Bushways

Environmental Services -Tasmania

Falmouth and Henderson Lagoon Environmental Management Plan

24th April 2009

Cover photo: Henderson Lagoon in November 2008

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Disclaimer
This plan addresses terrestrial aspects of coastal management, and some aspects of marine or freshwater management (where existing information and management planning is available). Good management of coastal and riparian vegetation is the aspect most amenable to being addressed by stakeholders in this plan, although some direct management and monitoring of aquatic environments may be possible. Other aspects of aquatic management may be addressed by appropriate experts and future studies.

The survey supporting this plan was intended to broadly confirm the terrestrial vegetation communities and fauna habitat potential. Detailed surveys over many seasons would be necessary to thoroughly identify all natural values here. Access was not possible on private land, so these areas could only be assessed from a distance.

The information provided here is constrained by limited time and resources. Therefore it is likely that Henderson Lagoon's coastal management plan will continue to evolve over time. Those who use this information do so at their own risk, and it is recommended that users seek further information before relying on this report.

Acknowledgements

Bushways especially thanks Benjamin Dean of Falmouth Community Centre, who drove the development of this plan, and whose knowledge and energy were essential to the project. We also thank residents and visitors who contributed their time and ideas to this project:

Heather Cole; David Godfrey-Smith; Alison Hugo, Polly Buchhorn, Break O'Day Council and NRM North; Murray Luttrell, Dave Frelek, Parks and Wildlife Service; Denys Walter, Paul Frater, Winifred Curtis Scamander Reserve; Stephen Woods and Mike Graham, Enstone Park Pastoral Co; Gloria Andrews, Aboriginal cultural heritage representative; Valerie and Andrew Legg; Amanda Lohrey; Andrew Lohrey; Moira Corby; Marjorie Luck; Michael Di Giovanni; Jim Darby; Marnie Brennan; Lorraine Biggs; Graeme Wathen and the many other helpers and participants at the consultation workshops.

Information and specialist advice was kindly provided by Sarah Lloyd (ornithologist), Stewart Blackhall, Rob Moreton and Tim Rudman (Department of Primary Industries and Water), Christine Crawford (Tasmanian Aquaculture and Fisheries Institute), Debbie Searle (Waterwatch), Craig Proctor, Robert Gurney and Ron Thresher (Commonwealth Scientific and Industrial Research Organisation), Tim Farrell (Inland Fisheries Service); Eric Woehler (Birds Tasmania); Paul Rosevear (Forestry Tasmania); Phil Duggan (Fire Operations Officer, Parks and Wildlife Service); Peter Lee-Archer (Spray Information & Referral Unit, Department of Primary Industries and Water).

Mapping data in this management plan has been sourced from the The List (Raster Data: Base image by TASMAP (www.tasmap.tas.gov.au), © State of Tasmania;Vector Data: Base data from the LIST (www.thelist.tas.gov.au), © State of Tasmania; TASMAP Series; DPIW Natural Values Atlas; Coastal Values Atlas; CFEV database; and TASVEG (version 2.0 Tasmanian Vegetation Monitoring and Mapping Program, Vegetation Conservation Section – Department of Primary Industries and Water); and field work conducted by Bushways.

The production of this plan was funded by the Australian Government's Envirofund, as well as NRM North.

Australian Government

Bushways
Environmental Services – Tasmania

NRM North
Natural Resource Management in Northern Tasmania

Statement of Endorsement

The Henderson Lagoon Environmental Management Plan has been prepared by Bushways Environmental Services Tasmania for and with the assistance of Falmouth Community Centre Inc.

At a public meeting on 18th April 2009, at Falmouth Community Centre, all present agreed with the following statement:

"We, representing the community that
cares for Henderson Lagoon and Falmouth,
support and endorse this
Falmouth and Henderson Lagoon Environmental Management Plan
and commit to its implementation and ongoing development."

List of Acronyms

ACDC	Assessment Committee for Dam Construction
AHT	Aboriginal Heritage Tasmania
Barway Protocol	Interim Guidelines for the Artificial Opening of Henderson Lagoon Sand Barrier
BODC	Break O'Day Council
BODNRM	Break O'Day NRM
Bushways	Bushways Environmental Services – Tasmania
CAMBA	China Australia Migratory Bird Agreement
CRIMP	Centre for Research on Introduced Marine Pests, CSIRO
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVA	Conservation Volunteers Australia
DPIW	Department of Primary Industries and Water
FMCCA	Four Mile Creek Conservation Area
HLMSG	(Possible) Henderson Lagoon Management Steering Group
HLEMP	Henderson Lagoon Environmental Management Plan
JAMBA	Japan Australia Migratory Bird Agreement
NRM	Natural Resource Management
NRM	North Natural Resource Management in Northern Tasmania
Pc	*Phytophthora cinnamomi* (Root rot fungus)
PWS	Parks and Wildlife Service Tasmania
SCA	Scamander Conservation Area
TAFI	Tasmanian Aquaculture and Fisheries Institute
TFS	Tasmanian Fire Service
WCSR	Winifred Curtis Scamander Reserve
WSUD	Water Sensitive Urban Design

