the proponent. The Minister decides whether assessment and approval is required under the EPBC Act. Ramsar sites are one of the nine MNES and so assessments would be required for any activity that is likely to impact on the ecological character of the site, whether inside the site or in the catchment.
7E. Undertake a regular review of the status of the ecological character of the Ramsar site. This review should include new and emerging issues as well as the current listed values and threats	DELWP	The Ramsar Rolling Review is undertaken every three years and reports on the status of ecological character of the Ramsar site. As new knowledge on the values and threats within the Ramsar site becomes available (e.g. new species supported in a changing climate), this should be incorporated into the sites ecological character and management planning.
7F. Develop implementation plans for this strategy	East Gippsland CMA with Ramsar Steering Committee DELWP	This plan has identified high level strategies for a number of agencies. Implementation plans, together with resourcing need to be developed within the first 12 months.

Reviewing the boundary: Heart Morass

Need

Heart Morass is a variably saline fringing wetland along the shores of Lake Wellington. It has declined in condition due to altered water and salinity regimes and past grazing. In 2006, the wetland dried completely for the first time. Heavy grazing of the property up until this time meant that the ground layer of vegetation was absent. The dry, dusty conditions and salt-encrusted wetland bed created a symbolic "blank canvas" from which the restoration project began.

Planning

The project is built around a partnership between five key organisations, Bug Blitz Trust, Field and Game Australia, Hugh Williamson Foundation, Watermark Inc. and West Gippsland CMA. It aims to inspire and be inspired by the local community by restoring the values of the historic wetland. It is a unique partnership between hunters, conservationists and government which aspires to develop the Heart Morass Wetland as an icon. This is achieved by enhancing biodiversity, water quality and recreational and social values within the Heart Morass and through its contribution towards the health of the Gippsland Lakes.

A community project has developed to support the purchase of over 1,000 hectares of the wetland area and undertake one of the largest restoration projects in Australia on private land.

Works

The partnership has:

- planted more than 60 000 indigenous trees, shrubs and grasses
- direct seeded indigenous vegetation including grasses and rushes on five hectares of the wetlands
- controlled weeds including blackberry, boxthorn and invasive grasses
- developed a seed collection program from over 50 wetland and riparian plant species to support future revegetation efforts
- constructed a new gravel road surface and parking area
- managed existing drain entrances to maintain water levels in the wetland and rock beaching at the entrance of two main drains
- removed over 20 tonnes of carp.

Outcomes

The recent purchase of an additional 245 hectares brings the entire area of woodlands and wetlands under management as part of the Heart Morass Restoration Project to 1,370 hectares. Of this 1,125 hectares is now covered by a protective covenant with Trust for Nature, one of the largest in Victoria.

Much of the ecosystem, including all of the newly acquired land by the WET Trust is outside the current Gippsland Lakes Ramsar Site boundary. There is an opportunity to reassess the boundary and recognise the significant work of volunteers, show casing the principles of Wise Use at this wetland.

Map of Heart Morass with the Current Gippsland Lakes Ramsar Site Boundary in pink.

9 References

Allinson, G. (2009). An assessment of xenobiotic chemicals in (and entering) the Gippsland Lakes: sources and potential ecological risks. Department of Primary Industries, Queenscliff, Victoria.

Arrowsmith, C., Race, G., and Rosengren, N.J. (2014). Gippsland Lakes/90 Mile Beach Local Coastal Hazard Assessment Project: Report 4 Lakes Shoreline Erosion Hazard. Water Technology.

Barter, M. (1995). For the record - large numbers of Red-necked Stint and Banded Stilt at Lake Reeve. Stilt **26**: 36.

Beardall, J. (2008). Blooms of Synechococcus An analysis of the problem worldwide and possible causative factors in relation to nuisance blooms in the Gippsland Lakes. School of Biological Studies, Monash University, Clayton, Victoria.

Berra, T.M. (1982). Life history of the Australian grayling, Prototroctes maraena (Salmoniformes: Prototroctidae) in the Tambo River, Victoria. Copeia: 795–805.

Bird, E.C.F. (1978). The geomorphology of the Gippsland Lakes region. Ministry for Conservation, Victoria.

BMT WBM. (2010a). Ecological Character Description of the Gippsland Lakes Ramsar Site. Australian Government Department of Sustainability, Environment, Water, Population and Communities, Canberra.

BMT WBM. (2010b). Ecological Character Description for the Kakadu National Park Ramsar Site. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Boon, P.I., Raulings, E., Morris, K., Roache, M., Robinson, R., Hatton, M., and Salter, J. (2007). Ecology and management of the Lake Wellington wetlands, Gippsland Lakes: a report on the R&D project, 2003-2006. Victoria University and Monash University, Clayton, Victoria.

Boon, P.I., Raulings, E., Roach, M., and Morris, K. (2008). Vegetation Changes Over a Four Decade Period in Dowd Morass, a Brackish-Water Wetland of the Gippsland Lakes, South-Eastern Australia. Proceedings of the Royal Society of Victoria **120**(2): 403–418.

Boon, P.J., Allen, T., Brook, J., Carr, G., Frood, D., Harty, C., Hoye, J., McMahon, A., Mathews, S., Rosengren, N.J., Sinclair, S., White, M., and Yugovic, J. (2011). Victorian Saltmarsh Study: Mangroves and coastal saltmarsh of Victoria: distribution, condition, threats and management. Institute for Sustainability and Innovation, Victoria University, Melbourne, Australia.

Boon, P.J., Rosengren, N.J., Frood, D., Oates, A., and Reside, J. (2014). Shoreline Geomorphology and Fringing Vegetation of the Gippsland Lakes. Institute for Sustainability & Innovation Victoria University, Melbourne, Australia.

Borg, D. and Savage, G. (2005). Heart Morass Feasibility Study. GHD, Morwell, Victoria.

Brandis, K. (2010). Colonial waterbird breeding in Australia: Wetlands, water requirements and environmental flows. University of NSW.

Burger, J., Howe, M.A., Hahn, D.C., and Chase, J. (1977). Effects of tide cycles on habitat selection and habitat partitioning by migrating shorebirds. The Auk **94**(4): 743–758.

Butcher, R., Brooks, S., Cottingham, P., Hale, J., and Watkins, D. (2011). Ramsar Rolling Review. Australian Government Department of Sustainability, Environment, Water, Population and Communities.

Calder, D., Cropper, S., and Tonkinson, D. (1989). The Ecology of Thelymitra epipactoides F Muell (Orchidaceae) in Victoria, Australia, and the Implications for Management of the Species. Australian Journal of Botany **37**(1): 19–32.

Carter, O. and Walsh, N. (2010a). National Recovery Plan for the Swamp Everlasting Xerochrysum palustre. Department of Sustainability and Environment, East Melbourne.

Carter, O. and Walsh, N. (2010b). National Recovery Plan for the Dwarf Kerrawang Rulingia prostrata. Dept. of Sustainability and Environment, East Melbourne.

Charlton-Robb, K., Gershwin, L., Thompson, R., Austin, J., Owen, K., and McKechnie, S. (2011). A New Dolphin Species, the Burrunan Dolphin Tursiops australis sp. nov., Endemic to Southern Australian Coastal Waters. PLoS ONE **6**(9): e24047.

Charlton-Robb, K., Taylor, A.C., and McKechnie, S.W. (2014). Population genetic structure of the Burrunan dolphin (Tursiops australis) in coastal waters of south-eastern Australia: conservation implications. Conservation Genetics.

Clemann, N. and Gillespie, G.R. (2012). National Recover Plan for the Southern Bell Frog. Department of Sustainability and Environment, East Melbourne.
Clemens, R., Oldland, J., Berry, L., and Purnell, C. (2009). Shorebirds 2020 Migratory Shorebird Population Monitoring Project. Birds Australia, Carlton, Victoria.
Cole, M.L., Leslie, D.M., and Fisher, W.L. (2002). Habitat use by shorebirds at a stopover site in the southern Great Plains. The Southwestern Naturalist **47**(3): 372.
Connolly, B. and Brain, P. (2009). Economic Impact of the 2008 Blue Green Algal Bloom on the Gippsland Tourism Industry. Nexus Consulting, Bairnsdale, Victoria.
Cook, P., Holland, D., and Longmore, A. (2008). Interactions between phytoplankton dynamics, nutrient loads and the biogeochemistry of the Gippsland Lakes. Monash University, Clayton, Victoria.
Cook, P.L.M. and Holland, D.P. (2012). Long term nutrient loads and chlorophyll dynamics in a large temperate Australian lagoon system affected by recurring blooms of cyanobacteria. Biogeochemistry **107**(1-3): 261–274.
Corrick, A.H. and Norman, F.I. (1980). Wetlands of Victoria I. Wetlands and waterbirds of the Snowy River and Gippsland Lakes catchment. Proceedings of the Royal Society of Victoria **91**(1): 15.
Coutin, P.C., Reside, J., and Cowx, I.G. (2003). Fish predation by great cormorants, Phalacrocorax carbo carboides, in the Gippsland Lakes, south-eastern Australia. Interactions between fish and birds: Implications for management: 196–210.
Crook, D.A., Macdonald, J.I., O'Connor, J.P., and Barry, B. (2006). Use of otolith chemistry to examine patterns of diadromy in the threatened Australian grayling Prototroctes maraena. Journal of Fish Biology **69**(5): 1330–1344.
Davis, C.A. and Smith, L.M. (2001). Foraging strategies and niche dynamics of coexisting shorebirds at stopover sites in the southern great plains. The Auk **118**(2): 484–495.
Davis, J. and Brock, M. (2008). Detecting unacceptable change in the ecological character of Ramsar wetlands. Ecological Management & Restoration **9**(1): 26–32.
Day, P., Cribb, J., and Burgi, A. (2011). The ecology of algal blooms in the Gippsland Lakes. Gippsland Lakes and Catchments Task Force, Bairnsdale, Victoria.
Department of Environment and Primary Industries. (2013). Improving our waterways: Victorian waterway management strategy.
Department of Environment and Primary Industries. (2014). Commercial catch for each major species caught in Gippsland Lakes and Lake Tyers during 1978/79–2010/11.
Department of Primary Industries. (2011). Fisheries Status Report 2010. State of Victoria, Melbourne, Australia.
Department of Sustainability and Environment. (2003). Gippsland Lakes Ramsar Site: Strategic Management Plan. Dept. of Sustainability and Environment, East Melbourne.
Department of the Environment, Water, Heritage and the Arts. (2008). National framework and guidance for describing the ecological character of Australian Ramsar Wetlands: module 2 of the National Guidelines for Ramsar Wetlands - implementing the Ramsar Convention in Australia. Dept. of the Environment, Water, Heritage and the Arts, Canberra.
Department of the Environment, Water Heritage and the Arts. (2009). National guidance on notifying change in ecological character of Australian Ramsar Wetlands (Article 3.2): module 3 of the National Guidelines for Ramsar Wetlands - implementing the Ramsar Convention in Australia. Dept. of the Environment, Water, Heritage and the Arts, Canberra, A.C.T.
DSE. (2013). Indicative Assessment of Climate Change Vulnerability for Wetlands in Victoria. Department of Sustainability and Environment, East Melbourne.
Earth Tech. (2003). Sale Common Ramsar Wetlands: A Background Paper reviewing available literature on the Sale Common Ramsar Wetlands and identifying information gaps. Vic Roads.
East Gippsland CMA. (2014). East Gippsland Waterway Strategy. Coramgamite CMA, Colac, Victoria.
EPA Victoria. (2008). Gippsland Lakes Blue-Green Algae Monitoring Program 2006-07. Report to the Gippsland Lakes Task Force.
EPA Victoria. (2013). Gippsland Lakes Condition Report 1990 - 2011. EPA Victoria, Carlton, Victoria.

Ethos NRM. (2011). Upper Macleod Morass: Vegetation Distribution Assessment. Bainsdale Field and Game Association, Bairnsdale, Victoria.
Fabris, G. (2012). Lake Wellington Mercury Pilot Study. Department of Primary Industries.
Fabris, G., Theodoropoulos, T., Sheehan, A., and Abbott, B. (1999). Mercury and Organochlorines in Black Bream,< i> Acanthopagrus butcheri</i>, from the Gippsland Lakes, Victoria, Australia: Evidence for Temporal Increases in Mercury levels. Marine pollution bulletin **38**(11): 970–976.
Filby, N.E., Stockin, K.A., and Scarpaci, C. (2014). Long-term responses of Burrunan dolphins (Tursiops australis) to swim-with dolphin tourism in Port Phillip Bay, Victoria, Australia: A population at risk. Global Ecology and Conservation **2**: 62–71.
Forests Commission. (1983). Wetlands Nominated by the State of Victoria for Inclusion on the List of Wetlands of International Importance. State of Victoria, Melbourne, Australia.
Fryer, J.J. and Easton, A.K. (1980). Hydrodynamics of the Gippsland Lakes. *In* 7th Australasian Conference on Hydraulics and Fluid Mechanics 1980: Preprints of Papers. Institution of Engineers, Australia. p. 500.
Gauthreaux Jr, S.A. and Belser, C.G. (2006). Effects of artificial night lighting on migrating birds. *In* Ecological Consequences of Artificial Night Lighting. *Edited by* C. Rich and T. Longcore. Island Press, Washington, USA. pp. 67–93.
Gillespie, G.R. (1996). Distribution, habitat and conservation status of the green and golden bell frog Litoria aurea (Lesson 1829)(Anura: Hylidae) in Victoria. Australian Zoologist **30**(2): 199–207.
GLMAC. (2013). Gippsland Lakes Environmental Strategy. Gippsland Lakes Ministerial Advisory Committee, Bairnsdale, Victoria.
Glover, J., Bacher, G., and Pearce, T. (1980). Gippsland Regional Environmental Study: Heavy Metals in Biota and Sediments of the Gippsland Lakes. Arthur Rylah Institute for Environmental Research, Heidelberg, Victoria.
Grayson, R. (2006). Prioritising nutrient reduction for the Gippsland Lakes and catchments - Part 1 - Loads and Sources. Catchment to Sea Pty Ltd.
Grayson, R., Candy, R., Tan, K.S., McMaster, M., Chiew, F., Provis, D., and Zhou, S. (2004). Gippsland Lakes: Flood Level Modelling Project. Centre for Environmental Applied Hydrology, University of Melbourne.
Grigg, N., Webster, I., Parslow, J., and Sakov, P. (2004). Sensitivity analysis of the CSIRO model for the Gippsland Lakes. CSIRO.
Grose, M., Abbs, D., Bhend, J., Chiew, F., Church, J., Ekstrom, M., Kirono, D., Lenton, A., Lucas, C., McInnes, K., Moise, A., MonselesanD., Mpelasoka, F., Webb, L., and Whetton, P. (2015). Southern Slopes Cluster Report, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports. *Edited by*M. Ekstrom, P. Whetton, C. Gerbing, M. Grose, L. Webb, and J. Risby. CSIRO and Bureau of Meteorology, Australia.
Gross, J. (2003). Developing Conceptual Models for Monitoring Programs. NPS Inventory and Monitoring Program, USA.
Harris, G., Batley, G., Webster, I.T., Molloy, R., and Fox, D. (1998). Gippsland Lakes Environmental Audit: Review of Water Quality and Status of the Aquatic Ecosystems of the Gippsland Lakes. CSIRO, Melbourne.
Healey, C. (2013). Wetland birds in the Gippsland Lakes important bird area: Diversity and reporting rates over 26 years. The Chat **58**: 7–9.
Heyligers, P.C. (2002). The spread of the introduced Euphorbia paralias (Euphorbiaceae) along the mainland coast of southeastern Australia. Cunninghamia.
Hindell, J.S., Jenkins, G.P., and Womersley, B. (2008). Habitat utilisation and movement of black bream Acanthopagrus butcheri (Sparidae) in an Australian estuary. Marine Ecology Progress Series **366**: 219–229.
Holland, D. and Cook, P. (2009). November 2008 Gippsland floods - potential impact on the Gippsland Lakes. Water Studies Centre, Monash University, Clayton, Victoria.
Holland, D., Cook, P., Beardall, J., and Longmore, A. (2009). Gippsland Lakes "Snapshot" – Nutrient Cycling and phytoplankton population dynamics. A report prepared for the Gippsland Lakes and Catchment Task Force. Water Studies Centre, Monash University, Clayton, Victoria.
Holland, D., Jennings, M., Beardall, J., Gell, P., Phuong, D., Mills, K., Briles, C., Zawadzki, A., and Cook, P. (2013a). Two hundred years of blue-green algae blooms in the Gippsland Lakes. Water Studies Centre, Monash University, Clayton, Victoria.

Holland, D., Woodland, R., and Cook, P. (2013b). Ecological impacts of a Nodularia bloom on nitrogen dynamics in food webs and seagrass beds. Water Studies Centre, Monash University, Clayton, Victoria.
Howes, L., Scarpaci, C., and Parsons, E.C.M. (2012). Ineffectiveness of a marine sanctuary zone to protect burrunan dolphins (Tursiops australis sp. nov.) from commercial tourism in Port Phillip Bay, Australia. Journal of Ecotourism **11**(3): 188–201.
Kemp, J., Brown, L., Bridge, N., and Conron, S. (2013). Black Bream Stock Assessment 2012. Department of Primary Industries, Queenscliff, Victoria.
Koehn, J.D. and O'connor, W.G. (1990). Threats to Victorian native freshwater fish. Victorian Naturalist **107**(1): 5–12.
Ladson, A. (2012). Importance of catchment-sourced nitrogen loads as a factor in determining the health of the Gippsland Lakes. Gippsland Lakes and Catchments Task Force, Melbourne, Australia.
Lawrence, D.P. (2013). Impact Assessment: Practical Solutions to Recurrent Problems and Contemporary Challenges. Wiley.
Leggett, M. (2013). Gippsland Regional Water Strategy: Gunaikurnai Land and Waterways Aboriginal Corporation Input Paper. West Gippsland CMA.
McInnes, K., Macadam, I., and Hubbert, G.G. (2013). Climate Change in Eastern Victoria Stage 3 Report: The effect of climate change on extreme sea levels in Corner Inlet and Gippsland Lakes. CSIRO Marine and Atmospheric Research.
McMastera, M.J., Provisb, D.G., Graysona, R.B., and Bishopb, W.A. (2003). Calibration and testing of a hydrodynamic model of the Gippsland Lakes. *In* Proc., Int. Congress on Modelling and Simulation (MODSIM 2003). Modelling and Simulation Society of Australia and New Zealand. pp. 909–914.
Monk, A., Charlton-Robb, K., Buddhadasa, S., and Thompson, R.M. (2014). Comparison of Mercury Contamination in Live and Dead Dolphins from a Newly Described Species, Tursiops australis. PLoS ONE **9**(8): e104887.
Montevecchi, W. (2006). Influences of artifical light on marine birds. *In* Ecological Consequences of Artificial Night Lighting. *Edited by* C. Rich and T. Longcore. Island Press, Washington, USA. pp. 94–112.
Parks Victoria. (2005). Macleod Morass and Jones Bay Wildlife Reserves: management plan February 2005. Parks Victoria, Melbourne.
Parks Victoria. (2007). Lake Wellington Wetlands management plan. Parks Victoria, Melbourne.
Primary Industries Research Victoria. (2006). Port Phillip Bay Channel Deepening Project Supplementary Environment Effects Statement, Aquaculture and Fisheries. Primary Industries Reserach Victoria, Queenscliff, Victoria.
Ramm, D.C. (1986). An ecological study of the ichthyoplankton and juvenile fish in the Gippsland Lakes, Victoria. University of Melbourne.
Ramsar Convention. (2005). Resolution IX.1 Annex A. A Conceptual Framework for the wise use of wetlands and the maintenance of their ecological character.
Ramsar Convention. (2009). Strategic Framework for the List of Wetlands of International Importance, Third edition, as adopted by Resolution VII.11 (COP7, 1999) and amended by Resolutions VII.13 (1999), VIII.11 and VIII.33 (COP8, 2002), IX.1 Annexes A and B (COP9, 2005), and X.20 (COP10, 2008).
Reynolds, S., Arrowsmith, C., and Womersley, T. (2011). Review of Hydrodynamic and Salinity Effects Associated with TSHD on the Gippsland Lakes. Water Technology, Notting Hill, Victoria.
Roob, R. and Ball, D. (1997). Seagrass: Gippsland Lakes: a report for Fisheries Victoria, Department of Natural Resources and Environment. Marine & Freshwater Resources Institute, [Melbourne].
Rosengren, N.J. (1984). Sites of geological and geomorphological significance in the Gippsland Lakes catchment. Dept. of Conservation, Forests and Lands, [Melbourne].
Santos, C.D., Miranda, A.C., Granadeiro, J.P., Lourenço, P.M., Saraiva, S., and Palmeirim, J.M. (2010). Effects of artificial illumination on the nocturnal foraging of waders. Acta Oecologica **36**(2): 166–172.
Schmidt, D.J., Crook, D.A., O'Connor, J.P., and Hughes, J.M. (2011). Genetic analysis of threatened Australian grayling Prototroctes maraena suggests recruitment to coastal rivers from an unstructured marine larval source population. Journal of Fish Biology **78**(1): 98–111.

Sjerp, E., Riedel, P., Martin, B., and Bird, E. (2002). Gippsland Lakes Shore Erosion and Revegetation Strategy. Gippsland Coastal Board, Bairnsdale, Victoria.
SKM. (2001). Lake Wellington Catchment Salinity Management Plan Wetlands Monitoring Project. Part A: Analysis and interpretation of wetland monitoring data. Department of Natural Resources and Environment, Melbourne, Australia.
SKM. (2004a). Lake Coleman Salt and Water Balance Study. SKM, Maffra, Victoria.
SKM. (2004b). Hydrology and Management of Lake Reeve. SKM, Maffra, Victoria.
SKM. (2008). Impacts of Bushfires on Water Quality in the Gippsland Lakes: Exploring Options for Mitigation. Sinclair Knight Merz, Melbourne, Australia.
Taylor, H.L. (2011). The current status of acid sulfate soils, their severity and associated environmental implications from the Heart Morass and Dowd Morass, West Gippsland, Victoria. Monash University, Clayton, Victoria.
Tilleard, J. and Ladson, A. (2010). Understanding the environmental water requirements of the Gippsland Lakes system: Stage 2: Input to the Gippsland Region Sustainable Water Strategy. Moroka.
Tilleard, J., O'Connor, N., and Boon, P.J. (2009). Understanding the environmental water requirements of the Gippsland Lakes system. East and West Gippsland Catchment Management Authorities.
Unland, N.P. (2009). The Extent, Severity and Implication of Acid Sulfate Soils in the Heart Morass, West Gippsland, Victoria. Honours, Monash University, Clayton, Victoria.
Urlus, J. and Ricciardello, J. (2012). Thomson and Latrobe River Floodplains - Fauna Surveys. Ecology Australia, Fairfield, Victoria.
Warry, F.Y. and Hindell, J.S. (2012). Fish Assemblages and Seagrass Condition of the Gippsland Lakes. Arthur Rylah Institute for Environmental Research, Heidelberg, Victoria.
Wassens, S., Hall, A., Osborne, W., and Watts, R.J. (2010). Habitat characteristics predict occupancy patterns of the endangered amphibian Litoria raniformis in flow-regulated flood plain wetlands. Austral Ecology **35**(8): 944–955.
Webster, I.T., Parslow, J., Grayson, R., Molloy, R., Andrewartha, J., Sakov, P., Seong Tan, K., Walker, S.J., and Wallace, B. (2001). Gippsland Lakes Environmental Study: Assessing Options for Improving Water Quality and Ecological Function. CSIRO, Glen Osmond, SA.
West Gippsland CMA. (2014). West Gippsland Regional Waterway Strategy 2014-2022. State of Victoria.
Wetlands International. (2013). Waterbird Population Estimates, Fifth Edition.
Wheeler, P.J., Peterson, J.A., and Gordon-Brown, L.N. (2010a). Channel Dredging Trials at Lakes Entrance, Australia: A GIS-Based Approach for Monitoring and Assessing Bathymetric Change. Journal of Coastal Research **26**(6): 1085–1095.
Wheeler, P., Peterson, J., and Gordon-Brown, L. (2010b). Flood-tide Delta Morphological Change at the Gippsland Lakes Artificial Entrance, Australia (1889–2009). Australian Geographer **41**(2): 183–216.
Wheeler, P., Peterson, J., and Gordon-Brown, L. (2010c). Long-term bathymetric effects of groyne array emplacement at Lakes Entrance, Victoria, Australia. Applied Geography **30**(1): 126–140.
Wright, M. and Wright, I. (2012). The 2012 challenge count. The Chat **55**: 3.