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Executive Summary

Special values of Henderson Lagoon

Beauty, nature and heritage:
Henderson Lagoon, near the township of Falmouth, is a beautiful natural area, highly valued by residents and visitors for its quiet character, views and opportunities for walking, swimming, fishing and nature watching. There are at least nine Aboriginal heritage sites in the area, which would have been highly valued by Aboriginal people for its abundant food resources. There is a long history of European settlement in the area, and several historic sites.

National Estate listed:
The lagoon area is listed on the Register of the National Estate, and encompasses a diversity of coastal geomorphological features unusual in Tasmania. The area covers several significant conservation areas (Scamander Conservation Area, Four Mile Creek Conservation Area, and Winifred Curtis Scamander Reserve, as well as other private conservation covenanted areas).

An estuary, which teams with wildlife:
Natural and cultural values of the lagoon area are described in section 3. The lagoon is an intermittently open-closed lagoon (ICOLL), which is a highly variable estuarine system. As such, it is home to many species of flora and fauna, a productive fish nursery, and provides special habitat for migratory and shore birds.

Saltmarsh to forests, including threatened vegetation communities:
Native vegetation communities in the area include saltmarsh, freshwater wetlands, coastal scrub, coast wattle scrub, coastal grassland, black peppermint coastal forest, ironbark forest (not on granite), white gum-blue gum coastal forest, and black gum forest. Other forest types exist in areas in the upper catchment.

Threatened native vegetation communities in the area include wetlands, White Gum-Blue Gum coastal forest, Blue Gum dry forest and Black Gum forest.

Threatened species and shorebird nests:
Nineteen species of threatened flora have been recorded within 5 km of the lagoon. The lagoon and Scamander area is a key site for Tasmanian Smokebush, Lesser Guineaflower and Juniper Wattle. Devils Creek Bridge at Falmouth is also a key site for Soft Peppercress, and Shade Peppercress occurs under exotic trees in farmland near Falmouth.

This is the only known location in Tasmania of a species of crab, *Amarinus paralacustris*.

Threatened fauna species recorded nearby include White-bellied Sea-Eagle, Little Tern, Fairy Tern, Swift Parrot, Tasmanian Devil, Spotted-tailed Quoll, Green and Golden Frog, Australian Grayling Giant, Velvet Worm, and Leathery Turtle. It is possible that New Holland Mice also find habitat in the heath of Winifred Curtis Scamander Reserve. Migratory birds (protected under international agreements) found here include Bar-tailed Godwit, Red-necked Stint and Caspian Tern.

The threatened and declining Fairy and Little Terns and Hooded Plovers, as well as other shorebirds, sometimes nest here. This is of critical importance, as they have few breeding sites in Tasmania and are extremely vulnerable to disturbance. There are fewer than 10 pairs of Little Terns known in Tasmania, and sometimes Henderson Lagoon hosts a pair.

Management issues around Henderson Lagoon

Issues for management are discussed in section 5. These include:

- Potential **acid sulphate soils** in the area.

- **Pests, weeds and disease** in the area including marine pests (Northern Seastar, European Greencrab, and others), environmental weeds (gorse, and others), and phytophthora rootrot (a disease which can devastate heathy vegetation).
- **Loss and degradation of native vegetation** (from urban development, garden expansion, fire hazard control, and plantation development), and fire management.
- Sediment, stormwater, nutrient and chemical impacts on the waterways and lagoon from various **land-uses in the catchment** have not been properly assessed.
- **Wildlife** may be affected by dogs and people (especially shorebird nests), and loss of habitat and habitat connectivity.
- **Climate change** may have many impacts on the lagoon, including changes to rainfall, temperature and sea level, and increased risk of erosion.
- **Changing hydrology and water quality** of the lagoon. These are complex due to the highly variable nature of the estuary and little is known about these scientifically. There is some local concern over impacts of occasional prolonged flooding, as well as concern over artificial opening of the sand barway which may disrupt natural systems. Land-uses in the catchment also affect water quality.
- **Fire management** is complex, with protection of life and property important, along with protection of natural values.
- Potential pressure of population, development and works on **landscape character, access issues, and heritage values**.