Appendix A: Work plan

Table A- 1: Work Plan

Objective	Task	Responsibility	Planned completion date
Project management	Jennifer Hale will be the project manager for the consultant team and all communication between the Steering Committee, EGCMA project manager and the consultant team will be via her. She will provide the EGCMA project manager regular updates via email and ensure the project runs on time. We would like to draft a project timetable at the start of the project that schedules meetings and workshops in advance, so that Steering Committee and TAG members can plan for their involvement.	Jennifer Hale	
	Project inception meeting between the consultant team leader (Jennifer Hale) and / or Rhonda Butcher, and the EGCMA project manager and potentially steering committee: Agree to project plan and timelines Communication plan Identification of potential TAG members and process for engaging them.	Jennifer Hale / Rhonda Butcher; EGCMA, WGCMA, GLMAC	Aug 13, 2014
1. Analysis and prioritisation	A. Prioritisation approach Develop draft criteria for the prioritisation of values and threats. Will include recommendations for a scoring and weighting system. Preliminary identification of values and threats from the ECD, Ramsar Rolling Review, existing strategy documents and GLEE. Documentation of above into a draft paper and workshop agenda to RC, EK and HA for review, with final to be distributed the Steering Committee one week prior to the workshop.	Jennifer Hale / Rhonda Butcher	Sept 9, 2014
	Workshop 1 with steering committee, to be held in a central location (Bairnsdale, Traralgon or Sale): Ramsar management planning requirements Project plan (including roles and responsibilities of PSC and TAG) Objectives of the GLRMP Spatial scale and scope of the GLRSMP (including agreement on boundary) Prioritisation criteria and method Values and threats to be considered in the prioritisation.	Jennifer Hale	One day (Bairnsdale) - Sept 16, 2014
	Documented outcomes of Workshop 1 in a short report.	Jennifer Hale	Sept 25, 2014
	B. Data collation	Shane Brooks / Jennifer Hale	Sept 25, 2014

	Collation of relevant data and information on the values and threats. Contact (by telephone) with TAG members to identify additional information sources. Spatial analysis of values. Production of a map and summary of values and threats.		
	C. Risk assessment Update stressor models from Ramsar Rolling Review Identify risk pathways Draft risk assessment Document and provide to workshop participants, together with an agenda one week prior to workshop	Jennifer Hale / Rhonda Butcher	Oct 1, 2014
	Workshop 2: Morning - Risk assessment (PSC and TAG members), to run through each risk pathway and assign consequence and likelihood. Afternoon - (PSC) summary of outcomes and agreed way forward (assigning tasks and responsibilities)	Jennifer Hale, PSC and TAG	One day (Traralgon) – Oct 7, 2014
	Documented outcomes of Workshop 2 in a short report.	Jennifer Hale	Oct 14, 2014
	D. Prioritisation of values and threats Preliminary application of the prioritisation documented in a short report and provided to Steering Committee members together with workshop agenda, one week prior to workshop.	Rhonda Butcher / Jennifer Hale	Oct 22, 2014
	Workshop 3: Identification of priority values (and locations) and threats for consideration in developing resource condition targets and strategic actions. Participants will be guided through the prioritisation process and reach agreement on priorities. Workshop will also consider high level themes for the management plan	Rhonda Butcher / Jennifer Hale, PSC and TAG	One day (Traralgon) – Oct 29, 2014
	Map and short report on priorities and themes	Jennifer Hale / Shane Brooks	Nov 11, 2014

Table A- 2: Gantt Chart

Activities	Week beginning																																
	11 Aug 2014	18 Aug 2014	25 Aug 2014	1 Sep 2014	8 Sep 2014	15 Sep 2014	22 Sep 2014	29 Sep 2014	6 Oct 2014	13 Oct 2014	20 Oct 2014	27 Oct 2014	3 Nov 2014	10 Nov 2014	17 Nov 2014	24 Nov 2014	1 Dec 2014	8 Dec 2014	15 Dec 2014		5 Jan 2015	12 Jan 2015	19 Jan 2015	26 Jan 2015	2 Feb 2015	9 Feb 2015	16 Feb 2015	23 Feb 2015	2 Mar 2015	9 Mar 2015	16 Mar 2015	23 Mar 2015
Project management																																	
Communication with EGCMA																																	
Inception meeting	13																																
TAG identification and engagement																																	
Finalise work plan and meeting dates																																	
Communication with GLMAC exec.																																	
1. Analysis and prioritisation																																	
1A. Prioritisation approach																																	
Develop draft criteria (values & threats)																																	
Preliminary id of values & threats																																	
Paper & workshop agenda to PSC					9																												
Workshop 1 with PSC						16																											
Minutes and outcomes circulated							25																										
1B. Data collation																																	
Data collation – values & threats																																	
Map and summary of values & threats							25																										
1C. Risk Assessment																																	
Update stressor models																																	
Identify impact pathways																																	
Draft risk assessment																																	
Paper and agenda to PSC and TAG								1																									
Workshop 2 PSC & TAG									7																								
Minutes and outcomes circulated										14																							
1D. Prioritisation of values & threats																																	
Draft prioritisation (paper and agenda)											22																						
Workshop 3 with PSC and TAG												29																					
Minutes and outcomes													5																				
Map & short report (priorities & themes)														11																			

Activities	Week beginning																																
	11 Aug 2014	18 Aug 2014	25 Aug 2014	1 Sep 2014	8 Sep 2014	15 Sep 2014	22 Sep 2014	29 Sep 2014	6 Oct 2014	13 Oct 2014	20 Oct 2014	27 Oct 2014	3 Nov 2014	10 Nov 2014	17 Nov 2014	24 Nov 2014	1 Dec 2014	8 Dec 2014	15 Dec 2014		5 Jan 2015	12 Jan 2015	19 Jan 2015	26 Jan 2015	2 Feb 2015	9 Feb 2015	16 Feb 2015	23 Feb 2015	2 Mar 2015	9 Mar 2015	16 Mar 2015	23 Mar 2015
2. Strategic actions																																	
2A. Review																																	
Achievements of current GLRSMP																																	
Review of existing strategies and plans																																	
2B. Resource condition targets																																	
Draft targets																																	
2C. Strategic actions																																	
Approach to identifying effective actions																																	
Paper to PSC and TAG																	2																
Workshop(s) 4																		9															
Draft list of strategic actions																			14														
Review of draft actions																						15											
Response to comments and final actions																								30									
Report																								30									
3. Monitoring requirements																																	
Identification of monitoring needs																																	
Paper / report																	2																
Gap / overlap analysis																																	
Workshop(s) 4																		9															
Draft list of monitoring needs																			15														
Review of monitoring needs																						15											
Response to comments and final actions																								30									
Report																								30									
4. Writing plan and report																																	
GLRSMP and management report - draft																												1					
Review by PSC																														13			
Response to comments																																	27
Final plan and report																																	27

Table A- 3: Meeting and workshop dates

Meeting / workshop	Attendees	Purpose	Dates
Inception	Consultant team (Rhonda); EGCMA (Rex); WGCMA (Elisha); GLMAC (Heather)	Confirm / fine tune work plan Communication protocols Process for identifying and engaging TAG members Contract and milestone payments	August 13 @ 2pm
Workshop 1	Project Steering Committee (PSC)	Requirements of a Ramsar site management plan Spatial scale and scope of the plan Agreement on objectives Agree to prioritisation approach for values and threats Fine tune criteria Confirm values and threats to be included in prioritisation	September 16 @ 10 am DELWP / EGCMA Office, Meeting Room 8, Bairnsdale
Workshop 2*	PSC and TAG	Risk assessment Fine tuning impact pathways Assigning likelihood and consequence	October 7 @ 10 am WGCMA, Traralgon
	PSC	Summary of outcomes and agreed way forward (assigning tasks and responsibilities)	October 7 @ 1 pm WGCMA, Traralgon
Workshop 3*	PSC and TAG	Prioritisation of values and threats Scoring against each criterion	October 29 @ 10 am WGCMA, Traralgon
	PSC	Summary of outcomes (priority values and threats) Identification of themes for GLRSMP	October 29 @ 1 pm WGCMA, Traralgon
Workshop(s) 4	PSC and TAG	Review and refinement of resource condition targets (RCT) Identification of actions to meet RCT (including responsibilities)	December 9 @ 10 am WGCMA, Traralgon

Appendix B: Stakeholder engagement plan

Project Scope

The focus of the Ramsar Site Plan Renewal is to set out a management framework for the Ramsar Site, so that clear and transparent priorities are identified, with associated strategic actions, each with clear responsibilities assigned so that each agency's role in maintaining or restoring the ecological character of the Lakes is distinct.

This is the Stakeholder Engagement plan for the project. This document will be updated and revised throughout the life of the project to reflect the engagement needs and activities at various stages. It identifies the key stakeholders, the purpose of engagement, and the engagement implementation plan.

The Australian Ramsar management principles (Environment Protection and Biodiversity Conservation Regulations 2000 – Schedule 6) provide guidance about community involvement in management of Ramsar sites.

Specifically

> '1.02 Wetland management should provide for public consultation on decisions and actions that may have a significant impact on the wetland.
> 1.03 Wetland management should make special provision, if appropriate, for the involvement of people who:
>
> (a) have a particular interest in the wetland; and
> (b) may be affected by the management of the wetland.
>
> 1.04 Wetland management should provide for continuing community and technical input.'

The implementation of this Stakeholder Engagement plan will reflect these principles in the renewal of the Ramsar Site Plan. It is not the role of this plan to give direction regarding ongoing community and technical input in site management; this will be facilitated by the responsible agencies.

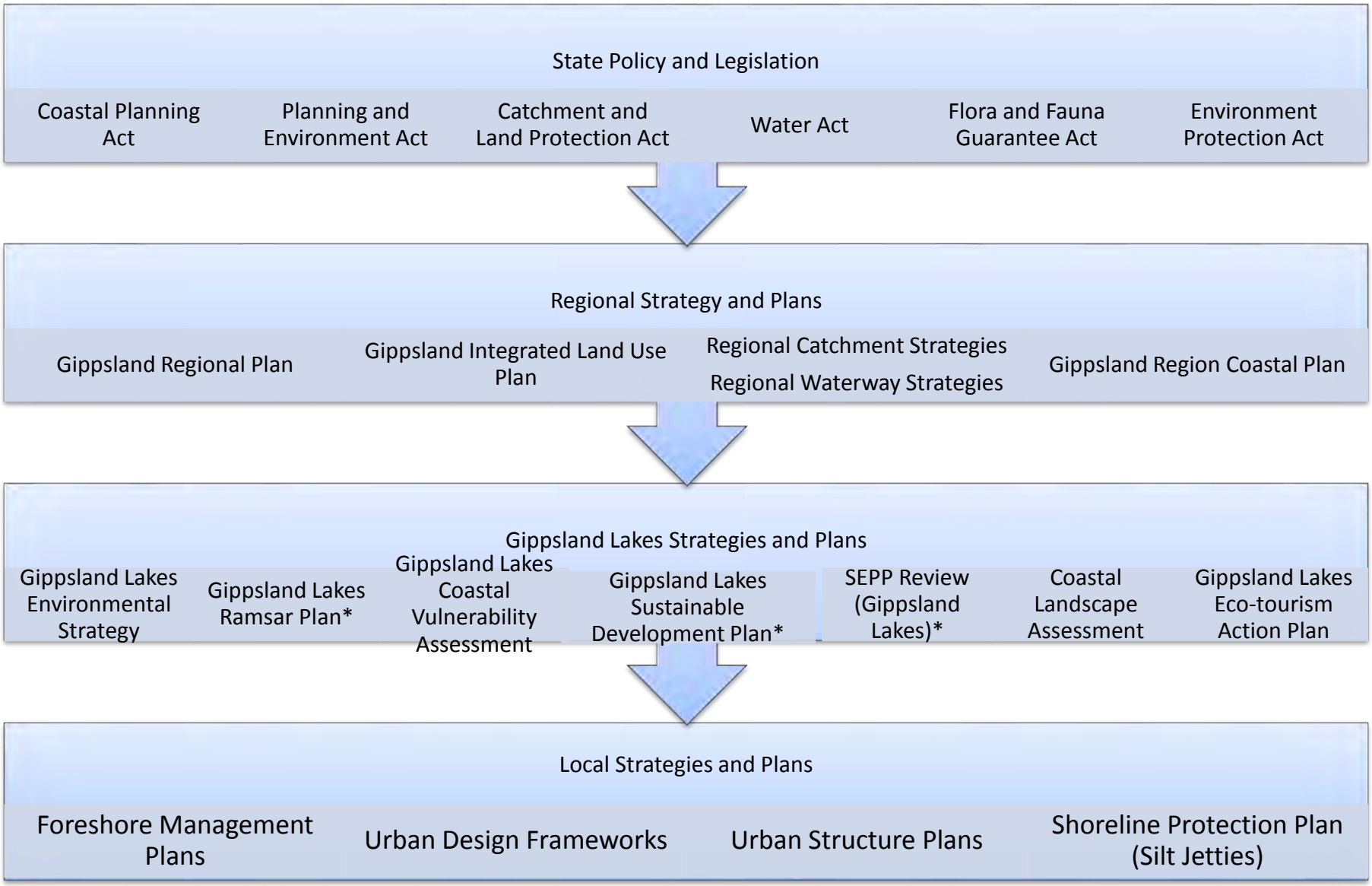
Engagement Aim

The aim of the engagement is to contribute to the development of the Ramsar Site Plan Renewal.

The key target audience is comprised of the Project Steering Committee (PSC) and the Technical Group, as the Plan will specify their assigned management responsibilities.

The engagement aim for the interest groups and community is to consult on decisions and actions that may have a significant impact on the wetland and involve those who have a particular interest in the wetland and/or may be affected by the management of the wetland.

Due to other related projects (see following page) developing throughout the same timeframe a key aim for this plan is avoid confusion, or over consultation with stakeholders involved in other projects. There is a need to differentiate the Ramsar plan whilst demonstrating the relationship with other projects.



- *These projects are included in the engagement at web-site http://glee.gippslandlakes.net.au/

There are three significant planning projects requiring consultation/engagement across a wide range of stakeholders.

- Ramsar Plan Renewal
- Sustainable Development Plan
- Review of State Environmental Protection Policy

All three of the plans are at a scale and level of technicality to require targeted, rather than shotgun public consultation. To obtain meaningful stakeholder input and avoid the high risk of consultation fatigue over three different projects, all with overlapping stakeholders, the Gippsland Lakes Ministerial Advisory Committee established an on-line engagement site http://glee.gippslandlakes.net.au/. This site was launched in June 2014 and a survey commenced (survey closes July 31st).

The site allows people to choose their level and extent of involvement by "signing up" to a communication process intended to gather and distribute information and views for each of the three projects. Stakeholders are able to choose whether they complete a survey, post a comment, respond to a draft document or just follow progress of the projects.

Those people who may not normally participate in an on-going on-line process would be involved via project briefings to key audiences in a more informal feedback process across all three projects. These briefings will be linked to existing or planned events, rather than as stand-alone consultation meetings, which are becoming less effective as consultation methods.

Implementation Responsibility

The consultant will lead communication with the Project Manager, the PSC and the Technical Group.

GLMAC will take a lead role in the communication with Stakeholder Groups and the community.

The consultant will be required to:

- Liaise with GLMAC staff regarding content for the web-site
- summarise the survey responses relating to the Ramsar plan for a) posting on the web-site for community information and b) to inform the preparation of the Plan
- contribute to the online forum
- collate and summarise stakeholder views shared on the forum for presentation to the Project Manager, the PSC, and to inform the development of the Plan
- prepare background and draft documents for stakeholder group and community information and comment for uploading to the web-site and/or email distribution
- contribute to populating the online "calendar" of activity for the Ramsar plan

Stakeholder groups

Stakeholder Group	Lead communication	Level of Engagement	Purpose	Tools	Engagement Objectives	Key Messages
Project Manager	Consultant	Empower	Effective project delivery	Regular meetings (minutes)	Ensure clarity of scope and process Encourage maximum partner input Ensure alignment with Government requirements Adhere to project plan and manage variations	
Steering Committee	Consultant	Empower	High ownership of Plan and involvement in development High agency commitment to implementation	Regular meetings (minutes) Workshop	Clear terms of reference Provide material for reporting back to agencies Maximise communication with Project Manager	
Technical Group	Consultant	Collaborate	To ensure the values threats and priorities are based on the best available information	Technical workshop Central database of relevant information	Minimise meetings Maintain focus on technical issues (development of management actions)	

Stakeholder Group	Lead communication	Level of Engagement	Purpose	Tools	Engagement Objectives	Key Messages
Groups	GLMAC	Involve	Involvement in confirming values and threats Increased involvement in Site management Increased understanding of Site management responsibilities	Project description Workshops Survey tool to establish values/concerns/involvement Online review and discussion of values Project newsletter/update (online) Provide briefings to groups upon request	Ensure early understanding and opportunity for input Connect with external networks and expertise Obtain confirmation of identified values and threats Identify opportunities for citizen science Keep updated with project progress Provide feedback on how input influenced decision	Their knowledge and support in monitoring is valued We need them to confirm the values of the Lakes and threats to the Lakes Expectation: it is a statutory process; there are clear responsibilities for gov agencies; There is a Plan and it is being updated The purpose of the Plan is to assign clear responsibilities for agencies. Implementation is ongoing by agencies Values are being maintained/protected/restored
Community	GLMAC	Consult	Increased understanding of role of Ramsar Plan Increased appreciation of value of Site	Newspaper articles Website – survey and discussion Public comment	Maintain confidence in management of the Site Increase knowledge Keep updated with project progress Provide feedback on how input influenced decision	There is a Plan The plan is being updated Implementation is ongoing by agencies Values are being maintained/protected/restored

Appendix C: Risk Assessment

Table A- 4: Risk Assessment for the Deep Lakes mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Residential and commercial development	Presence of development on lake shores	Affects visual amenity	Almost certain	Moderate	High	Commercial and residential development along the shorelines of the lakes has been identified as a community concern (GLMAC 2013).
Residential and commercial development	Increased erosion	Direct impacts on shoreline vegetation	Possible	Minor	Low	Studies have indicated that the vast majority of erosion hazard and shoreline erosion is due to historic change in salinity resulting in a loss of fringing vegetation (Sjerp et al. 2002). Direct impacts to littoral vegetation are small compared to the entire shoreline of the Deep Lakes.
Residential and commercial development	Increased erosion	Loss of vegetation results in loss of habitat for waterbirds	Possible	Minor	Low	See above
Residential and commercial development	Increased lighting at night and noise	Affects waterbirds	Possible	Minor	Low	Marine and wading bird species are attracted to artificial light, which has the potential to disrupt migratory shorebirds (Gauthreaux Jr and Belser 2006) and effect feeding patterns of night foragers (Montevecchi 2006). However, there is also evidence to suggest that artificial lighting in coastal and estuary areas increases feeding success of night foragers (Santos et al. 2010). The amount of light produced from urban areas compared to the size of the lakes is comparatively small.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and a decline in seagrass health	Likely	Moderate	Medium	Well documented ecological pathway (e.g. Cook et al. 2008, Holland et al. 2009, 2013b, Cook and Holland 2012) and there is a reported decline is seagrass from 1997 to 2008; although there is insufficient information to determine the causes for that decline (Warry and Hindell 2012).
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish)	Likely	Moderate	Medium	Low dissolved oxygen events are recorded in the lakes during bloom conditions (EPA Victoria 2008). There are documented fish deaths from low dissolved oxygen events in the Deep Lakes (e.g. Lake Tyers June 2014). Although ecological theory supports the premise that algal blooms can lead to low do and fish deaths, there is no direct report of this in the Gippsland Lakes. There is insufficient data to determine if there has been a decline in the diversity and abundance of fish in the lakes

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
						(Warry and Hindell 2012). Although there has been a change to the age structure of Black Bream (Kemp et al. 2013).
Pollution: Agricultural effluents	Increased nutrients	Increased algal growth and impacts to fish resources impacts feeding of dolphins	Possible	Moderate	Medium	Dolphins are not visual feeders, but hunt by sound and do have the ability to migrate out of the Lakes during unfavourable conditions. However, it is likely that disruptions to fish stocks and reduced water quality conditions contribute to reduced health and condition. The risks are exacerbated due to the small size of the population.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding (general)	Almost certain	Moderate	High	The pathway includes piscivores and ducks and swans feeding on submerged vegetation. Also includes the movement of birds onto adjacent lands and possible ramifications (e.g. swan cull in 2007).
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding (threatened species: little terns and fairy terns)	Likely	Major	High	Risk is considered high, due to the increased energy requirements by nesting terns from having to forage further; resulting in decreased recruitment success.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects visual amenity	Almost certain	Moderate	High	Previous algal blooms have elicited negative responses from residents and visitors. However, the impact does not extend for long after the bloom is no longer visible.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects water based recreation and tourism	Almost certain	Moderate	High	An assessment of the economic impact of the 2008 algal bloom estimated a 15 % decline in business activity, with a 6% reduction in visitors (Connolly and Brain 2009).
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects recreational fishing	Almost certain	Minor	Medium	There have been previous closures of the lake to recreational fishing due to algal blooms, but these have only been for periods of weeks.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects commercial fishing	Almost certain	Minor	Medium	Black bream stocks are considered stable, or in good condition; but there as been a change in age structure that may be related to environmental conditions such as algal blooms (Kemp et al. 2013). In the event of an algal bloom, the impact to commercial fisheries is more often due to increased processing and resources required as fish need to be gut and gilled before going to the consumer.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Agricultural effluents	Increased sediments	Reduced light / smothering affects seagrass	Possible	Minor	Low	Sediment loads from agricultural lands have been estimated to comprise approximately two thirds of the load to the lakes (Grayson 2006). While the pathway is based on sound ecological theory, much of the sediment may be deposited near the freshwater inflows. Turbidity in Lakes King and Victoria is mostly low, with secchi depths > 2 m (EPA Victoria

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
						2013). Large scale events of poor water quality (e.g. 2007 floods after the bushfire) are rare.
Pollution: Agricultural effluents	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Rare	Minor	Negligible	Primary Industries Research Victoria (2006\) indicated that a threshold of 100 mg/L was a conservative estimate for expecting effects on fish and marine invertebrates (considering effects to more vulnerable juvenile stages). TSS in the main lakes has not been recorded above this threshold, although samples are limited
Pollution: Agricultural effluents	Increased sediments	Reduced light affects waterbird feeding	Unlikely	Negligible	Negligible	The pathway includes piscivores and ducks and swans feeding on submerged vegetation. Assumption is that the bloom rarely covers the entire deep lakes system and birds can relocate to better feeding grounds; and that the disruption to feeding by sediment is less likely than from algal blooms.
Pollution: Agricultural effluents	Increased sediments	Affects visual amenity	Almost certain	Negligible	Negligible	On rare occasions the lakes are obviously coloured brown with sediments (e.g. 2007 / 8); but this is rare.
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects recreational fishing	Rare	Negligible	Negligible	Based on assessment of low risk to fish
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects commercial fishing	Rare	Negligible	Negligible	Based on assessment of low risk to fish
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from sewage and stormwater result in increased algal growth and a decline in seagrass health	Possible	Minor	Low	Although the loads of nutrients that enter the deep lakes from sewage and stormwater are unknown, it is expected that they are low compared to catchment inputs and in comparison to the volume of the lake. The likelihood and consequence of each pathway has been adjusted accordingly.
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from sewage and stormwater result in increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish)	Rare	Minor	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased algal growth - reduced light affects visual feeding of dolphins	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth, impact waterbird feeding	Unlikely	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects visual amenity	Possible	Minor	Low	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects water based recreation and tourism	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects recreational fishing	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects commercial fishing	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased sediments	Reduced light / smothering affects seagrass	Rare	Negligible	Negligible	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Sewage and stormwater	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Reduced light affects waterbird feeding	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Affects visual amenity	Possible	Minor	Low	In localised areas only
Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects recreational fishing	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects commercial fishing	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Sewage and stormwater	Hydrocarbons and toxicants	Affects visual amenity	Almost certain	Negligible	Negligible	Spills and discharges of chemicals and oils to stormwater drains flowing into the Gippsland Lakes. Has been observed, but effects are localised and short lived.
Pollution: Sewage and stormwater	Hydrocarbons and toxicants	Affects health of aquatic food webs (fish, birds, dolphins, etc)	Possible	Minor	Low	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Wildfire	Increased nutrients and sediment	Affects seagrass	Likely	Major	High	Assumption that this impact pathway is for a large fire followed by heavy rain / significant flow as what occurred in 2006/7. This event resulted in three times the average annual load of phosphorus and over twice the average annual load of nitrogen entered the lakes after intense rainfall fell on burned catchments mobilising large amounts of sediment and associated nutrients (SKM 2008). All likelihood and consequences for these pathways have been adjusted from those assessed for agricultural effluents to reflect the increased magnitude.
Wildfire	Increased nutrients and sediment	Affects aquatic biota (fish)	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Affects dolphins	Likely	Major	High	Increased dolphin deaths and disease recorded during 2006/7 event.
Wildfire	Increased nutrients and sediment	Affects waterbirds	Likely	Major	High	Swan cull from feeding in agricultural lands, following loss of feeding habitat in the 2006/7 event. Plus effect on nesting terns
Wildfire	Increased nutrients and sediment	Affects visual amenity	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Affects water based recreation	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Affects recreational fishing	Almost certain	Minor	Medium	
Wildfire	Increased nutrients and sediment	Affects commercial fishing	Almost certain	Minor	Medium	Effects are limited to extreme events, which are less likely to occur.
Wildfire	Increased nutrients and sediment	Affects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Mining effluents	Toxicants	Affects health of aquatic food webs (fish, birds, dolphins, etc)	Likely	Moderate	Medium	There is evidence of elevated levels of mercury in dolphins in the Gippsland Lakes and there is the potential for a role for mercury contamination in the mortality of these animals (Monk et al. 2014). Historical research indicates sediment concentrations of mercury > 1000 times ANZECC ISQG guidelines (Glover et al. 1980) and a 58% increase in the concentration of mercury in fish from the Lake from 1979 to 1997 (Fabris et al. 1999). Historical gold mining and current coal mining / power generation were identified as likely causes (Glover et al. 1980).
Pollution: Mining effluents	Toxicants	Affects recreational fishing	Likely	Minor	Medium	Average concentrations in 1997 were below food safety standards, but some individuals were above food safety standards (Fabris et al. 1999) and there is no recent data.
Pollution: Mining effluents	Toxicants	Affects commercial fishing	Likely	Minor	Medium	Knowledge gap
Pollution: Mining effluents	Toxicants	Affects Aboriginal cultural heritage	Likely	Minor	Medium	See above
Pollution: Mining effluents	Toxicants	Affects water based recreation and tourism	Possible	Moderate	Medium	Possible effects to tourism, but no known contact toxicants from mining in the catchment.
Pollution: Mining effluents	Increased sediments	Reduced light / smothering affects seagrass	Unlikely	Negligible	Negligible	Grayson (2006) indicated just 2% of TSS loads were from mining operations. All likelihood and consequences were assigned based on this low level of sediment contribution.
Pollution: Mining effluents	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Rare	Negligible	Negligible	
Pollution: Mining effluents	Increased sediments	Reduced light affects waterbird feeding	Rare	Negligible	Negligible	
Pollution: Mining effluents	Increased sediments	Affects visual amenity	Rare	Negligible	Negligible	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Mining effluents	Increased sediments	Effects on fish affects recreational fishing	Rare	Minor	Negligible	
Pollution: Mining effluents	Increased sediments	Effects on fish affects commercial fishing	Rare	Negligible	Negligible	
Pollution: Mining effluents	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Oil Spills (offshore)	Hydrocarbons	Affects shoreline vegetation	Rare	Moderate	Negligible	Oil spill mapping indicates that there needs to be a large, sustained release of oil from more than one production well in Bass Strait, for the spill to enter the Ramsar site. This is considered to be a very unlikely scenario, but consequences are based on the impacts in the event oil does enter the Ramsar site, which would be at comparatively low levels.
Pollution: Oil Spills (offshore)	Hydrocarbons	Direct oiling of wildlife	Rare	Minor	Negligible	
Pollution: Oil Spills (offshore)	Hydrocarbons	Indirect long term effects (food webs, aquatic biota)	Rare	Major	Low	
Pollution: Oil Spills (offshore)	Hydrocarbons	Affects visual amenity	Rare	Major	Low	
Pollution: Oil Spills (offshore)	Hydrocarbons	Affects recreational fishing	Rare	Moderate	Negligible	
Pollution: Oil Spills (offshore)	Hydrocarbons	Affects commercial fishing	Rare	Moderate	Negligible	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Oil Spills (offshore)	Hydrocarbons	Affects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Oil Spills (offshore)	Hydrocarbons	Affects water based recreation and tourism	Rare	Moderate	Negligible	
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects shoreline vegetation	Likely	Negligible	Negligible	Based on incidents reported to Gippsland Ports - spills occur, but effects are generally localised and short-lived.
Pollution: Oil Spills (vessels)	Hydrocarbons	Direct oiling of wildlife	Likely	Minor	Medium	
Pollution: Oil Spills (vessels)	Hydrocarbons	Indirect long term effects (food webs, aquatic biota)	Possible	Minor	Low	
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects visual amenity	Almost certain	Negligible	Negligible	
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects recreational fishing	Possible	Negligible	Negligible	
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects commercial fishing	Possible	Negligible	Negligible	
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects water based recreation and tourism	Possible	Negligible	Negligible	
Exposure of ASS					#N/A	Not a plausible pathway for this mega-habitat
Water resource use	Decreased freshwater inflows	Increased salinity affects breeding triggers for black bream and other estuarine fish (in estuarine reaches),	Possible	Minor	Low	The direct impact (decreased salinity affecting spawning and recruitment) occurs in the estuarine reaches of the rivers. However the flow on impacts to fish stocks and fishing are relevant to the deep water habitat. However, the recreational fishery covers more than just black bream and it is likely that fishers will catch whatever species is most common in the more saline conditions.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
		reducing fish populations and affecting recreational fishery				
Water resource use	Decreased freshwater inflows	Increased salinity affects breeding triggers for black bream and other estuarine fish (in estuarine reaches), reducing fish populations and affecting commercial fishery	Possible	Minor	Low	See above: commercial fishing is not for a single species only and can adapt to the fish present.
Water resource use	Altered freshwater inflows	Disrupts stratification and internal nutrient cycling; promoting algal blooms	Possible	Major	High	Based on current understanding of the factors that effect bloom formation and the importance of internal nutrient cycling (Cook et al. 2008, Cook and Holland 2012).
Water resource use	Decreased connectivity	Affects migratory routes of fish including threatened Australasian grayling	Rare	Minor	Negligible	The Australian grayiing migrates from fresh to marine waters as part of its lifecycle, with the return of juveniles to the river in spring (November) the most vulnerable phase (Koehn and O'Connor 1990). Recent research suggests that the fish migrate out to the open ocean in the juvenile phase (Schmidt et al. 2011) which would mean passing through the Lakes system and out to Bass Strait at Lakes Entrance. However, barriers to migration are in the upper reaches of rivers not in the deep lakes mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Invasive species	Introduced marine pests (European shore crab)	Increased competition and predation results in a decline in native species extent, diversity and abundance	Almost certain	Major	Extreme	Based on anecdotal reports of tonnes of crabs harvested monthly. Described as a voracious predator with the following potential impacts "In Australia they may have a great impact including direct impacts on prey species, indirect effects on species competing for the same prey, and indirect impacts on nutrient availability (by removing bivalves which filter algae and larvae) http://www.mesa.edu.au/marine_pests/marine_pests04.asp Risk based on presence of species in the Lakes and preliminary risk assessment by Nathan Bott for the GLMAC.
Invasive species	Introduced marine pests (other species)	Increased competition and predation results in a decline in native species extent, diversity and abundance	Unlikely	Major	Medium	Based on preliminary risk assessment by Nathan Bott for the GLMAC. These species have not yet been recorded in the lakes, and so potential for impact in next eight years is unlikely. However, some if introduced to the system could have a major impact (northern pacific seastar, Wakame seaweed, NZ screw shell).
Invasive species	Introduced marine pests	Impacts to fish affects commercial fishing	Unlikely	Negligible	Negligible	European shore crab: can be commercially harvested and sold.
Invasive species	Non-native terrestrial animals (foxes and cats)	Predation on nesting, feeding and roosting waterbirds	Almost certain	Moderate	High	Based on the presence of nesting little terns and fairy terns at Lake Tyers and Rigby Island, which are in this mega-habitat.
Invasive species	Non-native terrestrial plants (sea spurge)	Reduction in habitat for nesting terns	Almost certain	Moderate	High	Observations that terns will not nest in parts of the shoreline covered by the weed.
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects breeding triggers for black bream and other estuarine fish (in estuarine reaches), reducing fish	Possible	Minor	Low	Based on same evidence and assumptions as “decreased freshwater flows from water resource use”. An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013).

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
		populations and affecting recreational fishery				
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects breeding triggers for black bream and other estuarine fish (in estuarine reaches), reducing fish populations and affecting commercial fishery	Possible	Minor	Low	
Climate change and severe weather: Drought	Altered freshwater inflows	Disrupts stratification and internal nutrient cycling; promoting algal blooms	Possible	Major	High	
Climate change and severe weather: Drought	Decreased connectivity	Affects migratory routes of fish including threatened Australasian grayling	Rare	Minor	Negligible	See above - barriers to migration are in the river reaches, not in the deep lakes mega-habitat
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects intertidal and sub-tidal seagrass condition and extent	Likely	Moderate	Medium	Extensive climate modelling and impact assessments have indicated a likely increase in sea level coupled with an increase in the frequency and intensity of storms (DSE 2013, McInnes et al. 2013). Potential impacts include physical damage to shorelines, vegetation and assets; as well as increased inundation. Recent studies indicate that there is little impact expected to the shorelines of the deep lakes, except around Lakes Entrance.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Impacts to seagrass affect aquatic biota	Possible	Minor	Low	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Impacts to biota affect recreational fishing	Unlikely	Minor	Low	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Impacts to fish affects commercial fishing	Unlikely	Minor	Low	See above: commercial fishing is not for a single species only and can adapt to the fish present.
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Damage to recreational infrastructure impacting water based and beside water recreation	Possible	Minor	Low	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects visual amenity	Possible	Minor	Low	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Damages the silt jetties	Possible	Extreme	High	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects Aboriginal cultural heritage including significant sites	Possible	Major	High	
Dredging: changed entrance conditions	Increased tidal exchange	Altered hydrodynamic process lead to altered salinity in the Lakes due to increased tidal exchange and increased salinity in the lakes, impacting flora and fauna	Unlikely	Moderate	Low	Evidence from hydrodynamic modelling indicates no effect of the modifications to the channel on salinity in the Lakes ((Reynolds et al. 2011). Which is consistent with previous investigations (Webster et al. 2001).
Dredging: changed entrance conditions	Increased tidal exchange	Altered water levels in Lake Tyers due to artificial entrance opening (manual).	Possible	Moderate	Medium	Entrance to Lake Tyers has been opened in the past, which has lead to a reduction in habitat for nesting terns and decreased recruitment success. Is now managed through EGCMA.
Fishing and harvesting aquatic resources	Direct removal of native fauna	Affects diversity and abundance of aquatic biota	Possible	Negligible	Negligible	Current research indicates a stable fish population for commercial species (Kemp et al. 2013).
Recreational activities	Increased boat traffic	Impacts to dolphins	Almost certain	Moderate	High	Based on discussions with dolphin researcher Kate Charlton-Robb.
Recreational activities	Increased noise, traffic, dogs, walkers	Disturbance of shorebirds and nesting waterbirds	Almost certain	Moderate	High	The deep lakes are not core habitat for shorebirds, but contain the nesting habitat for little terns and fairy terns at Lake Tyers and Rigby Island. Nesting birds and migratory shorebirds can be impacted by noise (motorised watercraft), people and dogs on the beach.
Recreational activities	Increased boat traffic	Physical removal of seagrass	Almost certain	Minor	Medium	Knowledge gap - disturbance and recovery of seagrass beds. Large amounts of seagrass observed damaged by recreational boats

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Recreational activities	Nutrients and litter	Waste for recreational activities impacts aquatic biota and waterbirds	Possible	Negligible	Negligible	
Recreational activities	Nutrients and litter	Waste and oil from boats	Possible	Minor	Low	Knowledge gap - oil slicks associated with operation of bilge pumps following rain events: around Paynesville, Metung, Lakes Entrance

Table A- 5: Risk Assessment for the shallow lakes mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Residential and commercial development	Presence of development on lake shores	Affects visual amenity	Almost certain	Moderate	High	Commercial and residential development along the shorelines of the lakes has been identified as a community concern (GLMAC 2013). This would include Jones Bay
Residential and commercial development	Increased erosion	Direct impacts on shoreline vegetation	Possible	Negligible	Negligible	Studies have indicated that the vast majority of erosion hazard and shoreline erosion is due to historic change in salinity resulting in a loss of fringing vegetation, not from terrestrial activities
Residential and commercial development	Increased erosion	Loss of vegetation results in loss of habitat for waterbirds	Possible	Minor	Low	See above
Residential and commercial development	Increased lighting at night and noise	Affects waterbirds	Possible	Minor	Low	Marine and wading bird species are attracted to artificial light, which has the potential to disrupt migratory shorebirds (Gauthreaux Jr and Belser 2006) and effect feeding patterns of night foragers (Montevecchi 2006). However, there is also evidence to suggest that artificial lighting in coastal and estuary areas increases feeding success of night foragers (Santos et al. 2010). The amount of light produced from urban areas compared to the size of the lakes is comparatively small. The only area that this could apply to is Jones Bay - no light sources near Lake Wellington.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and a decline in seagrass health	Likely	Moderate	Medium	Well documented ecological pathway (e.g. Cook et al. 2008, Holland et al. 2009, Cook and Holland 2012) and there is a reported decline is seagrass from 1997 to 2008; although there is insufficient information to determine the causes for that decline (Warry and Hindell 2012). Ratings based on the small extent of seagrass in this mega-habitat (Jones Bay) - not present in Lake Wellington.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish)	Unlikely	Minor	Low	Again only plausible in Jones Bay, which experiences some low oxygen events. Lake Wellington remains large well mixed due to the shallow water and wind action
Pollution: Agricultural effluents	Increased nutrients	Increased algal growth and impacts to fish resources impacts feeding of dolphins	Possible	Moderate	Medium	Dolphins are not visual feeders, but hunt by sound and do have the ability to migrate out of the Lakes during unfavourable conditions. However, it is likely that disruptions to fish stocks and reduced water quality conditions contribute to reduced health and condition and the population is small.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding	Almost certain	Moderate	High	The pathway includes piscivores, large wading birds and ducks and swans. Jones Bay is a significant area for waterbirds within the Ramsar site, particularly for herbivores such as coots and swans. Past events have resulted in a loss of feeding habitat and the movement of birds to agricultural lands, instigating culls.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects visual amenity	Almost certain	Moderate	High	Previous algal blooms have elicited negative responses from residents and visitors. However, the impact does not extend for long after the bloom is no longer visible.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects waterbased recreation and tourism	Almost certain	Moderate	High	An assessment of the economic impact of the 2008 algal bloom estimated a 15 % decline in business activity, with a 6% reduction in visitors (Connolly and Brain 2009). How much of this is relevant to the shallow lakes habitat is not known.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects recreational fishing	Almost certain	Minor	Medium	There have been previous closures of the lake to recreational fishing due to algal blooms, but these have only been for periods of weeks.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects commercial fishing	Almost certain	Minor	Medium	Black bream stocks are considered stable, or in good condition; but there as been a change in age structure that may be related to environmental conditions such as algal blooms (Kemp et al. 2013). In the event of an algal bloom, the impact to commercial fisheries is more often due to increased processing and resources required as fish need to be gut and gilled before going to the consumer.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Agricultural effluents	Increased sediments	Reduced light / smothering affects seagrass	Almost certain	Negligible	Negligible	Sediment loads from agricultural lands have been estimated to comprise approximately two thirds of the load to the lakes (Grayson 2006). Historically, this was the cause of the decline in submerged plants in Lake Wellington (Harris et al. 1998). Turbidity measures from Jones Bay are not available, but the semi-enclosed nature of Jones Bay and its proximity to river discharges from the Mitchell catchment make this a plausible impact pathway. The lakes are by their nature shallow, and constant resuspension of bottom sediments makes these environments more turbid.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Agricultural effluents	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Possible	Minor	Low	Primary Industries Research Victoria (2006) indicated that a threshold of 100 mg/L was a conservative estimate for expecting effects on fish and marine invertebrates (considering effects to more vulnerable juvenile stages). There are no data to assess this against, but it is not likely that suspended sediments are above these thresholds for significant periods of time.
Pollution: Agricultural effluents	Increased sediments	Reduced light affects waterbird feeding	Possible	Minor	Low	The pathway includes piscivores, large wading birds and ducks and swans. Water clarity in Lake Wellington is very low (secchi depth median of < 5 m) (EPA Victoria 2013) and this has been attributed to catchment inflows of turbid water (Harris et al. 1998). However, this occurred post listing as a Ramsar site (benchmark for ecological character).
Pollution: Agricultural effluents	Increased sediments	Affects visual amenity	Possible	Minor	Low	The visual amenity of Lake Wellington is certainly reduced from historical (pre-1960's); but not since the time of listing. Jones Bay experiences periodic discoloured water from sediment, but arguably this would have less of an impact than the deep lakes.
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects recreational fishing	Rare	Negligible	Negligible	Based on assessment of low risk to fish
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects commercial fishing	Rare	Negligible	Negligible	Based on assessment of low risk to fish
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from sewage and stormwater result in increased algal growth and a	Possible	Minor	Low	Although the loads of nutrients that enter the deep lakes from sewage and stormwater are unknown, it is expected that they are low compared to catchment inputs and in comparison to the volume of the lake. However, there is a project to reduce stormwater inflow to Jone's Bay so this must have been

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
		decline in seagrass health				considered an issue. The likelihood and consequence of each pathway has been adjusted accordingly.
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from sewage and stormwater result in increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish)	Rare	Minor	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased algal growth and impacts to fish resources impacts feeding of dolphins	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth, impact waterbird feeding	Unlikely	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects visual amenity	Possible	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased	Unlikely	Minor	Low	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
		algal growth and affects waterbased recreation and tourism				
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects recreational fishing	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects commercial fishing	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Sewage and stormwater	Increased sediments	Reduced light / smothering affects seagrass	Rare	Negligible	Negligible	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Sewage and stormwater	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Reduced light affects waterbird feeding	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Affects visual amenity	Possible	Minor	Low	In localised areas only
Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects recreational fishing	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects commercial fishing	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Sewage and stormwater	Hydrocarbons and toxicants	Affects visual amenity	Almost certain	Negligible	Negligible	Spills and discharges of chemicals and oils to stormwater drains flowing into the Gippsland Lakes. Has been observed, but effects are localised and short lived.
Pollution: Sewage and stormwater	Hydrocarbons and toxicants	Affects health of aquatic food webs (fish, birds, dolphins, etc)	Possible	Minor	Low	
Wildfire	Increased nutrients and sediment	Effects on seagrass	Likely	Major	High	Assumption that this impact pathway is for a large fire followed by heavy rain / significant flow as what occurred in 2006/7. This event resulted in three times the average annual load of phosphorus and over twice the average annual load of

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
						nitrogen entered the lakes after intense rainfall fell on burned catchments mobilising large amounts of sediment and associated nutrients (SKM 2008). All likelihood and consequences for these pathways have been adjusted from those assessed for agricultural effluents to reflect the increased magnitude.
Wildfire	Increased nutrients and sediment	Effects aquatic biota (fish)	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Effects dolphins	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Effects waterbirds	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Effects visual amenity	Likely	Major	High	
Wildfire	Increased nutrients and sediment	Effects waterbased recreation	Likely	Moderate	Medium	
Wildfire	Increased nutrients and sediment	Effects recreational fishing	Likely	Minor	Medium	
Wildfire	Increased nutrients and sediment	Effects commercial fishing	Likely	Minor	Medium	Effects are limited to extreme events, which are less likley to occur.
Wildfire	Increased nutrients and sediment	Effects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Mining effluents	Toxicants	Effects health of aquatic food webs (fish, birds)	Likely	Moderate	Medium	Historical research indicates sediment concentrations of mercury > 100 times ANZECC ISQG guidelines (Glover et al. 1980) and a 58% increase in the concentration of mercury in fish from the Lake from 1979 to 1997 (Fabris et al. 1999). Historical gold mining and current coal mining / power generation were identified as likely causes (Glover et al. 1980).
Pollution: Mining effluents	Toxicants	Effects recreational fishing	Likely	Minor	Medium	Average concentrations in 1997 were below food safety standards, but some individuals were above food safety standards (Fabris et al. 1999) and there is no recent data. Consequences based on lower levels of recreational fishing in this habitat
Pollution: Mining effluents	Toxicants	Effects commercial fishing	Likely	Minor	Medium	Knowledge gap
Pollution: Mining effluents	Toxicants	Effects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Mining effluents	Toxicants	Effects waterbased recreation and tourism	Possible	Moderate	Medium	Possible effects to tourism, but no known contact toxicants from mining in the catchment.
Pollution: Mining effluents	Increased sediments	Reduced light / smothering affects seagrass	Unlikely	Minor	Low	Question to the TAG - how does this relate to current bioregional assessments for coal seam gas? Grayson (2006) indicated just 2% of TSS loads were from mining operations. All likelihood and consequences were assigned based on this low level of sediment contribution.
Pollution: Mining effluents	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Possible	Minor	Low	
Pollution: Mining effluents	Increased sediments	Reduced light affects waterbird feeding	Unlikely	Negligible	Negligible	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Mining effluents	Increased sediments	Affects visual amenity	Unlikely	Negligible	Negligible	
Pollution: Mining effluents	Increased sediments	Effects on fish affects recreational fishing	Unlikely	Negligible	Negligible	
Pollution: Mining effluents	Increased sediments	Effects on fish affects commercial fishing	Unlikely	Negligible	Negligible	
Pollution: Mining effluents	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Oil Spills (offshore)	Hydrocarbons				#N/A	Oil spill mapping indicates even in the event of a very large spill, oil would not extend to this mega-habitat. Not a plausible pathway
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects shoreline vegetation	Likely	Negligible	Negligible	Based on incidents reported to Gippsland Ports - spills occur, but effects are generally localised and short-lived.
Pollution: Oil Spills (vessels)	Hydrocarbons	Direct oiling of wildlife	Likely	Minor	Medium	
Pollution: Oil Spills (vessels)	Hydrocarbons	Indirect long term effects (food webs, aquatic biota)	Possible	Minor	Low	
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects visual amenity	Almost certain	Negligible	Negligible	
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects recreational fishing	Possible	Negligible	Negligible	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects commercial fishing	Possible	Negligible	Negligible	
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Oil Spills (vessels)	Hydrocarbons	Affects water based recreation and tourism	Possible	Negligible	Negligible	
Exposure of ASS					#N/A	Not a plausible pathway for this mega-habitat – addressed in the fringing wetlands.
Water resource use	Decreased freshwater inflows	Increased salinity affects native vegetation	Unlikely	Minor	Low	Approximately one-third of average annual flow in the Latrobe, Thomson and Macalister Rivers is diverted, affecting all but large floods (Tilleard and Ladson 2010). However, the literature suggests that the changes to ecology have already occurred at Lake Wellington, and the risk of future increases in salinity are focused more on the fringing wetlands. Therefore, the risk here is considered low, but effects to fringing wetlands have been considered in their risk assessments
Water resource use	Decreased freshwater inflows	Increased salinity affects fauna directly (e.g. fish and invertebrates) or indirectly through habitat alteration (e.g. waterbirds)	Unlikely	Minor	Low	See above
Water resource use	Decreased freshwater inflows	Increased salinity affects breeding triggers for black bream and other estuarine fish (in estuarine reaches), reducing fish populations	Possible	Moderate	Medium	Salinity is important in the success of the spawning of black bream and a reduction in freshwater inflows has been identified as a threat to the population of this species (Tilleard et al. 2009, BMT WBM 2010a, Kemp et al. 2013). However, current populations are considered stable, despite a change in age structure (Kemp et al. 2013).

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Water resource use	Decreased freshwater inflows	Impacts to fish affect recreational fishery	Possible	Minor	Low	The direct impact (decreased salinity affecting spawning and recruitment) occurs in the estuarine reaches of the rivers. However the flow on impacts to fish stocks and fishing are relevant to the deep water habitat. However, the recreational fishery covers more than just black bream and it is likely that fishers will catch whatever species is most common in the more saline conditions.
Water resource use	Decreased freshwater inflows	Impacts to fish affect commercial fishery	Possible	Minor	Low	See above: commercial fishing is not for a single species only and can adapt to the fish present.
Water resource use	Decreased connectivity	Affects migratory routes of fish including threatened Australasian grayling	Possible	Major	High	The Australian Grayiing migrates from fresh to marine waters as part of its lifecycle, with the return of juveniles to the river in spring (November) the most vulnerable phase (Koehn and O'Connor 1990). Recent research suggests that the fish migrate out to the open ocean in the juvenile phase (Schmidt et al. 2011) which would mean passing through the Lakes system and out to Bass Strait at Lakes Entrance. As this mega habitat includes the estuarine reaches of the Mitchell, Nicholson and Tambo Rivers, this impact pathway has been included. Australian Grayling and other diadromous fish require low flow freshes in spring and summer to complete their lifecycles. Recruitment failures in 3 to 4 years would represent a high risk to short lived species (Tilleard and Ladson 2010).
Invasive species	Introduced marine pests (European shore crab)	Increased competition and predation results in a decline in native species extent, diversity and abundance	Almost certain	Major	Extreme	Based on anecdotal reports of tonnes of crabs harvested monthly. Described as a voracious predator with the following potential impacts "In Australia they may have a great impact including direct impacts on prey species, indirect effects on species competing for the same prey, and indirect impacts on nutrient availability (by removing bivalves which filter algae and larvae) http://www.mesa.edu.au/marine_pests/marine_pests04.asp Risk based on presence of species in the Lakes and preliminary risk assessment by Nathan Bott for the GLMAC.
Invasive species	Introduced marine pests (other species)	Increased competition and predation results	Unlikely	Major	Medium	Based on preliminary risk assessment by Nathan Bott for the GLMAC. These species have not yet been recorded in the lakes, and so potential for impact in next eight years is unlikely.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
		in a decline in native species extent, diversity and abundance				However, some if introduced to the system could have a major impact (northern pacific seastar, Wakame seaweed, NZ screw shell).
Invasive species	Introduced marine pests	Impacts to fish affects commercial fishing	Unlikely	Negligible	Negligible	European shore crab: can be commercially harvested and sold.
Invasive species	Non-native terrestrial animals (foxes)	Predation on nesting, feeding and roosting waterbirds	Likely	Moderate	Medium	Particularly in Jones Bay which is a major bird hotspot and a refuge for salt tolerant bird species.
Invasive species	Non-native fish (carp)	Increase in turbidity affecting flora and fauna	Almost certain	Moderate	High	Carp are known to occur in Lake Wellington and have been identified as a cause for loss of vegetation and increased turbidity (Harris et al. 1998).
Invasive species	Non-native fish (carp)	Competition and predation affect native fish abundance and diversity	Almost certain	Moderate	High	See above
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects native vegetation	Unlikely	Minor	Low	Again based on the assumption that the vegetation of Lake Wellington is already switched to a new stable state.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects fauna directly (e.g. fish and invertebrates) or indirectly through habitat alteration (e.g. waterbirds)	Unlikely	Minor	Low	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects breeding triggers for black bream and other estuarine fish (in estuarine reaches), reducing fish populations	Likely	Major	High	Based on same evidence and assumptions as “decreased freshwater flows from water resource use”. An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013). This was considered to be a significantly increased risk to the ecology of the system than from water resource use alone.
Climate change and severe weather: Drought	Decreased freshwater inflows	Impacts to fish affect recreational fishery	Possible	Minor	Low	
Climate change and severe weather: Drought	Decreased freshwater inflows	Impacts to fish affect commercial fishery	Possible	Minor	Low	See above: commercial fishing is not for a single species only and can adapt to the fish present.
Climate change and severe weather: Drought	Decreased connectivity	Affects migratory routes of fish including threatened Australian grayling	Likely	Extreme	Extreme	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects littoral vegetation	Likely	Major	High	Extensive climate modelling and impact assessments have indicated a likely increase in sea level coupled with an increase in the frequency and intensity of storms (DSE 2013, McInnes et al. 2013). Potential impacts include physical damage to shorelines, vegetation and assets; as well as increased inundation. Recent studies indicate that there is significant risk of erosion around the shores of Lake Wellington and Jones Bay (Arrowsmith et al. 2014).
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects intertidal and sub-tidal seagrass condition and extent	Likely	Major	High	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Impacts to seagrass affect aquatic biota	Possible	Moderate	Medium	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Impacts to biota affect recreational fishing	Possible	Minor	Low	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Impacts to fish affects commercial fishing	Possible	Minor	Low	See above: commercial fishing is not for a single species only and can adapt to the fish present.
Climate change and severe weather:	Increased inundation and physical damage	Damage to recreational infrastrcture impacting waterbased and	Possible	Moderate	Medium	

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Storms and sea level rise		beside water recreation				
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects visual amenity	Possible	Minor	Low	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Damages the silt jetties	Possible	Extreme	High	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects Aboriginal cultural heritage including significant sites	Not assessed through the risk assessment process, but through separate consultation.			
Dredging: changed entrance conditions	Increased tidal exchange	Altered hydrodynamic process lead to altered salinity in the Lakes due to increased tidal exchange and increased salinity in the lakes, impacting flora and fauna	Rare	Negligible	Negligible	Evidence from hydrodynamic modelling indicates no effect of the modifications to the channel on salinity in the Lakes (Reynolds et al. 2011). Which is consistent with previous investigations (Webster et al. 2001)
Fishing and harvesting aquatic resources	Direct removal of native fauna	Effects diversity and abundance of aquatic biota	Unlikely	Negligible	Negligible	Current research indicates a stable fish population for commercial species (Kemp et al. 2013). Fisheries in Lake Wellington are mostly for carp.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Hunting and collecting terrestrial animals	Direct removal of native species	Decreased waterbird diversity and abundance (ducks)	Possible	Minor	Low	Hunting for ducks permitted in parts of Lake Wellington, where it remains a popular activity (Parks Victoria 2007); but controlled by existing management plan and limits placed to ensure sustainability.
Recreational activities	Increased boat traffic	Impacts to dolphins	Almost certain	Moderate	High	Based on discussions with dolphin researcher Kate Charlton-Robb.
Recreational activities	Increased boat traffic	Physical removal of seagrass	Almost certain	Minor	Medium	Knowledge gap - disturbance and recovery of seagrass beds. Large amounts of seagrass observed damaged by recreational boats
Recreational activities	Increased noise, traffic, dogs, walkers	Disturbance of shorebirds and nesting waterbirds	Likely	Minor	Medium	The shallow lakes are not core habitat for shorebirds, nor do they contain the nesting habitat for the threatened species.
Recreational activities	Nutrients and litter	Waste for recreational activities impacts aquatic biota and waterbirds	Possible	Negligible	Negligible	

Table A- 6: Risk Assessment for the freshwater wetlands mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth impacting freshwater macrophytes	Possible	Minor	Low	Presence of algal blooms (including toxic cyanobacteria) have been reported for both Sale Common and Macleod Morass; linked to increased nutrients in the system (Earth Tech 2003, Parks Victoria 2005). Impacts of this on vegetation are less certain.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish)	Possible	Minor	Low	Although algal blooms have occurred, there is little or no water quality information from these freshwater areas and low dissolved oxygen events and fish kills have not been reported.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding	Possible	Negligible	Negligible	Macleod Morass and Sale Common are characterised by extensive reed beds (Parks Victoria 2005, BMT WBM 2010a). This habitat for feeding waterbirds is not likely to be significantly impacted by algal blooms. Given the lack of evidence of impacts on fish, the only plausible impact pathway is reduced visibility and catch success in piscivores.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects visual amenity	Possible	Minor	Low	The presence of algal blooms, and slicks caused by cyanobacterial blooms affect visual amenity. However, this was considered to be less of an impact in marsh wetlands, than in open water lagoons that are normally clear and blue.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects water based	Possible	Minor	Low	Water based recreation at Sale Common and Macleod Morass are mostly related to nature observation, camping, and in Macleod Morass, hunting (Parks Victoria 2005, 2007). The impact of algal blooms is likely to be marginal.

		recreation and tourism				
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects recreational fishing	Unlikely	Minor	Low	Recreational fishing is permitted in both freshwater wetlands, but other locations in the Gippsland Lakes are more popular for this activity (Parks Victoria 2005, 2007, BMT WBM 2010)
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects commercial fishing	Unlikely	Negligible	Negligible	Commercial fishing of eels and carp occurs in Macleod Morass (Parks Victoria 2005). These species are known to be tolerant of high turbidity and productive systems (Baker 2012) and unlikely to be affected by the water quality within these systems.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Agricultural effluents	Increased sediments	Impacts freshwater macrophytes	Unlikely	Minor	Low	Sediment loads from agricultural lands have been estimated to comprise approximately two thirds of the load to the lakes (Grayson 2006). Historically, this was the cause of the decline in submerged plants in Lake Wellington (Harris et al. 1998). However, both Macleod Morass and Sale Common are emergent macrophyte dominated, reducing the impact in this mega-habitat.
Pollution: Agricultural effluents	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Rare	Minor	Negligible	Primary Industries Research Victoria (2006) indicated that a threshold of 100 mg/L was a conservative estimate for expecting effects on fish and marine invertebrates (considering effects to more vulnerable juvenile stages). Although there is no data, this level of TSS is unlikely to occur for any length of time.
Pollution: Agricultural effluents	Increased sediments	Reduced light affects waterbird feeding	Unlikely	Negligible	Negligible	

Pollution: Agricultural effluents	Increased sediments	Affects visual amenity	Unlikely	Minor	Low	
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects recreational fishing	Rare	Minor	Negligible	
Pollution: Agricultural effluents	Increased sediments	Increased nutrients from the catchment result in increased algal growth and affects commercial fishing	Rare	Minor	Negligible	
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Agricultural effluents	Toxicants (steroid hormones)	Affects fish (including threatened species)	Possible	Moderate	Medium	Risk assessment on chemicals in the Gippsland Lakes identified the highest risk from steroid hormones from the dairy industry and concluded (Allinson 2009): “Extremely high profile environmental issue; very highly plausible threat in lower reaches of rivers servicing GLRS (dairy and beef farming); could affect amphibian reproduction and development via EDC mechanisms; could affect fish reproduction and development through EDC mechanisms; potential population effects.”
Pollution: Agricultural effluents	Toxicants (steroid hormones)	Affects frogs (including threatened species)	Possible	Moderate	Medium	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth impacting freshwater macrophytes	Possible	Minor	Low	Sale Common receives water from Flooding Creek which has considerable input of wastewater and stormwater from the town of Sale (Earth Tech 2003, Parks Victoria 2007). Similarly, Macleod Morass receives wastewater form the Bairnsdale WTP (Parks Victoria 2005). Elevated nutrients and sediments have been identified as a potential issue from this source at both locations, and so risk have been considered equivalent to those from catchment loads.

Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish)	Possible	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding	Possible	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects visual amenity	Possible	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects water based recreation and tourism	Possible	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects recreational fishing	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result	Unlikely	Negligible	Negligible	

		in increased algal growth and affects commercial fishing				
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Sewage and stormwater	Increased sediments	Impacts freshwater macrophytes	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Rare	Minor	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Reduced light affects waterbird feeding	Unlikely	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Affects visual amenity	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects recreational fishing	Rare	Minor	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Increased nutrients from the catchment result in increased algal growth and affects commercial fishing	Rare	Minor	Negligible	

Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Wildfire	Increased nutrients and sediment	Effects on freshwater macrophytes	Possible	Minor	Low	Assumption that this impact pathway is for a large fire followed by heavy rain / significant flow as what occurred in 2006/7. This event resulted in three times the average annual load of phosphorus and over twice the average annual load of nitrogen entered the lakes after intense rainfall fell on burned catchments mobilising large amounts of sediment and associated nutrients (SKM 2008). However, the impacts on freshwater marshes dominated by emergent vegetation were considered less than that on open clear water systems (Deep Lakes). It is also likely that the small catchments of the creeks that feed onto the freshwater systems are less likely to carry significant loads post fire.
Wildfire	Increased nutrients and sediment	Effects aquatic biota (fish)	Possible	Minor	Low	
Wildfire	Increased nutrients and sediment	Effects waterbirds	Possible	Negligible	Negligible	
Wildfire	Increased nutrients and sediment	Effects visual amenity	Possible	Minor	Low	
Wildfire	Increased nutrients and sediment	Effects waterbased recreation	Possible	Minor	Low	
Wildfire	Increased nutrients and sediment	Effects recreational fishing	Unlikely	Negligible	Negligible	
Wildfire	Increased nutrients and sediment	Effects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Mining effluents	Toxicants	Effects health of aquatic food webs (fish,frogs, birds)	Possible	Moderate	Medium	Evidence of elevated mercury concentrations in dead dolphins in the Gippsland Lakes. Levels in live animals were also high, and are attributable to chronic low dose exposure to mercury from the dolphin's diet (Monk et al. 2014). Historical research indicates sediment concentrations of mercury > 100 times ANZECC ISQG

						guidelines (Glover et al. 1980) and a 58% increase in the concentration of mercury in fish from the Lake from 1979 to 1997 (Fabris 2012). Historical gold mining and current coal mining / power generation were identified as likely causes (Glover et al. 1980).
Pollution: Mining effluents	Toxicants	Effects recreational fishing	Possible	Minor	Low	Average concentrations in 1997 were below food safety standards, but some individuals were above food safety standards (Fabris et al. 1999) and there is no recent data. Consequences based on lower levels of recreational fishing in this habitat
Pollution: Mining effluents	Toxicants	Effects commercial fishing	Possible	Moderate	Medium	
Pollution: Mining effluents	Toxicants	Effects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Mining effluents	Toxicants	Effects waterbased recreation and tourism	Possible	Moderate	Medium	Possible effects to tourism, but no known contact toxicants from mining in the catchment.
Pollution: Mining effluents	Increased sediments	Impacts freshwater macrophytes	Rare	Minor	Negligible	
Pollution: Mining effluents	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Rare	Minor	Negligible	
Pollution: Mining effluents	Increased sediments	Reduced light affects waterbird feeding	Rare	Negligible	Negligible	
Pollution: Mining effluents	Increased sediments	Affects visual amenity	Rare	Minor	Negligible	
Pollution: Mining effluents	Increased sediments	Effects on fish affects recreational fishing	Rare	Minor	Negligible	
Pollution: Mining effluents	Increased sediments	Effects on fish affects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			

		(fishing, collecting aquatic foods)				
Pollution: Oil Spills	Hydrocarbons				#N/A	Oil spill mapping indicates even in the event of a very large spill, oil would not extend to this mega-habitat. Not a plausible pathway. See Transport: Roads and railways for impacts from road wash.
Exposure of ASS	Increased acidity	Impacts flora and fauna (including threatened species)	Unlikely	Moderate	Low	Acid sulphate soils are known from the fringing wetlands ((Boon et al. 2007), but studies from Sale Common indicate that there are Potential ASS, but not active.
Exposure of ASS	Toxicants	Toxicants in the sediments are mobilised impacting flora and fauna	Unlikely	Major	Medium	Toxicant levels in these freshwater systems are not known, results from brackish fringing wetlands indicated no mobilisation of toxicants from acidification (Boon et al. 2007).
Water resource use	Decreased freshwater inflows	Altered water regime affects native vegetation diversity, community composition and extent	Almost certain	Major	Extreme	Approximately one-third of average annual flow in the Latrobe, Thomson and Macalister Rivers is diverted, affecting all but large floods (Tilleard and Ladson 2010). Altered water regimes have been identified as a significant threat to these freshwater systems (Parks Victoria 2005, 2007), with altered flows suggested as mechanisms for changes to vegetation community composition and extent (BMT WBM 2010a).
Water resource use	Decreased freshwater inflows	Altered water regimes affect threatened plant species	Possible	Major	High	Dwarf kerrawang is known from Sale Common (BMT WBM 2010) and is known to require periodic / seasonal inundation with freshwater (Carter and Walsh 2010b). Alteration to wetting and drying regimes is a serious threat.
Water resource use	Decreased freshwater inflows	Altered water regimes affect waterbird feeding through habitat alteration (including Australiasin bittern)	Likely	Moderate	Medium	Australasian bittern has been recorded at Macleod Morass and prefers dense emergent vegetation.
Water resource use	Decreased freshwater inflows	Altered water regimes affect waterbird breeding (abandonment of nests, etc)	Likely	Moderate	Medium	Macleod Morass is considered important for breeding colonial nesting species: Australian white ibis (up to 300 pairs); straw-necked ibis (up to 300 pairs); and Sale Common for black swan (up to 500 pairs) (BMT WBM 2010a). The importance of maintaining water levels to complete waterbird breeding cycles is well established (Brandis 2010).

Water resource use	Decreased freshwater inflows	Altered water regimes affect threatened frog species	Likely	Major	High	Growling grass frog (*Litoria raniformis*) has been recorded in Sale Common (Urlus and Ricciardello 2012) which is reliant on freshwater habitat for feeding and breeding (Gillespie 1996). Recent reviews have indicated that altered water regimes and reduced complexity of aquatic vegetation are probably causes of current localised extinctions, and predictors of future extinctions in growling grass frog (Wassens et al. 2010).
Water resource use	Decreased freshwater inflows	Increased salinity affects native vegetation	Unlikely	Moderate	Low	Increased salinity has been identified as a critical threat to both Sale Common and Macleod Morass (Earth Tech 2003, Parks Victoria 2005), although there is a lack of water quality data from these sites.
Water resource use	Decreased freshwater inflows	Increased salinity affects threatened plant species	Unlikely	Major	Medium	Dwarf kerrawang is known from Sale Common (BMT WBM 2010) and is known to require periodic / seasonal inundation with freshwater (Carter and Walsh 2010). Salinisation, could result in a decline in the species.
Water resource use	Decreased freshwater inflows	Increased salinity affects aquatic fauna (fish and invertebrates); including threatened dwarf galaxias	Unlikely	Moderate	Low	Dwarf galaxias is a freshwater species, and an increase in salinity could reduce the habitat for this and other freshwater native species
Water resource use	Decreased freshwater inflows	Increased salinity affects waterbirds through habitat alteration	Unlikely	Minor	Low	Waterbirds are mobile and adapted to a range of aquatic habitats. However, Sale Common and Macleod Morass represent the only freshwater wetlands in the Ramsar site. Some waterbirds are dependent on freshwater habitat for drinking water and food resources.
Water resource use	Decreased freshwater inflows	Increased salinity affects threatened frog species	Unlikely	Moderate	Low	Growling grass frog (*Litoria raniformis*) has been recorded in Sale Common (Urlus and Ricciardello 2012) which is reliant on freshwater habitat for feeding and breeding (Gillespie 1996). Salinisation would reduce suitable habitat for the species.
Invasive species	Native species (Typha and giant rush)	Increased competition displaces native vegetation species, reducing diversity of native wetland flora	Almost certain	Moderate	High	Expansion of Typha has been identified as an ongoing problem in Macleod Morass (Parks Victoria 2005) and Sale Common (BMT WBM 2010)

Invasive species	Native species (Typha and giant rush)	Impacts to vegetation impact fauna through habitat alteration	Likely	Moderate	Medium	
Invasive species	Non-native plants (e.g. Brazillian milfoil)	Competition impacts diversity and abundance of native flora	Possible	Moderate	Medium	Brazilian milfoil is listed in the ECD as a threat to Sale Common (BMT WBM 2010)
Invasive species	Non-native fish (carp and gambusia)	Predation and competition affect diversity and abundance of native fish	Almost certain	Moderate	High	Carp are known from both locations of this mega-habitat, but *Gambusia holbrooki*, is not presently known to be a key threat to the site (BMT WBM 2010).
Invasive species	Non-native fish (carp and gambusia)	Habitat alteration results in impacts to aquatic macrophytes	Almost certain	Minor	Medium	
Invasive species	Non-native fish (carp and gambusia)	Increased turbidity affects visual amenity	Likely	Moderate	Medium	
Invasive species	Non-native terrestrial animals (foxes and cats)	Predation on nesting, feeding and roosting waterbirds	Likely	Moderate	Medium	
Invasive species	Non-native terrestrial animals (foxes and cats)	Impacts to waterbirds affect recreational activities such as bird watching	Rare	Negligible	Negligible	
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regime affects native vegetation diversity, community composition and extent	Almost certain	Moderate	High	Based on same evidence and assumptions as “decreased freshwater flows from water resource use”. An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013). This was considered to be a significantly increased risk to the ecology of the system than from water resource use alone.

Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect threatened plant species	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect waterbird feeding through habitat alteration	Likely	Minor	Medium	
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect waterbird breeding (abandonment of nests, etc)	Likely	Moderate	Medium	
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect threatened frog species	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects native vegetation	Almost certain	Moderate	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects threatened plant species	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects aquatic fauna (fish and invertebrates); including threatened dwarf galaxias	Likely	Moderate	Medium	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects waterbirds through habitat alteration	Likely	Minor	Medium	

Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects threatened frog species	Likely	Major	High	
Hunting and collecting terrestrial animals	Direct removal of native species	Decreased waterbird diversity and abundance (ducks)	Possible	Minor	Low	Hunting for ducks permitted in Macleod Morass, where it remains a popular activity (Parks Victoria 2005); but controlled by existing management plan and limits placed to ensure sustainability.
Recreational activities	Increased noise	Disturbance of nesting waterbirds	Likely	Moderate	Medium	Walking tracks close to rookeries at Sale Common, but impact less than at Deep Lakes on nesting threatened species
Recreational activities	Nutrients and litter	Waste for recreational activities impacts aquatic biota and waterbirds	Possible	Negligible	Negligible	
Recreational activities (illegal 4WD)	Physical damage	Affects vegeation and habitat for biota	Almost certain	Moderate	High	
Transport: Roads and railroads	Built environment	Affects visual amenity	Likely	Moderate	Medium	Upgrading of roads adjacent to freshwater sites
Transport: Roads and railroads	Oil and toxicants	Affects flora and fauna	Likely	Moderate	Medium	

Table A- 7: Risk Assessment for the variably saline wetlands mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Residential and commercial development	Presence of development on wetland shores	Affects visual amenity			#N/A	Not a plausible pathway. Fringing wetlands are buffered from development (i.e. you cannot see large tracts of developed buildings and houses from the wetlands?
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth impacting emergent macrophytes and saltmarsh	Rare	Minor	Negligible	Although algal blooms have been recorded in this mega-habitat (SKM 2001, Boon et al. 2007) the majority of these wetlands are marshes dominated by emergent vegetation, with coloured water. Algal blooms are unlikely to impact these vegetation types.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish)	Possible	Minor	Low	Low dissolved oxygen events have been recorded in some of these wetlands e.g Dowds Morass (Boon et al. 2007), but whether this has resulted in fish deaths remains unknown.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding	Rare	Negligible	Negligible	These wetlands are considered most important for large wading birds and shorebirds (BMT WBM 2010). These feeding habitats are less likely to be impacted by increased primary productivity.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects visual amenity	Unlikely	Minor	Low	The presence of algal blooms, and slicks caused by cyanobacterial blooms affect visual amenity. However, this was considered to be less of an impact in marsh wetlands, than in open water lagoons that are normally clear and blue.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result	Unlikely	Minor	Low	Water based recreation at these wetlands includes camping, hunting and nature observation (Parks Victoria 2005, 2007). The impact of algal blooms is likely to be marginal.

		in increased algal growth and affects water based recreation and tourism				
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects recreational fishing	Unlikely	Minor	Low	Recreational fishing is permitted in both freshwater wetlands, but other locations in the Gippsland Lakes are more popular for this activity (Parks Victoria 2005, 2007, BMT WBM 2010)
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects commercial fishing	Unlikely	Negligible	Negligible	Commercial fishing of eels occurs in is permitted in some of the reserves and wetlands (Parks Victoria 2007). These species are known to be tolerant of high turbidity and productive systems (Baker 2012) and unlikely to be affected by the water quality within these systems.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Agricultural effluents	Increased sediments	Impacts emergent macrophytes and saltmarsh	Rare	Minor	Negligible	Sediment loads from agricultural lands have been estimated to comprise approximately two thirds of the load to the lakes (Grayson 2006). Historically, this was the cause of the decline in submerged plants in Lake Wellington (Harris et al. 1998). However most of the fringing wetlands are dominated by emergent vegetation and / or coloured water, reducing the impact in this mega-habitat.
Pollution: Agricultural effluents	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Rare	Minor	Negligible	

Pollution: Agricultural effluents	Increased sediments	Reduced light affects waterbird feeding	Rare	Negligible	Negligible	
Pollution: Agricultural effluents	Increased sediments	Affects visual amenity	Unlikely	Minor	Low	
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects recreational fishing	Rare	Minor	Negligible	
Pollution: Agricultural effluents	Increased sediments	Increased nutrients from the catchment result in increased algal growth and affects commercial fishing	Rare	Minor	Negligible	
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Agricultural effluents	Toxicants (steroid hormones)	Affects fish	Possible	Major	High	Risk assessment on chemicals in the Gippsland Lakes identified the highest risk from steroid hormones from the dairy industry and concluded (Allinson 2009): “Extremely high profile environmental issue; very highly plausible threat in lower reaches of rivers servicing GLRS (dairy and beef farming); could affect amphibian reproduction and development via EDC mechanisms; could affect fish reproduction and development through EDC mechanisms; potential population effects.” Threatened fish species Dwarf galaxias has been recorded in Dowd Morass (SKM 2001)
Pollution: Agricultural effluents	Toxicants (steroid hormones)	Affects frogs (including threatened species)	Possible	Major	High	See above, and the growling grass frog was recently recorded in Heart Morass (Urlus and Ricciardello 2012).
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal	Possible	Minor	Low	SA number of the fringing wetlands receive wastewater form WTP or storm water sources (Parks Victoria 2007). Elevated nutrients and sediments have been identified as a potential issue from this source at a number of the fringing wetlands (SKM 2001, Boon et al. 2007).

		growth impacting emergent macrophytes and saltmarsh				
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, decreased dissolved oxygen and impacts to aquatic biota (fish)	Possible	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding	Possible	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects visual amenity	Possible	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects water based recreation and tourism	Possible	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects recreational fishing	Unlikely	Minor	Low	

Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects commercial fishing	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Sewage and stormwater	Increased sediments	Impacts emergent macrophytes and saltmarsh	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Rare	Minor	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Reduced light affects waterbird feeding	Unlikely	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Affects visual amenity	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects recreational fishing	Rare	Minor	Negligible	
Pollution: Sewage and stormwater	Increased sediments	Increased nutrients from the catchment result in increased algal growth and affects	Rare	Minor	Negligible	

		commercial fishing				
Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Wildfire	Increased nutrients and sediment	Effects on emergent macrophytes and saltmarsh	Possible	Minor	Low	Assumption that this impact pathway is for a large fire followed by heavy rain / significant flow as what occurred in 2006/7. This event resulted in three times the average annual load of phosphorus and over twice the average annual load of nitrogen entered the lakes after intense rainfall fell on burned catchments mobilising large amounts of sediment and associated nutrients (SKM 2008). However, the impacts on freshwater marshes dominated by emergent vegetation were considered less than that on open clear water systems (deep lakes).
Wildfire	Increased nutrients and sediment	Effects aquatic biota (fish)	Possible	Minor	Low	
Wildfire	Increased nutrients and sediment	Effects waterbirds	Possible	Negligible	Negligible	
Wildfire	Increased nutrients and sediment	Effects visual amenity	Possible	Minor	Low	
Wildfire	Increased nutrients and sediment	Effects waterbased recreation	Possible	Minor	Low	
Wildfire	Increased nutrients and sediment	Effects recreational fishing	Unlikely	Minor	Low	
Wildfire	Increased nutrients and sediment	Effects commercial fishing	Unlikely	Minor	Low	
Wildfire	Increased nutrients and sediment	Effects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			

Pollution: Mining effluents	Toxicants	Effects health of aquatic food webs (fish,frogs, birds)	Possible	Moderate	Medium	Evidence of elevated mercury concentrations in dead dolphins in the Gippsland Lakes. Levels in live animals were also high, and are attributable to chronic low dose exposure to mercury from the dolphin's diet (Monk et al. 2014). Historical research indicates sediment concentrations of mercury > 100 times ANZECC ISQG guidelines (Glover et al. 1980) and a 58% increase in the concentration of mercury in fish from the Lake from 1979 to 1997 (Fabris et al. 1999). Historical gold mining and current coal mining / power generation were identified as likely causes (Glover et al. 1980). Toxicant concentrations in the fringing wetland Dowd Morass were analysed from a small number of sediment samples collected in 2004, which found low concentrations of metal, including mercury (Boon et al. 2007).
Pollution: Mining effluents	Toxicants	Effects recreational fishing	Possible	Minor	Low	Average concentrations in 1997 were below food safety standards, but some individuals were above food safety standards (Fabris et al. 1999) and there is no recent data. Consequences based on lower levels of recreational fishing in this habitat
Pollution: Mining effluents	Toxicants	Effects commercial fishing	Possible	Minor	Low	
Pollution: Mining effluents	Toxicants	Effects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Mining effluents	Toxicants	Effects waterbased recreation and tourism	Possible	Minor	Low	Possible effects to tourism, but no known contact toxicants from mining in the catchment.
Pollution: Mining effluents	Increased sediments	Impacts emergent macrophytes and saltmarsh	Rare	Minor	Negligible	
Pollution: Mining effluents	Increased sediments	Reduced light / physical abrasion of gills affects aquatic biota (fish and invertebrates)	Rare	Minor	Negligible	
Pollution: Mining effluents	Increased sediments	Reduced light affects waterbird feeding	Rare	Negligible	Negligible	
Pollution: Mining effluents	Increased sediments	Affects visual amenity	Rare	Minor	Negligible	

Pollution: Mining effluents	Increased sediments	Effects on fish affects recreational fishing	Rare	Minor	Negligible	
Pollution: Mining effluents	Increased sediments	Increased nutrients from the catchment result in increased algal growth and affects commercial fishing	Rare	Minor	Negligible	
Pollution: Mining effluents	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Oil Spills	Hydrocarbons				#N/A	Oil spill mapping indicates even in the event of a very large spill, oil would not extend to this mega-habitat. Not a plausible pathway
Exposure of ASS	Increased acidity	Impacts flora and fauna (including threatened species)	Almost certain	Major	Extreme	Acid sulphate soils are known from the fringing wetlands (Boon et al. 2007), and recent studies indicate that at Dowd and Heart Morass, there are active ASS that have resulted in very low pH levels < 3 (Unland 2009, Taylor 2011).
Exposure of ASS	Toxicants	Toxicants in the sediments are mobilised impacting flora and fauna	Likely	Major	High	Recent studies indicated that the ASS in both Dowd and Heart Morass have lead to the mobilisation of metals at concentrations that are likely to cause biological effects (Unland 2009, Taylor 2011).
Water resource use	Decreased freshwater inflows	Altered water regime affects native vegetation diversity, community composition and extent	Almost certain	Major	Extreme	Approximately one-third of average annual flow in the Latrobe, Thomson and Macalister Rivers is diverted, affecting all but large floods (Tilleard and Ladson 2010). Altered water regimes have been identified as a significant threat to the fringing wetlands (Parks Victoria 2005, 2007), with altered flows suggested as mechanisms for changes to vegetation community composition and extent (BMT WBM 2010).
Water resource use	Decreased freshwater inflows	Altered water regimes affect threatened plant species (dwarf kerrawang;	Possible	Major	High	The three threatened flora species within the Ramsar site dwarf kerrawang (Commersonia prostrate); swamp everlasting (Xerochrysum palustre); and metallic sun-orchid (Thelymitra epipactoides) are present in the fringing wetlands near Blond Bay Nature Reserve (BMT WBM 2010) and all require freshwater

		metallic sun orchid and swamp everlasting)				inundation to varying degrees (Carter and Walsh 2010a, 2010b). Altered hydrology is considered threatening process for the species
Water resource use	Decreased freshwater inflows	Altered water regimes affect waterbird feeding through habitat alteration	Almost certain	Moderate	High	
Water resource use	Decreased freshwater inflows	Altered water regimes affect waterbird breeding (abandonment of nests, etc)	Possible	Moderate	Medium	Fringing wetlands have been identified as important breeding sites for waterbirds as follows (BMT WBM 2010): Lake Coleman (east) and Tucker Swamp: Australian pelican (200 pairs); pied cormorants Dowd Morass: large egret (50 pairs), little pied and little black cormorants (1000+ pairs), large black cormorants (two – 50 pairs), royal spoonbill (250 pairs); sacred ibis (1500 pairs); strawnecked ibis (1500 pairs); both rufous night heron and glossy ibis also breed in this wetland. The importance of maintaining water levels to complete waterbird breeding cycles, particularly for colonial nesting species, is well established (Brandis 2010)
Water resource use	Decreased freshwater inflows	Altered water regimes affect threatened frog species	Likely	Major	High	Growling grass frog (*Litoria raniformis*) has been recorded in Heart Morass (Urlus and Ricciardello 2012) which is reliant on freshwater habitat for feeding and breeding (Gillespie 1996). Recent reviews have indicated that altered water regimes and reduced complexity of aquatic vegetation are probably causes of current localised extinctions, and predictors of future extinctions in growling grass frog (Wassens et al. 2010).
Water resource use	Decreased freshwater inflows	Increased salinity affects native vegetation	Almost certain	Moderate	High	Increased salinity has been identified as a critical threat to a large number of the fringing wetlands (SKM 2001, 2004, Boon et al. 2007, Tilleard et al. 2009). Limited data suggested that increased salinity has occurred and continues to occur resulting in significant ecological shifts (Borg and Savage 2005).
Water resource use	Decreased freshwater inflows	Increased salinity affect threatened plant species (dwarf kerrawang; metallic sun orchid and swamp everlasting)	Possible	Major	High	The three threatened flora species within the Ramsar site dwarf kerrawang (*Commersonia prostrate*); swamp everlasting (*Xerochrysum palustre*); and metallic sun-orchid (*Thelymitra epipactoides*) are present in the fringing wetlands near Blond Bay Nature Reserve (BMT WBM 2010) and all require freshwater inundation to varying degrees (Carter and Walsh 2010a, 2010b). Salinisation, could result in a decline in the species.

Water resource use	Decreased freshwater inflows	Increased salinity affects aquatic fauna (fish and invertebrates); including threatened dwarf galaxias	Possible	Moderate	Medium	Dwarf galaxias is a freshwater species, that has been recorded in Dowd Morass (SKM 2001) and an increase in salinity could reduce the habitat for this and other freshwater native species
Water resource use	Decreased freshwater inflows	Increased salinity affects waterbirds through habitat alteration	Unlikely	Moderate	Low	Waterbirds are mobile and adapted to a range of aquatic habitats. Many of the species that use these variably saline wetlands would be adapted to the range of salinity.
Water resource use	Decreased freshwater inflows	Increased salinity affects threatened frog species	Almost certain	Moderate	High	Growling grass frog (*Litoria raniformis*) has been recorded in Heart Morass (Urlus and Ricciardello 2012) which is reliant on freshwater habitat for feeding and breeding (Gillespie 1996). Salinisation would reduce suitable habitat for the species.
Invasive species	Native species (Typha and common reed)	Increased competition displaces native vegetation species, reducing diversity of native wetland flora	Possible	Moderate	Medium	Expansion of Typha and common reed has been identified as an ongoing problem in a number of the fringing wetlands including Clydebank Morass (BMT WBM 2010)
Invasive species	Native species (Typha and common reed)	Impacts to vegetation impact fauna through habitat alteration	Possible	Moderate	Medium	
Invasive species	Non-native fish (carp and gambusia)	Predation and competition affect diversity and abundance of native fish	Almost certain	Moderate	High	Carp are known from a number of the fringing wetlands, but Gambusia holbrooki, is not presently known to be a key threat to the site (BMT WBM 2010).
Invasive species	Non-native fish (carp and gambusia)	Habitat alteration results in impacts to aquatic macrophytes	Almost certain	Moderate	High	
Invasive species	Non-native fish (carp and gambusia)	Increased turbidity affects visual amenity	Likely	Moderate	Medium	

Invasive species	Non-native terrestrial animals (foxes and cats)	Predation on nesting, feeding and roosting waterbirds	Likely	Moderate	Medium	
Invasive species	Non-native terrestrial animals (foxes and cats)	Impacts to waterbirds affect recreational activities such as bird watching	Rare	Negligible	Negligible	
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regime affects native vegetation diversity, community composition and extent	Almost certain	Moderate	High	Based on same evidence and assumptions as “decreased freshwater flows from water resource use”. An assessment of the potential impacts of altered climate on river flow and river fed wetlands (such as the Gippsland Lakes) indicated that there would be a significant reduction in flow in the Latrobe River and a longer period between flow events that would inundate and flush wetlands (Tilleard and Ladson 2010, DSE 2013). This was considered to be a significantly increased risk to the ecology of the system than from water resource use alone.
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect threatened plant species (dwarf kerrawang; metallic sun orchid and swamp everlasting)	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect waterbird feeding through habitat alteration	Likely	Minor	Medium	
Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect waterbird breeding (abandonment of nests, etc)	Likely	Moderate	Medium	

Climate change and severe weather: Drought	Decreased freshwater inflows	Altered water regimes affect threatened frog species	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects native vegetation	Almost certain	Moderate	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affect threatened plant species (dwarf kerrawang; metallic sun orchid and swamp everlasting)	Likely	Major	High	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects aquatic fauna (fish and invertebrates)	Likely	Moderate	Medium	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects waterbirds through habitat alteration	Likely	Minor	Medium	
Climate change and severe weather: Drought	Decreased freshwater inflows	Increased salinity affects threatened frog species	Likely	Major	High	
Hunting and collecting terrestrial animals	Direct removal of native species	Decreased waterbird diversity and abundance (ducks)	Likely	Moderate	Medium	Hunting for ducks permitted in a number of the reserves, where it remains a popular activity (Parks Victoria 2007)
Recreational activities	Increased noise	Disturbance of shorebirds and nesting waterbirds	Likely	Moderate	Medium	A number of the fringing wetlands are considered important shorebird sites (BMT WBM 2010) and activities such as dog walking, hunting and other active recreational activities have the potential to disturb birds, reducing resources for return migration to the northern hemisphere
Recreational activities	Nutrients and litter	Waste from recreational activities impacts	Possible	Negligible	Negligible	

		aquatic biota and waterbirds				
Recreational activities (illegal 4WD)	Physical damage	Affects vegetation and habitat for biota	Almost certain	Moderate	High	

Table A- 8: Risk Assessment for the hypersaline wetlands mega-habitat.

Threats	Stressors	Impact pathway	Likelihood of impact	Consequence of impact	Risk	Comments
Residential and commercial development	Presence of development on lake shores	Affects visual amenity	Unlikely	Minor	Low	Commercial and residential development along the shorelines of the lakes has been identified as a community concern (GLMAC 2013); but at Lake Reeve is limited to the edge of Loch Sport.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and a decline in saltmarsh health	Unlikely	Minor	Low	Hydrology of Lake Reeve is different from the rest of the lakes, it receives water from Merrimans Creek and Carrs Creek; with the latter the only sizeable stream draining into the Lake. It has a catchment area of 250 square kilometres and is non perennial and contributes very small flows except during a wet winter (SKM 2004b). It also receives some tidal flow from the main lakes, which might be a potential pathway for nutrients from the main catchments to enter the system. Algal blooms have been recorded in the Lake, but given the intermittent nature of Lake Reeve, ad the dominant vegetation community being fringing saltmarsh, it is unlikely to be impacting the vegetation.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, decreased dissolved oxygen and impacts to aquatic biota	Rare	Minor	Negligible	Lake Reeve is mostly intermittent, with only a small residual pool, salinity is hypersaline, and so it is unlikely to supports a diverse fish community. The invertebrates fauna would be resilient to harsh conditions, and not likely to be negatively impacted by algal blooms.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth, impact waterbird feeding	Rare	Negligible	Negligible	Lake Reeve is significant for supporting feeding and roosting of shorebirds (BMT WBM 2010). Increased primary productivity is not excepted to negatively impact on these species.

Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects visual amenity	Rare	Negligible	Negligible	The lake is visible from the Loch Sport causeway and from boating activities in the main lakes. Question for the TAG – assumption that locals are used to the intermittent nature of the Lake and would not be distressed by algal blooms here.
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects water based recreation and tourism	Rare	Negligible	Negligible	
Pollution: Agricultural effluents	Increased nutrients	Increased nutrients from the catchment result in increased algal growth and affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Agricultural effluents	Increased sediments	Affects visual amenity	Rare	Negligible	Negligible	
Pollution: Agricultural effluents	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)			#N/A	Not a plausible pathway for this mega-habitat
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from sewage and stormwater result in increased algal growth and a decline in saltmarsh health	Unlikely	Minor	Low	Previous studies have indicated that (SKM 2004): estimated total phosphorus load to Lake Reeve from Loch Sport septic tanks is 49% estimated total nitrogen load to Lake Reeve from Loch Sport septic tanks is 27% estimated faecal coliform load to Lake Reeve from Loch Sport septic tanks is 36% However, as stated above, emergent saltmarsh

						communities are unlikely to be significantly affected by increased nutrients and algae.
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients from sewage and stormwater result in increased algal growth, decreased dissolved oxygen and impacts to aquatic biota	Rare	Minor	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth, impact waterbird feeding	Rare	Negligible	Negligible	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects visual amenity	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects water based recreation and tourism	Unlikely	Minor	Low	
Pollution: Sewage and stormwater	Increased nutrients	Increased nutrients sewage and stormwater result in increased algal growth and affects Aboriginal	Not assessed through the risk assessment process, but through separate consultation.			

		cultural heritage (fishing, collecting aquatic foods)				
Pollution: Sewage and stormwater	Increased sediments	Reduced light affects waterbird feeding			#N/A	Not a plausible pathway – shorebirds feeding in shallows and mudflats.
Pollution: Sewage and stormwater	Increased sediments	Affects visual amenity	Possible	Minor	Low	In localised areas only
Pollution: Sewage and stormwater	Increased sediments	Effects on fish affects Aboriginal cultural heritage (fishing, collecting aquatic foods)	Not assessed through the risk assessment process, but through separate consultation.			
Wildfire	Increased nutrients and sediment	Effects on aquatic biota			#N/A	Assumption that this impact pathway is for a large fire followed by heavy rain / significant flow as what occurred in 2006/7. This event resulted in three times the average annual load of phosphorus and over twice the average annual load of nitrogen entered the lakes after intense rainfall fell on burned catchments mobilising large amounts of sediment and associated nutrients (SKM 2008). Question for the TAG: Did the plume of nutrients and sediment extend into Lake Reeve?
Wildfire	Increased nutrients and sediment	Effects waterbirds			#N/A	
Wildfire	Increased nutrients and sediment	Effects visual amenity			#N/A	
Wildfire	Increased nutrients and sediment	Effects water based recreation			#N/A	
Wildfire	Increased nutrients and sediment	Effects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Mining effluents	Toxicants	Effects health of aquatic food webs			#N/A	Not a plausible pathway for this mega-habitat?
Pollution: Oil Spills	Hydrocarbons	Effects shoreline vegetation	Rare	Moderate	Negligible	Oil spill mapping indicates that there needs to be a large, sustained release of oil from more than one production well in Bass Strait, for the spill to enter the Ramsar site. This is considered to be a very

						unlikely scenario, but consequences are based on the impacts in the event oil does enter the Ramsar site, which would be at comparatively low levels.
Pollution: Oil Spills	Hydrocarbons	Direct oiling of wildlife	Rare	Minor	Negligible	
Pollution: Oil Spills	Hydrocarbons	Indirect long term effects (food webs, aquatic biota)	Rare	Major	Low	
Pollution: Oil Spills	Hydrocarbons	Affects visual amenity	Rare	Major	Low	
Pollution: Oil Spills	Hydrocarbons	Effects Aboriginal cultural heritage	Not assessed through the risk assessment process, but through separate consultation.			
Pollution: Oil Spills	Hydrocarbons	Effects water based recreation and tourism	Rare	Moderate	Negligible	
Exposure of ASS					#N/A	Knowledge gap
Water resource use	Decreased freshwater inflows				#N/A	Knowledge gap
Invasive species	Introduced marine pests (European shore crab)	Increased competition and predation results in a decline in native species extent, diversity and abundance	Unlikely	Minor	Low	No shorecrabs observed in Lake Reeve or other hypersaline wetlands (stakeholder workshop)
Invasive species	Introduced marine pests (other species)	Increased competition and predation results in a decline in native species extent, diversity and abundance	Unlikely	Major	Medium	Based on preliminary risk assessment by Nathan Bott for the GLMAC. These species have not yet been recorded in the lakes, and so potential for impact in next eight years is unlikely. However, some if introduced to the system could have a major impact (northern pacific seastar, Wakame seaweed, NZ screw shell).
Invasive species	Non-native terrestrial animals (foxes)	Predation on nesting, feeding and roosting waterbirds	Likely	Minor	Medium	Important habitat for shorebirds and other wading birds, but less vulnerable than nesting birds in Deep Lakes.

Climate change and severe weather: Drought	Decreased freshwater inflows					Knowledge gap
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects saltmarsh extent, community composition and health	Likely	Major	High	Extensive climate modelling and impact assessments have indicated a likely increase in sea level coupled with an increase in the frequency and intensity of storms (DSE 2013, McInnes et al. 2013). Potential impacts include physical damage to shorelines, vegetation and assets; as well as increased inundation. Recent studies indicate that there is a major increase in inundation for Lake Reeve and potential erosion of the shoreline.
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects shorebird feeding and roosting habitat	Likely	Moderate	Medium	Shorebirds have very specific water depth limitations for feeding (Burger et al. 1977, Davis and Smith 2001, Cole et al. 2002). A reduction in optimum habitat and / or a reduction in productivity could impact the suitability of this site for these species.
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Damage to recreational infrastructure impacting water based and beside water recreation	Possible	Minor	Low	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects visual amenity	Possible	Minor	Low	
Climate change and severe weather: Storms and sea level rise	Increased inundation and physical damage	Affects Aboriginal cultural heritage including significant sites	Not assessed through the risk assessment process, but through separate consultation.			
Dredging: changed entrance conditions	Increased tidal exchange	Altered hydrodynamic process lead to altered salinity in the Lakes due to increased tidal exchange and	Rare	Minor	Negligible	Evidence from hydrodynamic modelling indicates no effect of the modifications to the channel on salinity in the Lakes (Reynolds et al. 2011). Which is consistent with previous investigations (Webster et al. 2001)

		increased salinity in the lakes, impacting flora and fauna				
Recreational activities	Increased noise	Disturbance of shorebirds and nesting waterbirds	Likely	Moderate	Medium	Migratory shorebirds can be impacted by noise (motorised watercraft), people and dogs on the beach.
Recreational activities	Nutrients and litter	Waste for recreational activities impacts aquatic biota and waterbirds	Possible	Negligible	Negligible	

Appendix D: Prioritisation of values

Values for each mega habitat were scored according to the following criteria:

Table A- 9: Criteria for prioritisation of values (and descriptions of low (1), medium (2) and high (3) rankings).

Criteria	Description	Score
1. Critical to the ecological character of the Gippsland Lakes Ramsar Site	**Low priority:** Not an identified critical CPS[4], nor related to priority species / ecological communities.	1
	Medium priority: Value relates to one or more state listed and/or one or more items listed under international agreements; regional management priorities included in regional planning frameworks, management plans etc., but were not identified as a critical CPS in the ECD.	2
	High priority: Value is a critical component, process or service and present in the mega-habitat.	3
2. Supports ecological character	**Low priority:** Value regularly present at site but not directly involved in supporting a critical CPS.	1
	Medium priority: Value is not identified as a critical CPS but is considered important in supporting a critical CPS of the Ramsar site.	2
	High priority: Value is considered influential on two or more of the critical CPS and / or other values.	3
3. Community priority	**Low priority:** Not identified of concern by general community.	1
	Medium priority: Value identified as of moderate interest/concern for the community.	2
	High priority: Value identified as a high priority by the community	3
4. Risk (from risk assessment)	**Low priority:** No high or extreme risks identified for the value.	1
	Medium priority: One high risk identified for the value.	2
	High priority: An “extreme” risk and / or two or more “high” risks identified for the value.	3
5. Current condition	**Low priority:** No qualitative or quantitative evidence of a decline in condition (against 1982 benchmark)	1
	Medium priority: Qualitative evidence of a decline in condition and / or a localised or non-sustained change in condition reported for the value.	2
	High priority: Quantitative evidence of a sustained decline in condition associated with the value.	3

[4] Critical components, processes and services (CPS) – as identified in the ecological character description for the Ramsar site.

Table A- 10: Prioritisation of values for the deep lake mega-habitat. Criteria descriptions are in Table A- 9 above.

Values	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Sum	Priority
Marine sub-tidal beds (seagrass)	3	3	2	3	3	14	1
Coastal lagoons (open water phytoplankton)	3	3	2	3	3	14	1
Abundance & diversity of waterbirds: Ducks and allies	3	2	3	3	3	14	1
Abundance & diversity of waterbirds: Piscivores	3	1	2	3	3	12	3
Abundance & diversity of waterbirds: Large wading birds	3	1	2	2	3	11	4
Abundance & diversity of waterbirds: Migratory shorebirds	3	1	2	2	3	11	4
Abundance & diversity of waterbirds: Australian shorebirds	3	1	2	2	3	11	4
Abundance & diversity of waterbirds: Raptors	2	1	3	1	1	8	7
Threatened species: Little tern and fairy tern	3	2	3	3	2	13	2
Abundance & diversity of native fish	3	2	2	3	2	12	3
Threatened species: Australasian grayling (*Prototroctes maraena*)	2	1	1	1	1	6	8
Waterbird breeding	3	2	3	3	3	14	1
Burrunan dolphin (*Tursiops australis*)	3	2	3	3	2	13	2
Geomorphic features (silt jetties)	3	1	3	2	3	12	3
Visual amenity / landscape	2	1	3	3	2	11	4
Recreational fishing	2	1	3	1	1	8	7
Commercial fishing (black bream; eels)	3	1	3	1	1	9	6
Water based recreation (swimming, boating)	2	1	3	2	2	10	5
Beside water recreation (camping, bushwalking, nature observation)	2	1	3	2	2	10	5
Aboriginal cultural heritage	Considered in a separate consultative process (see section 6.8)						
European cultural heritage	1	1	1	1	1	5	9

Table A- 11: Prioritisation of values for the shallow lake mega-habitat. Criteria descriptions are in Table A- 9 above.

Values	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Sum	Priority
Marine sub-tidal beds (seagrass)	3	3	2	3	3	14	1
Coastal lagoons (open water phytoplankton)	3	3	2	3	3	14	1
Abundance & diversity of waterbirds: Ducks and allies	3	2	3	3	3	14	1
Abundance & diversity of waterbirds: Piscivores	3	1	2	2	3	11	4
Abundance & diversity of waterbirds: Large wading birds	3	2	2	2	3	12	3
Abundance & diversity of waterbirds: Migratory shorebirds	3	2	3	2	3	13	2
Abundance & diversity of waterbirds: Australian shorebirds	2	1	2	2	3	10	5
Abundance & diversity of waterbirds: Raptors	2	1	3	1	1	8	7
Threatened species: Little tern and fairy tern	3	1	3	2	2	11	4
Abundance & diversity of native fish	3	2	2	3	2	12	3
Threatened species: Australasian grayling (*Prototroctes maraena*)	2	1	1	2	1	7	8
Threatened ecological community: Gippsland Red Gum (*Eucalyptus tereticornis* sub spp. *mediana*) Grassy Woodland	3	3	2	2	2	12	3
Burrunan dolphin (*Tursiops australis*)	3	2	3	3	2	13	2
Geomorphic features (silt jetties)	3	1	3	2	3	12	3
Visual amenity / landscape	2	1	3	3	2	11	4
Recreational fishing	2	1	3	1	1	8	7
Commercial fishing (black bream; eels)	3	1	3	1	1	9	6
Water based recreation (swimming, boating)	2	1	3	2	2	10	5
Beside water recreation (camping, bushwalking, nature observation)	2	1	3	2	2	10	5
Aboriginal cultural heritage	Considered in a separate consultative process (see section 6.8)						
Game hunting	2	1	3	1	1	8	7

Table A- 12: Prioritisation of values for the freshwater wetland mega-habitat. Criteria descriptions are in Table A- 9 above.

Values	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Sum	Priority
Marine sub-tidal beds (seagrass)	3	3	2	3	3	14	1
Coastal lagoons (open water phytoplankton)	3	3	2	3	3	14	1
Abundance & diversity of waterbirds: Ducks and allies	3	2	3	3	3	14	1
Abundance & diversity of waterbirds: Piscivores	3	1	2	2	3	11	4
Abundance & diversity of waterbirds: Large wading birds	3	2	2	2	3	12	3
Abundance & diversity of waterbirds: Migratory shorebirds	3	2	3	2	3	13	2
Abundance & diversity of waterbirds: Australian shorebirds	2	1	2	2	3	10	5
Abundance & diversity of waterbirds: Raptors	2	1	3	1	1	8	7
Threatened species: Little tern and fairy tern	3	1	3	2	2	11	4
Abundance & diversity of native fish	3	2	2	3	2	12	3
Threatened species: Australasian grayling (Prototroctes maraena)	2	1	1	2	1	7	8
Threatened ecological community: River red gum woodland	2	2	1	1	1	7	8
Burrunan dolphin (Tursiops australis)	3	2	3	3	2	13	2
Geomorphic features (silt jetties)	3	1	3	2	3	12	3
Visual amenity / landscape	2	1	3	3	2	11	4
Recreational fishing	2	1	3	1	1	8	7
Commercial fishing (black bream; eels)	3	1	3	1	1	9	6
Water based recreation (swimming, boating)	2	1	3	2	2	10	5
Beside water recreation (camping, bushwalking, nature observation)	2	1	3	2	2	10	5
Aboriginal cultural heritage	Considered in a separate consultative process (see section 6.8)						
Game hunting	1	1	3	1	1	7	8

Table A- 13: Prioritisation of values for the variably saline wetland mega-habitat. Criteria descriptions are in Table A- 9 above.

Values	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Sum	Priority
Fringing brackish wetlands (emergent vegetation)	3	3	2	3	3	14	1
Saltmarsh	3	3	1	2	2	11	4
Abundance & diversity of waterbirds: Ducks and allies	2	2	3	2	2	11	4
Abundance & diversity of waterbirds: Piscivores	2	2	2	2	2	10	5
Abundance & diversity of waterbirds: Large wading birds	2	2	2	2	2	10	5
Abundance & diversity of waterbirds: Migratory shorebirds	2	2	2	2	2	10	5
Abundance & diversity of waterbirds: Australian shorebirds	2	2	2	2	2	10	5
Abundance & diversity of waterbirds: Raptors	2	2	3	2	2	11	4
Threatened species: Green and golden bell frog (Litoria aurea)	3	2	2	3	2	12	3
Threatened species: Growling grass frog (Litoria raniformis)	3	2	2	3	2	12	3
Abundance and diversity of native fish	2	2	1	2	2	9	6
Threatened species: Dwarf galaxias (Galaxiella pusilla)	3	2	1	3	2	11	4
Threatened species: Australasian bittern (Botaurus poiciloptilus)	3	2	1	2	2	10	5
Threatened species: Dwarf kerrawang (Commersonia prostrate)	3	1	1	3	2	10	5
Threatened species: Swamp everlasting (Xerochrysum palustre)	3	1	1	3	2	10	5
Threatened species: Metallic sun-orchid (Thelymitra epipactoides)	3	1	1	3	2	10	5
Swamp scrub	2	2	1	1	1	7	8
Waterbird breeding	3	3	3	2	2	13	2
Visual amenity / landscape	2	1	2	1	2	8	7
Commercial fishing (black bream; eels)	2	1	3	1	1	8	7
Beside water recreation (camping, bushwalking, nature observation)	2	1	2	1	1	7	8
Aboriginal cultural heritage	Considered in a separate consultative process (see section 6.8)						
Game hunting	1	1	3	1	1	7	8

Table A- 14: Prioritisation of values for the hypersaline wetland mega-habitat. Criteria descriptions are in Table A- 9 above.

Values	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Sum	Priority
Saltmarsh	3	3	1	2	2	11	1
Abundance & diversity of waterbirds: Ducks and allies	3	1	3	1	3	11	1
Abundance & diversity of waterbirds: Migratory shorebirds	3	2	2	1	3	11	1
Abundance & diversity of waterbirds: Australian shorebirds	3	2	2	1	3	11	1
Abundance & diversity of waterbirds: Large wading birds	2	1	2	1	3	9	2
Abundance & diversity of waterbirds: Raptors	2	1	3	1	1	8	2
Visual amenity / landscape	2	1	2	1	1	7	3
Beside water recreation (camping, bushwalking, nature observation)	2	1	2	1	1	7	3
Game hunting	1	1	3	1	1	7	3
Aboriginal cultural heritage	Considered in a separate consultative process (see section 6.8)						
Game hunting	1	1	3	1	1	7	3

Table A- 15: Prioritisation of values for the estuarine mega-habitat. Criteria descriptions are in Table A- 9 above.

Values	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Sum	Priority
Abundance & diversity of waterbirds: Ducks and allies	2	1	3	1	1	8	4
Abundance & diversity of waterbirds: Piscivores	3	2	2	3	2	12	1
Abundance & diversity of waterbirds: Large wading birds	2	1	1	2	1	7	5
Abundance & diversity of waterbirds: Raptors	3	1	3	1	2	10	2
Threatened species: Green and golden bell frog (Litoria aurea)	2	1	3	1	1	8	4
Threatened species: Growling grass frog (Litoria raniformis)	3	1	3	1	1	9	3
Abundance and diversity of native fish	3	2	2	3	2	12	1
Threatened species: Australasian grayling (Prototroctes maraena)	3	1	2	3	1	10	2
Threatened ecological community: Red gum woodland	2	2	3	3	2	12	1
Swamp scrub	2	2	1	1	1	7	5
Plains grassy woodland	2	2	1	1	1	7	5
Waterbird breeding	3	2	3	2	3	13	1
Burrunan dolphin (Tursiops australis)	3	2	3	3	2	13	1
Geomorphic features (silt jetties)	3	1	3	2	3	12	1
Visual amenity / landscape	2	1	3	3	2	11	2
Recreational fishing	2	1	3	1	1	8	4
Commercial fishing (black bream; eels)	3	1	3	1	1	9	3
Water based recreation (swimming, boating)	2	1	3	2	2	10	2
Beside water recreation (camping, bushwalking, nature observation)	2	1	3	2	2	10	2
Aboriginal cultural heritage	Considered in a separate consultative process (see section 6.8)						
Game hunting	2	1	3	1	1	8	5

Appendix E: Prioritisation of threats

Prioritisation of threats adopted both a rules based approach, followed by a scoring system. In the first instance all threats, associated stressors and impact pathways that resulted in negligible or low risks were considered a low priority, and filtered from the remaining prioritisation process. Then any threats, for which no feasible management action could be identified, were also considered a low priority and filtered from the ranking process. Remaining threats were scored as follows:

Table A- 16: Criteria for prioritisation of threats (and descriptions of low (1), medium (2) and high (3) rankings).

Criteria	Description	Score
1. Identified as a significant risk to the ecological character of the site	**Low priority:** Risk assessment identified no high risks associated with the threatening activity	1
	Medium priority: Risk assessment identified one high risk associated with the threatening activity	2
	High priority: Risk assessment identified two or more high risks and / or an extreme risk associated with the threatening activity	3
2. Management intervention feasible or a current management focus (effectiveness aspect of cost effectiveness assessment)	**No active management:** Actions will not address the threatening activity nor measurably mitigate the impact.	1
	Some active management: Management activities in the site or catchment may address threat but are not likely to result in a significant and sustained effect on ecological character.	2
	Actively managed: Threatening activity able to be addressed or mitigation of impact is possible through active management.	3
3. Cost (cost aspect of cost effectiveness assessment)	**High cost:** Capital costs and / or ongoing costs are high.	1
	Moderate cost: Moderate capital cost and / or moderate ongoing cost of implementation.	2
	Low cost: Low capital cost and ongoing cost of implementing the option.	3
4. Community priority	**Low priority:** Not identified of concern by general community.	1
	Medium priority: Threat identified as of moderate interest/concern for the community.	2
	High priority: Threat identified as a high priority by the community	3

Table A- 17: Prioritisation of threats for the deep lakes mega-habitat. Criteria defined in Table A- 16, approach described above.

Stressor	Impact	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Sum
Increased nutrients	All pathways	3	2	1	3	9
Increased boat traffic	Impacts to dolphins	3	3	2	3	11
Presence of development on lake shores	Affects visual amenity	2	3	3	3	11
Increased tidal exchange	Altered water levels in Lake Tyers due to artificial entrance opening (manual).	1	3	3	2	9
Non-native terrestrial animals (foxes and cats)	Predation on nesting, feeding and roosting waterbirds	2	3	3	2	10
Increased noise, traffic, dogs, walkers	Disturbance of shorebirds and nesting waterbirds	3	3	3	1	10
Increased inundation and physical damage	Damages the silt jetties	3	2	1	3	9
Non-native terrestrial plants (sea spurge)	Reduction in habitat for nesting terns	2	3	3	1	9
Increased inundation and physical damage	Affects intertidal and sub-tidal seagrass condition and extent	3	2	2	1	8
Introduced marine pests (European shore crab)	All pathways	3	3	1	1	8
Introduced marine pests (other species)	All pathways	1	3	1	1	6
Hydrocarbons	Direct oiling of wildlife	Addressed through existing processes - not a priority for management under the Ramsar plan				
Altered freshwater inflows	Disrupts stratification and internal nutrient cycling; promoting algal blooms	2	1	Not feasible to manage		
Increased nutrients and sediment	All pathways	3	1	Not feasible to manage		
Toxicants (Hg)	All pathways	1	Deferred as a critical knowledge gap			
Increased boat traffic	Physical removal of seagrass	1	Deferred as a knowledge gap - more broadly with respect to causes of seagrass decline			
Increased inundation and physical damage	Affects Aboriginal cultural heritage including significant sites	Addressed through separate consultation process				
Altered freshwater inflows	Disrupts stratification and internal nutrient cycling; promoting algal blooms	2	1	Not feasible to manage		

Table A- 18: Prioritisation of threats for the shallow lakes mega-habitat. Criteria defined in Table A- 16, approach described above.

Stressor	Impact	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Sum
Increased nutrients	All pathways	3	2	2	3	10
Increased inundation and physical damage	All pathways	3	2	1	3	9
Decreased freshwater inflows	Increased salinity affects breeding triggers for black bream and other estuarine fish (in estuarine reaches), reducing fish populations	2	2	3	3	10
Decreased freshwater inflows	Increased salinity affects breeding triggers for black bream and other estuarine fish (in estuarine reaches), reducing fish populations	2	3	2	3	10
Non-native fish (carp)	All pathways	3	3	1	2	9
Increased boat traffic	Impacts to dolphins	2	3	3	3	11
Presence of development on lake shores	Affects visual amenity	2	3	3	3	11
Increased noise, traffic, dogs, walkers	Disturbance of shorebirds and nesting waterbirds	1	3	3	2	9
Decreased connectivity	Affects migratory routes of fish including threatened Australasian grayling	3	2	3	1	9
Introduced marine pests (European shore crab)	Increased competition and predation results in a decline in native species extent, diversity and abundance	3	3	1	1	8
Non-native terrestrial animals (foxes)	Predation on nesting, feeding and roosting waterbirds	1	2	2	2	7
Decreased connectivity	Affects migratory routes of fish including threatened Australasian grayling	2	3	2	1	8
Introduced marine pests (other species)	Increased competition and predation results in a decline in native species extent, diversity and abundance	1	3	1	1	6
Hydrocarbons	Direct oiling of wildlife	Addressed through existing processes - not a priority for management under the Ramsar plan				
Wildfire: Increased nutrients and sediment	All pathways	3	1	Not feasible to manage		
Toxicants (Hg)	All pathways	1	Deferred as a critical knowledge gap			
Increased boat traffic	Physical removal of seagrass	1	Deferred as a knowledge gap - more broadly with respect to causes of seagrass decline			
Increased inundation and physical damage	Affects Aboriginal cultural heritage including significant sites	Addressed through separate consultation process				

Table A- 19: Prioritisation of threats for the freshwater wetland mega-habitat. Criteria defined in Table A- 16, approach described above.

Stressor	Impact	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Sum
Water resource use: Decreased freshwater inflows	All pathways	3	3	3	1	10
Climate change: Decreased freshwater inflows	Altered water regime impacts	3	3	3	1	10
Climate change: Decreased freshwater inflows	Increased salinity impacts	3	3	3	1	10
Recreational vehicles: Physical damage	Affects vegetation and habitat for biota	2	3	3	2	10
Native species (Typha and giant rush)	Impacts flora and fauna	2	3	3	1	9
Exposure of acid sulphate soils: Toxicants	Impacts flora and fauna	1	3	3	1	8
Non-native terrestrial animals (foxes and cats)	Predation on nesting, feeding and roosting waterbirds	1	3	2	2	8
Recreational activities: Increased noise	Disturbance of nesting waterbirds	1	3	3	1	8
Non-native fish (carp and gambusia)	All pathways	1	2	3	1	7
Non-native plants (e.g. Brazillian milfoil)	Competition impacts diversity and abundance of native flora	1	2	3	1	7
Road construction and use: Oil and toxicants	Affects flora and fauna	1	Deferred as a critical knowledge gap			
Toxicants (Hg)	All pathways	3	Deferred as a critical knowledge gap			
Roads and transport: Built environment	Affects visual amenity	3	1	Not feasible to manage (road already in place)		
Toxicants (steroid hormones)	Affects fish and frogs	1	Deferred as a critical knowledge gap			

Table A- 20: Prioritisation of threats for the variably saline wetland mega-habitat. Criteria defined in Table A- 16, approach described above.

Stressor	Impact	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Sum
Water resource use: Decreased freshwater inflows	Altered water regime pathways	3	3	3	1	10
Water resource use: Decreased freshwater inflows	Increased salinity pathways	3	3	3	1	10
Climate change: Decreased freshwater inflows	Altered water regime pathways	3	3	3	1	10
Climate change: Decreased freshwater inflows	Increased salinity pathways	3	3	3	1	10
Exposure of acid sulphate soils: Increased acidity	Impacts flora and fauna (including threatened species)	3	3	2	1	9
Recreational vehicles: Physical damage	Affects vegeation and habitat for biota	2	3	3	2	10
Non-native fish (carp and gambusia)	Affects flora and fauna	3	2	2	1	8
Exposure of acid sulphate soils: Toxicants	Toxicants in the sediments are mobilised impacting flora and fauna	2	3	2	1	8
Native species (Typha and common reed)	Affects flora and fauna	1	3	2	1	7
Recreational activities: Increased noise	Disturbance of shorebirds and nesting waterbirds	1	3	3	1	8
Toxicants (Hg)	Effects health of aquatic food webs (fish,frogs, birds)	1	Deferred as a critical knowledge gap			
Hunting: direct removal of native species	Decreased waterbird diversity and abundance (ducks)	1	Addressed through existing processes - not a priority for management under the Ramsar plan			
Toxicants (steroid hormones)	Affects fish and frogs	1	Deferred as a critical knowledge gap			

Table A- 21: Prioritisation of threats for the hypersaline wetlands mega-habitat. Criteria defined in Table A- 16, approach described above.

Stressor	Impact	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Sum
Recreational vehicles: Physical damage	Affects vegetation and habitat for biota	2	3	3	2	10
Climate change: Increased inundation and physical damage	Affects saltmarsh extent, community composition and health	2	2	2	2	8
Recreational activities: Increased noise	Disturbance of shorebirds and nesting waterbirds	1	3	3	2	9
Introduced marine pests (other species)	Increased competition and predation results in a decline in native species extent, diversity and abundance	1	3	2	1	7
Non-native terrestrial animals (foxes)	Predation on nesting, feeding and roosting waterbirds	1	2	2	2	7
Climate change: Increased inundation and physical damage	Affects shorebird feeding and roosting habitat	1	2	2	2	7

Table A- 22: Prioritisation of threats for the estuarine mega-habitat. Criteria defined in Table A- 16, approach described above.

Stressor	Impact	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Sum
Increased nutrients	Affects aquatic biota	2	2	2	3	9
Increased acidity	Impacts flora and fauna	2	3	2	1	8
Decreased freshwater inflows	Altered water and salinity regime affects native fish breeding and migration cues	2	2	3	3	10
Decreased freshwater inflows	Altered water regimes affects instream and riparian vegetation	2	2	3	3	10
Decreased freshwater inflows	Altered water and salinity regime affects native fish breeding and migration cues	2	2	3	3	10
Decreased freshwater inflows	Altered water regimes affects instream and riparian vegetation	2	2	3	3	10
Physical damage	Affects vegetation and habitat for biota (riparian and instream)	2	3	3	2	10
Physical damage	Affects vegetation and habitat for biota (riparian and instream)	2	3	3	2	10
Non-native plants	Increased competition displaces native vegetation species, reducing diversity of native instream and riparian flora	2	3	2	1	8
Deer and rabbits	Impacts riparian vegetation	2	3	2	1	8
Development on estuarine banks	Affects visual amenity	2	3	3	3	11
Non-native fish (carp)	Competition and predation affect native fish abundance and diversity	2	2	3	1	8
Increased inundation and physical damage	Damages the silt jetties	2	2	1	3	8
Wildfire: Increased nutrients and sediment	All pathways	3	1	Not feasible to manage		

Appendix F: Derivation of Resource Condition Targets

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
C1 Marine subtidal aquatic beds (seagrass / aquatic plants)	Seagrass covers an area of approximately 4000 - 5000 hectares within the Gippsland Lakes Ramsar Site (BMT WBM 2010a), although there is a high degree of variability over time (Roob and Ball 1997). Sub-tidal aquatic beds are dominated by the seagrass species *Zostera nigricaulis* (formerly *Heterozostera tasmanica*) and *Zostera muelleri* with some patches of *Ruppia* spp. (Roob and Ball 1997, Warry and Hindell 2012). Seagrass predominantly occurs in sub-tidal beds at depths from 0.5 to 2 m, with very little seagrass in intertidal zones (Warry and Hindell 2012). Condition and density of seagrass varies significantly between years (Roob and Ball 1997, Warry and Hindell 2012) most likely in response to changes in salinity and water clarity related to climate variables and freshwater inflows (Webster et al. 2001, Holland and Cook 2009, Ladson 2012).	• Total seagrass extent will not decline by greater than 50 percent of the baseline value of Roob and Ball 1997 (that is, 2165 hectares) in two successive decades at a whole of site scale. • Total mapped extent of dense and moderate *Zostera* will not decline by greater than 80 percent of the baseline values determined by Roob and Ball (1997) in two successive decades at any of the following locations: o Fraser Island o Point Fullerton, Lake King o Point King, Raymond Island, Lake King o Gorcrow Point – Steel Bay, Lake Victoria o Waddy Island, Lake Victoria	The most recent Ramsar Rolling Review (Butcher et al. 2011) indicated that there was insufficient data to assess against this LAC, with no comprehensive mapping of seagrass since that undertaken by Roob and Ball in 1997. However, 2008 video footage suggests a decline in seagrass extent at 75 percent of sites compared to the 1997 mapping, although this could not be quantified (Warry and Hindell 2012).	The current extent and condition of seagrass in the Gippsland Lakes Ramsar Site will be maintained as indicated by the following: • Maintain extent of seagrass (as measured by Roob and Ball 1997) – 4000 to 5000 hectares. • Maintain medium-dense seagrass cover (as per Warry and Hindell 2012) in 25 percent of beds (measured as a long term average over the 20 year timeframe).

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
C2 Coastal brackish or saline lagoons (open water phytoplankton dominated habitats)	Planktonic food webs are an important part of the Gippsland Lakes trophic structure and the large lagoons that are dominated by phytoplankton drive the energy dynamics of the system (Grigg et al. 2004, Cook et al. 2008, Holland et al. 2009). The system experiences periodic algal blooms with seven diatom / dinoflagette blooms recorded between 1985 and 2012 (Day et al. 2011). Post 1997, a number blooms of the cyanobacterium (blue-green algae) *Nodularia spumigena* were recorded across Lake King and Lake Victoria (Webster et al. 2001, Beardall 2008, Day et al. 2011) and in 2007, for the first time a bloom of the cyanobacterium *Synechococcus* spp. blooms extended across large areas of the Ramsar site for over five months (Beardall 2008, Day et al. 2011). In 2011 *N. spumigena* again bloomed across the site from December 2011 to April 2012 causing the closure of fisheries, a second bloom occurred the following summer, but lasted a shorter period of time (Holland et al. 2013b).	• Long term: A long-term change in ecosystem state at Lake King, Lake Victoria or Lake Tyers from relatively clear, seagrass dominated estuarine lagoons to turbid, algae dominated system (characteristic of Lake Wellington) will represent a change in ecological character. • Short-term: No single cyanobacteria algal bloom event will cover greater than 10 per cent of the combined area of coastal brackish/saline lagoons (that is, Lake King, Victoria, Wellington and Tyers) in two successive years.	While the Ramsar Rolling Review indicated that there was an increasing trend in algal blooms, they concluded that the LAC at the time (2011) had not been exceeded (Butcher et al. 2011). There were successive blooms in 2011 and 2012. While the 2011 definitely covered more than 10 percent of the lakes, the 2012 covered a smaller area.	Lakes Victoria and King remain clear with median secchi depths of > 1 m A reduction in the number of years in which blue-green algal blooms occur in the lakes (8 in the 27 years from 1986 to 2013) – so < 5 over the 20 year timeframe. Knowledge gap related to understanding the biological and biogeochemical interactions known to control algal blooms.
Freshwater wetlands	Freshwater wetlands within the site at the time of listing were limited to Sale Common and Macleod Morass covering an area of approximately 400 hectares (BMT WBM 2010a). At the time of listing it is thought that these wetlands were dominated by giant rush (*Juncus ingens*) and in 1980 the sites were classified as deep freshwater marsh (Corrick and Norman 1980).	• Long term: The total mapped area of freshwater marshes (shrubs and reed wetland types) at Sale Common and Macleod Morass will not decline by greater than 50 per cent of the baseline value outlined in VMCS for 1980 (that is, 50 per cent of 402 hectares = 201 hectares) in two successive decades.	There is insufficient data to assess against the long and short term LAC (Butcher et al. 2011). There is anecdotal evidence of increased salinity, but no quantitative data upon which to base an assessment (Parks Victoria 2005, 2007, Butcher et al. 2011).	Maintain Macleod Morass and Sale Common as freshwater marshes. Maintain the extent, diversity and condition of freshwater vegetation communities. Water quality in the freshwater wetlands is a knowledge gap

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
	Currently, these systems are still dominated by freshwater emergent vegetation but there has been an expansion of common reed (*Phragmites australis*) and cumbungi (*Typha orientalis*) at the expense of giant rush (Parks Victoria 2005, 2007, BMT WBM 2010a, Ethos NRM 2011). This has been largely attributed to increased nutrient inflows and altered hydrological regimes at the two sites (Tilleard and Ladson 2010).	• Short-term: In existing freshwater wetland areas, the annual median salinity should not be > 1 ppt in two successive years.		and requires monitoring to determine a quantitative RCT.
Brackish wetlands	The brackish fringing wetlands within the Ramsar site fringe the open water areas of Lake Wellington and comprise Dowd, Heart and Clydebank Morasses, Lake Coleman and Tucker Swamp; covering an area of approximately 500 hectares (BMT WBM 2010a). They are dominated by swamp paperbark (*Melaleuca ericifolia*) woodland and common reed (*Phragmites australis*) emergent macrophyte beds (Boon et al. 2007).	• Long term: The total area of common reed at Dowd Morass will not decline by greater than 50 per cent of the 1982 baseline value (that is not less than 245 hectares) in two successive decades. • Short-term: The annual median salinity will be < 4ppt in five successive years.	There is evidence of change in the extent and distribution of these plant communities since listing. There has been a marked decline in the extent of common reed and an expansion of swamp paperbark from 1982 (around the time of listing) to 2003 (Boon et al. 2007, 2008). This has been attributed to alerted water regimes (a decline in freshwater inflows) increased tidal exchange and increases in salinity (Boon et al. 2008).	Maintain extent, diversity and condition of native vegetation communities: swamp paperbark (*Melaleuca ericifolia*) woodland and common reed (*Phragmites australis*) emergent macrophyte beds. Increase the extent and diversity, and improve the condition of native vegetation communities in and around the Heart Morass and other fringing wetlands on private land. Water quality and hydrological condition in many of the fringing wetlands is a knowledge gap and requires monitoring to determine a quantitative RCT.
Saltmarsh	Saltmarsh communities are the dominant vegetation community in the long shallow coastal lagoon of Lake Reeve. Dominant species include *Sarcocornia quinqueflora*, *Tecticornia pergranulata* and *Gahnia*	• Medium term: The total mapped area of salt flat, saltpan and salt meadow habitat at Lake Reeve Reserve will not decline by greater than 50 percent of the	There is no evidence to suggest that the saltmarsh habitats at Lake Reeve have changed in the past two decades.	Maintain extent, diversity and condition of saltmarsh communities.

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
	filum (Boon et al. 2011). There is little information on the extent of saltmarsh habitat at the time of listing. The ECD for the site states that there approximately 5000 hectares of saltflat, saltpan and salt meadow (BMT WBM 2010a). More recent mapping suggests approximately 2200 hectares of saltmarsh vegetation community, excluding unvegetated habitats (Boon et al. 2011).	baseline value outlined in VMCS for 1980 (that is, 50 percent of 5035 hectares = 2517 hectares) in two successive decades.		
Abundance & diversity of waterbirds: Ducks and allies	The Gippsland Lakes Ramsar Site is known to support over 86 species of waterbird with periodic counts exceeding 20,000 individuals (BMT WBM 2010b). The majority of the significant waterbird habitat is in the margins and fringing wetlands. Satlmarsh and saltflats such as those found at Lake Reeve are important feeding grounds for waders, including migratory species, with significant numbers of red-necked stint (*Calidris ruficollis*) recorded on a number of occasions (Barter 1995, Clemens et al. 2009). Lake Tyers supports breeding of significant numbers of little tern (*Sternula albifrons*) and fairy tern (*Sternula nereis nereis*), which then move to other areas in the site such as Jones Bay and adjacent swamps to feed (Faye Bedford, biodiversity officer, DELWP, personal communication). The freshwater and brackish habitats support significant numbers of waterfowl including black swan (*Cygnus atratus*), chestnut teal (*Anas castanea*) and musk duck (*Biziura lobata*) and larger resident wading bird species (Corrick and Norman	• The number of standard 20 minute searches (within any ten year period) where waterbird abundance is less than 50 individuals will not fall below 50 per cent of the 'baseline' value (based on Birds Australia count data – 1987-2010), for the following species: ○ black swan = 15 percent of surveys ○ chestnut teal = 10 percent of surveys ○ Eurasian coot = 11 percent of surveys. • The absence of records in any of the following species in five successive years will represent a change in character: red-necked stint, sharp-tailed sandpiper, black swan, chestnut teal, fairy tern, little tern, musk duck, Australasian grebe, grey teal, Eurasian coot, great cormorant, red knot, curlew sandpiper.	There is little data upon which the LAC can be assessed as complete counts for the site are mostly lacking. However, data contained in volunteer bird group newsletters and from the Australian Bird Atlas (Clemens et al. 2009, Wright and Wright 2012, Healey 2013) indicate that the target species have all been observed in the site in the last five years. A recent review of bird abundance and diversity in the Gippsland Lakes indicated a long-term stability in total diversity, but a very high inter-annual variation (Healey 2013). Short term declines in waterbird abundance and diversity in the system have been associated with bushfires, floods and algal blooms (Healey 2013).	Total diversity of waterbirds across the site remains above 86.
Abundance & diversity of waterbirds: Piscivores				The site supports greater than 20,000 waterbirds in three out of five years.
Abundance & diversity of waterbirds: Large wading birds				Targets for abundance of individual species and waterbodies remain a knowledge gap
Abundance & diversity of waterbirds: Migratory shorebirds				
Abundance & diversity of waterbirds: Australian shorebirds				
Abundance & diversity of waterbirds: Raptors				

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
	1980). The large expanses of open water in Lakes Wellington, King and Victoria are considered less important as bird habitat, although may be important foraging areas for fish eating birds such as pelicans and cormorants (Coutin et al. 2003).			
Threatened species: Little tern and fairy tern		LAC only associated with breeding and then only as a presence of breeding of Little tern (*Sternula albifrons*) and fairy tern (*Sternula nereis nereis*) at the Bunga Arm and Lake Tyers.		Maintain successful breeding of Little Tern and Fairy Tern, with recruitment of 1.5 chicks per nest.
Threatened species: Green and golden bell frog (*Litoria aurea*) Threatened species: Growling grass frog (*Litoria raniformis*)	There are intermittent records for two threatened frog species from the Gippsland Lakes Ramsar Site; the green and golden bell frog (*Litoria aurea*) and growling grass frog (*Litoria raniformis*) (BMT WBM 2010a). Despite intensive surveys, there is insufficient data to assess population sizes or determine trends in abundance from the Ramsar site (Gillespie 1996). Records from the site are from vegetated freshwater habitats (BMT WBM 2010a), and both species are known to prefer sites with a large proportion of emergent vegetation and slow moving or ponded water (Clemann and Gillespie 2012). Species have been recorded in Sale Common, Dutson Downs, Dowd Morass, Heart Morass, Clydebank Morass, Macleod Morass (Jim Reside, pers. comm.).	Insufficient data to develop a LAC for this critical component, nor to assess changes in populations over time.	Population data is available for Dutson Downs and Macleod Morass.	Green and golden bell frog and growling grass frog are recorded at Dutson Downs, Heart Morass, Clydebank Morass, Dowd Morass, Macleod Morass within a 5 year period. Successful breeding of green and golden bell frog and growling grass frog at a minimum of five sites in any five year period, as evidenced by tadpoles and juveniles.
Abundance and diversity of native fish	The Gippsland Lakes Ramsar Site is an important commercial and recreational fishery as well as providing nursery habitat for a range of fish that form part of the Bass Strait commercial fishery (Hindell et al. 2008, Warry and Hindell	The Critical service is "fisheries resource value" is the LAC is based only on Black Bream: • Total annual black bream commercial fishing catch per unit	The most recent commercial catch data (Department of Environment and Primary Industries 2014) indicates that the annual catch of black bream over the past decade years has	Maintain species richness, with a minimum of 70 species recorded in the Deep and Shallow lakes over any five year period (based on Warry and Hindell 2012).

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
	2012, GLMAC 2013). Over 170 species of fish have been recorded within the site boundary, the vast majority estuarine or marine species, with a number of diadromous species that move between fresh, estuarine and marine environments (Ramm 1986). Commercially and recreationally important native fish species include black bream (*Acanthopagrus butcheri*), yelloweye mullet (*Aldrichetta forsteri*), tailor (*Pomatomus saltatrix*) and Australian salmon (*Arripis* spp.) (Department of Environment and Primary Industries 2014). The introduced common carp (*Cyprinus carpio*) was also, at the time of listing a significant commercial fish within the freshwater areas of the Ramsar site, often accounting for over half the total commercial catch (Department of Environment and Primary Industries 2014).	effort will not fall below 6.1 tonnes in a five successive year period. • Sub-optimal black bream spawning conditions should not occur in any successive five year period within key spawning grounds (that is, mid-lower estuaries and adjacent waters of main lakes) during the peak spawning period (October to December). Optimal conditions are as follows: o Water column salinity is maintained in brackish condition (for example, between 17-21 ppt median value) in the middle of the water column in the mid-lower estuaries and adjacent waters of the main lakes o The salt wedge is located within the mid-lower section of the estuarine river reaches or just out into the main lakes as opposed to far upstream or well-out into the Lakes.	ranged from 26 to 148 tonnes, well above the LAC of 6 tonnes. Although the salinity portion of the LAC is difficult to measure against, water quality data form Lakes Wellington, Victoria and King (as provided by the Victorian EPA) indicate that salinity largely remained within the 17 to 21 ppt threshold October to December for the past decade; with the exception of flood years (e.g. 2008, 2011) when salinity was lower.	Maintain fish diversity for species within each of the following life history strategy: estuarine dependent, estuarine opportunists, marine migrants, diadromous, and obligate freshwater species. Maintain sustainable native fish populations of important recreational and commercial fishes.
Threatened species: Australasian grayling (*Prototroctes maraena*)	Insufficient data	Presence in the catchment		Maintain hydrological and biotic connectivity between the catchment and the sea. Habitat use by the Australian grayling within the site remains a knowledge gap.
Threatened species: Dwarf galaxias (*Galaxiella pusilla*)	Not a critical CPS – so no description or LAC			Maintain populations. Knowledge gap

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
Threatened species: Australasian bittern (*Botaurus poiciloptilus*)	Not a critical CPS – so no description or LAC			Maintain populations. Knowledge gap
Threatened species: Dwarf kerrawang (*Rulingia prostrata*) Threatened species: Swamp everlasting (*Xerochrysum palustre*) Threatened species: Metallic sun-orchid (*Thelymitra epipactoides*)	Three species of aquatic ecosystem dependent threatened flora have been recorded within the Gippsland Lakes Ramsar Site: dwarf kerrawang (*Commersonia prostrate*); swamp everlasting (*Xerochrysum palustre*); and metallic sun-orchid (*Thelymitra epipactoides*). Populations of all three species are located on the fringes of Lake Victoria in Blond Bay Nature Reserve (Calder et al. 1989, Carter and Walsh 2010a, 2010b). The three species inhabit a gradient of wetland habitats from the swamp everlasting, which prefers permanent wetland habitats, through the dwarf kerrawang which inhabits seasonally inundated wetlands, to the metallic sun orchid which grows in seasonally water logged soil (Calder et al. 1989, Carter and Walsh 2010a, 2010b).	• The three threatened flora species (*Rulingia prostrata*, *Thelymitra epipactoides* and *Xerochrysum palustre*) continue to be supported within the boundaries of the Gippsland Lakes Ramsar Site.	The most recent published surveys for these species are from 2008 and all were still present within the Ramsar site at that time (DSE Flora and Fauna Database), indicating that the LAC is still met. However, population data for the swamp everlasting shows a decline from 500 plants to just 150 within the Ramsar site from 2005 to 2008 (Carter and Walsh 2010a). Whereas the dwarf kerrawang populations within the Ramsar site have increased following a fire in 2004 which may have stimulated germination (Carter and Walsh 2010b). No trend data for the sun-orchid could be sourced.	Maintain populations of threatened plant species: dwarf kerrawang (*Commersonia prostrate*); swamp everlasting (*Xerochrysum palustre*); metallic sun-orchid (*Thelymitra epipactoides*), river swamp wallaby grass (*Amphibromus fluitans*).
Threatened ecological community: Red gum woodland	(Gippsland Red Gum (*Eucalyptus tereticornis* sub spp. *mediana*) Grassy Woodland and Associated Native Grassland) Not a critical CPS – so no description or LAC			Maintain extent and community composition of Gippsland Red Gum (*Eucalyptus tereticornis* sub spp. *mediana*) Grassy Woodland. Current extent and composition is a knowledge gap that must be filled before success of this RCT can be measured.

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
Burrunan dolphin (*Tursiops australis*)	Population of the Gippsland Lakes is estimated at only 70 individuals. It is genetically isolated from the population in Port Phillip Bay and likely to be resident (Charlton-Robb et al. 2014).	Not a critical CPS – so no LAC	Population estimate is current – no idea what it might have been at the time of listing, nor of trends.	Maintain the existing population of Burrunan dolphins within the Ramsar site.
Geomorphic features (silt jetties)		Not a critical CPS – so no LAC	The morphology and physical integrity of the Mitchell River Silt Jetties (a primary reason for its regional, state, national and international significance) is currently under threat from extensive areas of shoreline erosion. Significant areas of the shoreline are now armoured with rock beaching (60%), however much of the rock in place (50%) is providing very little protection from current erosion processes. Very few areas of emergent vegetation now exist along the lakeside shorelines of the site. The terrestrial areas of the site contains a mixture of remnant native vegetation and extensive areas of revegetation which, along with the adjacent near shore and aquatic environments, provides habitat for over 100 species of birds (Birdlife East Gippsland 1988-2008).	Maintain the current (2014) shoreline alignment in priority areas identified in Parks Victoria (2014)
Riparian vegetation communities		Not a critical CPS – so no LAC		Maintain extent, diversity and condition of native riparian and shoreline vegetation communities

Value	Baseline description	Limit of Acceptable Change	Current condition	Resource Condition Targets
				Maintain extent and community composition of Gippsland Red Gum (*Eucalyptus tereticornis* sub spp. *mediana*) Grassy Woodland.
Waterbird breeding	The Gippsland Lakes Ramsar Site supports breeding of a number of waterbird species across a variety of habitats. The ECD indicates that breeding of the following waterbird species within the Ramsar site is critical to the ecological character (BMT WBM 2010a): • Australian pelican (*Pelecanus conspicillatus*) at Lake Coleman, Tucker Swamp and Albifrons Island; • Little tern (*Sternula albifrons*) and fairy tern (*Sternula nereis nereis*) at the Bunga Arm and Lake Tyers; and • Black swan (*Cygnus atratus*), Australian white ibis (*Threskiornis molucca*), straw-necked ibis (*Threskiornis spinicollis*) and little black cormorant (*Phalacrocorax sulcirostris*) at Macleod Morass, Sale Common and Dowd Morass. In addition, Royal Spoonbills at Dowd Morass.	There are insufficient breeding records to quantitatively assess trends in breeding attempts or success and for this reason the LAC for this critical process has been set based only on presence of breeding activities at the above locations.		Protect regularly used colonial waterbird breeding sites (Pelicans, Darters, Ibis, Pied Cormorants, Little Black Cormorants, Royal Spoonbills)
In-stream habitat in riparian reaches		Not a critical CPS – so no LAC		Increase instream habitat (woody debris and in channel vegetation) in the estuarine river reaches

Appendix G: Cross reference of management strategies with Resource Condition Targets, knowledge gaps and threats

Resource Condition Targets

1. The current extent and condition of seagrass in the Gippsland Lakes Ramsar Site will be maintained as indicated by the following:
- Maintain extent of seagrass (as measured by Roob and Ball 1997) – 4000 to 5000 hectares.
- Maintain medium-dense seagrass cover (as per Warry and Hindell 2012) in 25 percent of beds (measured as a long term average over the 20 year timeframe).
2. Lakes Victoria and King remain clear with median secchi depths of > 1 m
3. A reduction in the number of years in which blue-green algal blooms occur in the lakes (8 in the 27 years from 1986 to 2013) – so < 5 over the 20 year timeframe.
4. Maintain Macleod Morass and Sale Common as freshwater marshes.
5. Maintain the extent, diversity and condition of freshwater vegetation communities.
6. Maintain extent of variably saline fringing wetlands.
7. Maintain extent, diversity and condition of native vegetation communities: swamp paperbark (*Melaleuca ericifolia*) woodland and common reed (*Phragmites australis*) emergent macrophyte beds.
8. Increase the extent and diversity, and improve the condition of native vegetation communities in and around the Heart Morass and other fringing wetlands on private land.
9. Maintain the extent, diversity and condition of saltmarsh communities
10. Total diversity of waterbirds across the site remains above 86.
11. The site supports greater than 20,000 waterbirds in three out of five years.
12. Maintain successful breeding of little tern and fairy tern, with recruitment of 1.5 chicks per nest.
13. Green and golden bell frog and growling grass frog are recorded at Dutson Downs, Heart Morass, Clydebank Morass, Dowd Morass, Macleod Morass within a 5 year period.
14. Successful breeding of green and golden bell frog and growling grass frog at a minimum of five sites in any five year period, as evidenced by tadpoles and juveniles.
15. Maintain native fish species richness, with a minimum of 70 species recorded in the Deep and Shallow lakes over any five year period (based on Warry and Hindell 2012).
16. Maintain fish diversity, as indicated by the following life history strategies: estuarine dependent, estuarine opportunists, marine migrants, diadromous, and obligate freshwater species.
17. Maintain sustainable native fish populations of important recreational and commercial fishes.
18. Maintain hydrological and biotic connectivity between the catchment and the sea.
19. Maintain populations of dwarf galaxias (*Galaxiella pusilla*).
20. Maintain populations of Australasian bittern (*Botaurus poiciloptilus*)
21. Maintain populations of threatened plant species: dwarf kerrawang (*Commersonia prostrate*); swamp everlasting (*Xerochrysum palustre*); metallic sun-orchid (*Thelymitra epipactoides*), river swamp wallaby grass (*Amphibromus fluitans*).
22. Maintain extent and community composition of Gippsland Red Gum (Eucalyptus tereticornis sub spp. mediana) Grassy Woodland.
23. Maintain the existing population of Burrunan dolphins within the Ramsar site.
24. Maintain the current (2014) shoreline alignment in priority areas identified in Parks Victoria (2014).
25. Protect regularly used colonial waterbird breeding sites (Pelicans, Darters, Ibis, Pied Cormorants, Little Black Cormorants, Royal Spoonbills)
26. Increase instream habitat (woody debris and in channel vegetation) in the estuarine river reaches

Priority threats

1. Nutrient inflows from agricultural activities in the catchment
2. Development on the shores affecting visual amenity
3. Foxes and cats predating on waterbirds
4. Climate change (storms and sea level rise) affects silt jetties
5. Climate change (storms and sea level rise) impacts vegetation
6. Artificial opening at Lake Tyers affects biota (including nesting terns)
7. Non-native invasive species (sea spurge) affects terns nesting
8. Non-native invasive plant species affects native flora and habitat
9. Native invasive species (e.g. Typha) affects flora diversity and habitat
10. Introduced marine pests (European shore crab) affects native species
11. Introduced marine pests – potential introduction on new species
12. Invasive species (carp and gambusia) affect native fish and habitat
13. Decreased freshwater inflows – impacts on breeding triggers for estuarine fish
14. Decreased freshwater inflows – altered water regimes impacts flora and fauna
15. Decreased freshwater inflows – increased salinity impacts flora and fauna
16. Exposure of acid sulphate soils (ASS)
17. Disturbance of migratory shorebirds and / or nesting birds by recreational activities (vehicles, people, dogs and noise)
18. Vessels affecting the behaviour and condition of dolphins

19. Recreational vehicles causing physical damage to vegetation and habitat
20. Grazing and trampling on riparian/coastal habitats from deer pigs, goats and rabbits

Knowledge gaps

1. Mercury: bioavailability in sediments and bioaccumulation through the food chain
2. Risks and mitigation strategies for endocrine disruptors in dairy, urban, and human waste from STP's in Macleod Morass
3. Groundwater relationships with fringing wetlands, status, effects, potential causes
4. Wetland hydrology, current condition and potential threats to altered water regime and salinity
5. Environmental water requirements and setting realistic management goals for Macleod Morass and Jones Bay
6. Cues for migration and recruitment of native fish
7. Impacts of blue-green algae on waterbirds and recruitment success
8. Impacts of reduced freshwater inflows on stratification and nutrient cycling in the deep lakes mega habitat
9. Effects of fire in the catchment on freshwater and fringing wetlands
10. Productivity changes from altered water regimes and thresholds for change
11. Seagrass – reasons for fluctuations and possible management interventions, including thresholds
12. Water quality in the freshwater wetlands
13. Water quality and hydrological conditions in the fringing wetlands.
14. Waterbird breeding: species and important breeding habitats / locations.
15. Important habitats and populations of the threatened Australasian bittern in the Ramsar site.
16. The populations and movement of native fish (including threatened species) in the freshwater wetlands and lower river reaches.
17. Habitat use by the Australian grayling within the site.
18. Vegetation extent and community composition in the fresh and variably saline wetlands and estuarine river reaches and drivers of change.
19. Importance of the estuarine river reaches to water dependent reptiles and mammals.
20. Feasibility of and options for the improving the ecological condition of Lake Wellington.
21. Implications of climate change for the ecological character of the Ramsar site.
22. Refuge for green and golden bell frog and growling grass frog during out of breeding season habitat requirements.
23. Migratory wader refuge: species and locations of important habitats; impact of recreational activities on migratory waders at these locations.

Management strategies

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant Resource Condition Targets	Relevant knowledge gaps	Relevant threats	Relevant Mega-habitat(s)	Theme
1A. Manage boat and swing moorings to minimize physical damage to seagrass beds.	Gippsland Ports		1, 15, 16, 17		19	Deep Lakes Shallow Lakes	Maintaining and restoring habitats
1B. Implement island renourishment and re-vegetation.	Gippsland Ports, DELWP, Parks Victoria	On-going active management of sand islands for nesting bird habitat.	7, 10, 11, 12		2, 5, 8	Deep Lakes Shallow Lakes	Maintaining and restoring habitats
1C. Protect and restore habitat at little tern and fairy tern nesting and post-breeding sites. Manage sea spurge at little tern and fairy tern nesting sites.	DELWP, Parks Victoria	GLEF (Gippsland Lakes Environment Fund) program.	10, 11, 12		7, 8, 17	Deep Lakes Shallow Lakes	Maintaining and restoring habitats
1D. Improve native vegetation corridors and connectivity within and between all habitat types represented in the Ramsar site.	East and West Gippsland CMAs	East and West Gippsland Regional Waterway Strategies	4, 5, 22	5	13, 14, 15, 16	All	Maintaining and restoring habitats
1E. Continue protection and rehabilitation of the Heart Morass.	WET Trust	Heart Morass restoration plan	8	4	8. 9. 13, 14, 15, 16, 20	Variably saline wetlands	Maintaining and restoring habitats
1F. Continue strategic protection and rehabilitation of wetlands on private property that contribute to maintaining the ecological character of the Ramsar site.	East and West Gippsland CMAs	Greening Australia Western wetlands protection program	5, 6		3, 8, 9, 16, 19	Variably saline wetlands	Maintaining and restoring habitats
1G. Implement actions to control invasive native species such as Typha and Giant Rush in freshwater wetlands as required.	Parks Victoria, East and West Gippsland CMAs	DELWP, Parks Victoria Macleod Morass Vegetation Project	5, 6, 7		9	Freshwater wetlands	Maintaining and restoring habitats
1H. Actively manage priority non-native pest plants.	Parks Victoria	Parks Victoria invasive species strategy	5, 6, 7		7, 8	Freshwater wetlands Variably saline wetlands Estuarine reaches	Maintaining and restoring habitats

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant Resource Condition Targets	Relevant knowledge gaps	Relevant threats	Relevant Mega-habitat(s)	Theme
1I. Develop and implement instream and riparian habitat protection and/or rehabilitation programs for the estuarine river reaches	East and West Gippsland CMAs	East and West Gippsland Regional Waterway Strategies	22, 24, 26		8, 9, 20	Estuarine reaches	Maintaining and restoring habitats
1J. Explicitly consider impacts to visual amenity of the landscape when assessing planning applications adjacent to the site	Shire Councils	Gippsland Lakes Sustainable Development Strategy Gippsland Lakes Coastal Action Plan	5, 7		2	All	Maintaining and restoring habitats
1K. Monitor and where possible control off-road vehicle use at priority locations within the Ramsar site	Parks Victoria		5, 7, 21		19	Deep Lakes, Shallow Lakes Hypersaline wetlands	Maintaining and restoring habitats
1L. Develop management strategies to maintain and restore the Mitchell River silt jetties	Parks Victoria East Gippsland CMA	Shoreline protection and enhancement of key areas of the Mitchell River Silt Jetties	5		4	Deep Lakes	Maintaining and restoring habitats
2A. Control of introduced predators in priority bird areas	Parks Victoria, DELWP	Biodiversity programs by Parks Victoria and DELWP	10, 11, 12, 13, 14		3	All	Protecting fauna
2B. Increase signs in priority migratory wader and nesting bird habitats to reduce disturbance	Parks Victoria, DELWP	Biodiversity programs by Parks Victoria and DELWP	10, 11, 12		17	Deep Lakes Shallow Lakes	Protecting fauna
2C. Identify key nursery areas for the Burrunan dolphins	DELWP	AMMCF	23			Deep Lakes, Shallow Lakes, Estuarine reaches	Protecting fauna
2D. Investigate the risk posed by human disturbance to migratory waders develop and implement feasible actions to address the risks	Parks Victoria, DELWP		10, 11, 12	23	17	Shallow Lakes, Variably saline and hypersaline wetlands	Protecting fauna
2E. Develop and implement a public awareness campaign to reduce harassment and boating injuries to Burrunan dolphins	DELWP / Gippsland Ports	AMMCF	23		18	Deep Lakes, Shallow Lakes, Estuarine reaches	Protecting fauna

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant Resource Condition Targets	Relevant knowledge gaps	Relevant threats	Relevant Mega-habitat(s)	Theme
2F. Implement an introduced marine pest strategy for the Gippsland Lakes	DELWP	GLMAC: Introduced marine pest investigation	15, 16, 17		10, 11	Deep Lakes, Shallow Lakes	Protecting fauna
3A. Reduce nutrient and sediment loads to the Gippsland Lakes through riparian riparian, in-stream and catchment works to improve water quality of river flows to the Gippsland Lakes.	East and West Gippsland CMAs DEDJTR	Riparian, in-stream and catchment works in the East and West Gippsland Regional Catchments Strategies and Regional Waterway Strategies Existing Parks Victoria vegetation management programs CORE 4 program in dryland and irrigated areas of West Gippsland MID extension and incentives program SEPP Waters of Victoria (currently under revision)	1, 2, 3		1, 20	Deep Lakes Shallow Lakes	Managing nutrients and sediments
4A. Undertake regular planning, delivery, monitoring and evaluation of the use of environmental water entitlements in the lower Latrobe wetlands (Sale Common, Heart Morass, Dowd Morass) and the Latrobe River estuary.	West Gippsland CMA Parks Victoria Victorian Environmental Water Holder	West Gippsland CMA environmental water program. Gippsland Region Sustainable Water Strategy	4, 5, 6, 7, 13, 14, 21	3, 4, 5, 12, 13	13, 14, 15, 16	Fresh and variably saline wetlands	Managing water regimes
4B. Investigate, and where feasible and cost effective, implement actions that enable and facilitate effective management of the water and salt regimes of priority fringing wetlands, including Sale Common, Heart Morass, Dowd Morass, Lake Reeve and Macleod Morass. For example: technical studies, management plans	East and West Gippsland CMA Parks Victoria Victorian Environmental Water Holder Wellington Shire Council	West Gippsland CMA environmental water program Gippsland Region Sustainable Water Strategy	4, 5, 6, 7, 9, 13, 14, 21	3, 4, 5, 12, 13	13, 14, 15, 16	Fresh and variably saline wetlands	Managing water regimes

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant Resource Condition Targets	Relevant knowledge gaps	Relevant threats	Relevant Mega-habitat(s)	Theme
and/or agreements, water entitlements, on-ground works, operational management and monitoring.	East Gippsland Water, Department of Environment, Land, Water and Planning						
4C. Maintain and where necessary improve hydrological connectivity and freshwater inflows to the Gippsland Lakes for fish migration and breeding.	East and West Gippsland CMAs	East and West Gippsland Regional Waterway Strategies	15, 16, 17, 18		13, 14, 15, 20	Deep Lakes, Shallow Lakes, Estuarine reaches	Managing water regimes
4D. Develop and implement a procedure for the management of estuary mouth closures for Lake Tyers and Merriman Creek	West and East Gippsland CMAs	East Gippsland CMA estuary opening strategy for Lake Tyers West Gippsland Regional Waterway Strategy	12		6	Deep Lakes	Managing water regimes
4A. Undertake regular planning, delivery, monitoring and evaluation of the use of environmental water entitlements in the lower Latrobe wetlands (Sale Common, Heart Morass, Dowd Morass) and the Latrobe River estuary.	West Gippsland CMA Parks Victoria Victorian Environmental Water Holder	West Gippsland CMA environmental water program. Gippsland Region Sustainable Water Strategy	4, 5, 6, 7, 9, 13, 14, 21	3, 4, 5, 12, 13	13, 14, 15, 16	Deep lakes, Shallow Lakes, Hypersaline wetlands	Integrating Aboriginal and European knowledge and management
5A. Implement joint management of the Gippsland Lakes Coastal Park, The Lakes National Park, Lake Tyers State Park and Raymond Island Gippsland Lakes Reserve	GLaWAC Parks Victoria	Whole of Country Plan and Joint Management Plans currently under development				All	Integrating Aboriginal and European knowledge and management
5B. Deliver training and knowledge to increase the capacity of the Aboriginal community to be involved in the management of the Ramsar site	GLaWAC					All	Integrating Aboriginal and European knowledge and management

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant Resource Condition Targets	Relevant knowledge gaps	Relevant threats	Relevant Mega-habitat(s)	Theme
5C. Conduct a comprehensive survey of all waterways in the Ramsar site with respect to cultural significance.	GLaWAC					All	Integrating Aboriginal and European knowledge and management
5E. Recognise the cultural value of water bodies, collect data on cultural flows and to take steps to ensure that these values are included in decisions regarding Ramsar site management	GLaWAC					All	Integrating Aboriginal and European knowledge and management
6A. Investigate priority species and locations for waterbird breeding and migratory wader refuges within the Ramsar site. Assess that habitat requirements are being met at priority locations.	DELWP	Oil Spill Response Atlas (OSRA) Gippsland Lakes Hotspots Project – BirdLife East Gippsland	10, 11, 12, 20, 25	14, 15		All	Improving our understanding
6B. Assess the distribution of heavy metals and other contaminants (including mercury) in the Gippsland Lakes and the level of risk (i.e. bioavailability).	EPA Victoria, DHHS	Current EPA desktop review of sources.		1		Deep Lakes, Shallow Lakes, Estuarine reaches	Improving our understanding
6C. Investigate the risks of toxicants (steroid hormones) in Macleod Morass.	EPA Victoria, Parks Victoria East Gippsland CMA			2		Freshwater wetlands	Improving our understanding
6D. Investigate the cues for migration and recruitment of native fish	DELWP	Current research on black bream in the Latrobe River, including tracking (West Gippsland CMA)	15, 16, 17, 18, 19	6, 16	13, 14, 15	Deep Lakes, Shallow Lakes, Estuarine reaches	Improving our understanding
6E. Assess the impacts of blue-green algal blooms on waterbird populations and recruitment success	DELWP		10,11,12	7	1	Deep Lakes, Shallow Lakes	Improving our understanding
6F. Assess variability in the extent and condition of seagrass, including environmental thresholds for change	DELWP		1	11, 12	1, 5	Deep Lakes, Shallow Lakes	Improving our understanding

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant Resource Condition Targets	Relevant knowledge gaps	Relevant threats	Relevant Mega-habitat(s)	Theme
6G. Investigate the habitat use and requirements for Australian grayling within the Ramsar site	DELWP			17	13, 14, 15	Deep Lakes, Shallow Lakes, Estuarine reaches	Improving our understanding
6H. Assess the importance of estuarine reaches to amphibians, aquatic reptiles and mammals	DELWP			16, 19		Estuarine River Reaches	Improving our understanding
6I. Investigate the risk associated with and potential mitigation strategies for climate change impacts to ecological character of the Ramsar site	DELWP East and West Gippsland CMAs			21	4, 5	All	Improving our understanding
6J. Investigate the impacts of altered freshwater inflows on nutrient cycling and productivity in the Deep Lakes, including thresholds for change	DELWP			8		Deep Lakes	Improving our understanding
6K. Investigate the impact of high nutrient and sediment loads to fresh and variably saline wetlands following bushfires	DELWP East and West Gippsland CMAs			9	1	Fresh and variably saline wetlands	Improving our understanding
6L. Investigate feasible management options for the control of invasive freshwater fish (carp and gambusia)	DELWP		13, 14, 15, 16, 17. 19		12	Fresh and variably saline wetlands	Improving our understanding
6M. Investigate options for improving the ecological condition of Lake Wellington.	DELWP			20		Shallow Lakes	Improving our understanding
6N. Investigate the non-breeding habitat requirements of threatened frog species	DELWP		13	22		Fresh and variably saline wetlands	Improving our understanding
6O. Awareness raising/education about the Ramsar Convention, the condition of the Gippsland Lakes, environmental impact assessment, management options and implications.	DELWP East and West Gippsland CMAs					All	Improving our understanding

Management Strategies	Responsibility	Linkages to existing programs / activities	Relevant Resource Condition Targets	Relevant knowledge gaps	Relevant threats	Relevant Mega-habitat(s)	Theme
7A. Review the Ramsar site boundary	DELWP DoE Ramsar Steering Committee					All	Ramsar administration
7B. Update the Ramsar Information Sheet	DELWP DoE Ramsar Steering Committee					All	Ramsar administration
7C. Review and where necessary update Limits of Acceptable Change, in particular for areas that are currently not covered by current LAC such as Lake Tyers.	DELWP DoE Ramsar Steering Committee					All	Ramsar administration
7D. Apply the appropriate State and Commonwealth environmental impact assessment processes for activities that have the potential to impact on the Ramsar site and Matters of National Environmental Significance (MNES).	DELWP DoE Ramsar Steering Committee					All	Ramsar administration
7E. Undertake a regular review of the status of the ecological character of the Ramsar site. This review should include new and emerging issues as well as the current listed values and threats	DELWP	Ramsar Rolling Review				All	Ramsar administration
7F. Develop implementation plans for this strategy	East Gippsland CMA with Ramsar Steering Committee DELWP					All	Ramsar administration

Monitoring requirements

Monitoring recommendations				Linkages to existing programs / activities	Relevant Resource Condition Targets	Relevant knowledge gaps	Relevant Mega-habitat(s)
Program	**Indicators and method**	**Frequency**	**Responsibility**				
Seagrass	Extent (mapping consistent with Roob and Ball 1997) and condition (consistent with recent programs e.g. Warry and Hindell 2012).	Mapping every five years. Condition every two years.	DELWP	Proposed mapping to be undertaken in 2015 by Monash University, DELWP (Arthur Rylah Institute)	1		Deep Lakes Shallow Lakes
Water quality monitoring in priority lakes and wetlands	Salinity, dissolved oxygen, water clarity, nutrients (dissolved and total) and chlorophyll-a Algal species and enumeration	Monthly and event based (i.e. more frequent sampling during, algal blooms)	EPA Victoria, DELWP, West Gippsland CMA	Current water quality monitoring by EPA covers Deep and Shallow Lakes. Suggest expand to include: Sale Common, Macleod Morass, Lake Reeve and priority estuarine reaches.	2, 3, 4, 6	4, 10, 12, 13	All
Sediment quality monitoring in lakes and wetlands	Nutrients, toxicants	Every five years	EPA Victoria, DELWP	Not currently included in any routine monitoring programs.		1, 2	All
Mapping of wetland (including saltmarsh) vegetation communities in the Ramsar site.	Mapping of wetland EVCs, consistent with that of Boon (2011) and current WGCMA mappng.	Every five years	DELWP, Parks Victoria	Boon et al (2011) mapped saltmarsh communities. Current mapping of wetland EVCs in West Gippsland CMA region (lower Latrobe wetlands only). Needs to be expanded to East Gippsland CMA Region	5, 6, 7, 9	18	All
Condition assessments of priority vegetation communities: Freshwater marshes Swamp paperbark Common reed emergent beds	A purpose built condition assessment that measures: Species composition and abundance (cover); Invasive species Structure Recruitment	Every five years	DELWP, Parks Victoria, East and West Gippsland CMAs		5, 6, 7, 8, 9, 22	18	All

Monitoring recommendations				Linkages to existing programs / activities	Relevant Resource Condition Targets	Relevant knowledge gaps	Relevant Mega-habitat(s)
Program	**Indicators and method**	**Frequency**	**Responsibility**				
Saltmarsh River Red Gum grassy woodland Riparian vegetation							
Monitoring of threatened plant species: dwarf kerrawang (*Commersonia prostrate*); swamp everlasting (*Xerochrysum palustre*); and metallic sun-orchid (*Thelymitra epipactoides*), River swamp wallaby grass (*Amphibromus fluitans*).	Extent and condition	Annual	DELWP, Parks Victoria	Existing monitoring and protection programs in place by DELWP and PV	21		Variably saline wetlands
Waterbird counts and breeding records (including for cryptic species such as the Australasian bittern).	Abundance of each species, and evidence of breeding. Build on existing programs, but with a preference for a total wetland / site count at priority locations (can use a combination of aerial survey, with ground / boat surveys).	Annual	DELWP, Parks Victoria	Current: Shorebirds 2020; Waterfowl annual counts (game species); nesting tern monitoring; and DELWP Hotspot program. Needs to be expanded to include an annual count at all priority locations in the site and targeted to specific species.	10, 11, 12, 20	14, 15	All
Frog monitoring: adults and tadpoles / juveniles	Audio monitoring of calls Fyke net trapping of tadpoles	Annual	DELWP, Parks Victoria	DELWP Hotspot, does adult calls, but not breeding.	13, 14		Fresh and variably saline wetlands
Native fish: abundance and species	Purpose built monitoring program will need to be developed. Different methods will be required for wetland vs	Annual	DELWP	Current (historic) sampling in the Deep and Shallow Lakes only. Needs to be expanded to	15, 16, 17, 19	16	All

Monitoring recommendations				Linkages to existing programs / activities	Relevant Resource Condition Targets	Relevant knowledge gaps	Relevant Mega-habitat(s)
Program	**Indicators and method**	**Frequency**	**Responsibility**				
	open water habitats. At a minimum surveys should measure abundance and community composition. Consideration given to population age structure, perhaps via the use of otolith samples for a subsample of common species.			include sampling in the freshwater wetlands and estuarine reaches			
Abundance and population structure of Burrunan dolphins	Using the methods developed by Kate Charlton-Robb, for visual surveillance	Annual	DELWP	Current program funded by GLMAC, but is not on-going.	23		Deep and Shallow Lakes