What can be done about these issues

A number of actions are outlined (in section 5 and tabled in Appendix 8) to address the issues, through community involvement. Management directions include monitoring, community education and on-ground works, as well as discussions with relevant authorities over planning and legislation changes.

Some of the **key on-ground actions** recommended in section 7 include;

- completing fencing and revegetation of waterways, wetlands and the lagoon edge;
- revegetation and continued weed control of the coastal vegetation;
- track improvement and erosion controls;
- installation of picnic tables;
- clean up of litter;
- installation of interpretive signage; and
- landscaping of public areas with local native species.

Increased awareness and knowledge of the natural values and management issues would greatly assist management of the lagoon area. Information networks should be developed, and community skills developed through practical working bees, field days, organised walks, distribution of pamphlets etc. A stewardship ethic should be encouraged amongst residents and visitors, with active involvement in management activities.

Key indicators which could be monitored by community volunteers are outlined in section 6, including:

- locations of shorebird nests,
- numbers of waterbirds,
- presence of acid sulphate soils,
- water levels,
- water quality,
- fishkills,
- algal blooms,
- invasive species,
- wildlife deaths and
- phytophthora rootrot.

The next step towards co-ordinating community involvement and action will be to form a Henderson Lagoon Environmental Management "steering group", representative of stakeholders and supported by land managers, to drive this plan.

Map 1 Henderson Lagoon Catchment, Reserved Land and Cadastral Areas

1 Overview

1.1 Background

Falmouth Community Centre engaged Bushways Environmental Services - Tasmania *(*Bushways) to produce a Management Plan for Henderson Lagoon.

This Management Plan aims to:

- identify natural and cultural values of Henderson Lagoon;
- identify threats to these values;
- recommend and prioritise management directions which will maintain values and address threats; and
- facilitate on-ground works.

This non-statutory document is intended to form a guide for management of the values of Henderson Lagoon by relevant authorities and the wider community. It has a particular focus on management within the Conservation Areas, but extends to surrounding land within the catchment which has an impact on the Lagoon. This document will provide useful information and further inspiration for good coastal management by all stakeholders. All management in the Conservation Areas must be consistent with reserve Management Plans, which are being updated at the time of writing.

1.2 Location

The study area covers primarily the Scamander Conservation Area which incorporates Henderson Lagoon. Areas adjoining Henderson Lagoon and within its catchment are also covered, where activities are relevant to management of the lagoon. The area extends from the southern edge of the Scamander township to the coastal esplanade at Falmouth (Four Mile Creek Conservation Area).

The catchment covers about 50 km^2, and is shown outlined in Map 1.

A sandy spit over 3 kilometres long encloses Henderson Lagoon. The lagoon is tidal but water levels are influenced by the narrow barway that governs fluctuating levels through sediment deposition. This is dependent on various weather (rainfall in the catchment), tidal and sea conditions, as well as artificial opening.

Henderson Lagoon is located at approximately E: 604678 N: 5406730 (GDA94). The area can be found on the Scamander TASMAP 1:25000 mapsheet No 6040.

This area is in the Flinders bioregion.

1.3 Land tenure and uses

The Lagoon itself and coastal spit are protected within the Scamander Conservation Area. South of the mouth of Henderson Lagoon is the Four Mile Creek Conservation Area, which includes the Falmouth "esplanade" around the headland.

Private land adjoins Henderson Lagoon on the northern, western and southern shores. This includes the Winifred Curtis Scamander Reserve, which is protected under a Protected Areas on Private Land (PAPL) conservation covenant. A recent subdivision further north includes a protected area of vegetation on private land (to be known as Scamander Sanctuary). Areas of remnant native vegetation on private land, including the Peat Marsh, are also protected under PAPL conservation covenants. Private lots northwest of the lagoon and over the Tasman Highway include some rural-residential areas, and recent larger subdivisions with some protections on native vegetation. Agricultural land covers the area southwest of the lagoon, and Falmouth township occupies the higher ground south of the lagoon outlet.

The catchment area of the lagoon extends beyond the study area into the hills west and southwest of the lagoon, most of which is State Forest.

Scamander township is not covered by this management plan, although parts of it are within the northern catchment.

Tenure and reserves of the area are shown in Maps 1 and 6.
(Note that the exact location of the boundary of the Conservation Areas on the ground would probably require a surveyor, as the lagoon and land have changed over time.)

1.4 Regional context

The Henderson Lagoon wetlands and surrounding bushland is part of a series of lagoons and native vegetation occurring along the east coast of Tasmania. It includes the Scamander Conservation Area, which extends further north to join the St Helens Conservation Area, and the Four Mile Creek Conservation Area, which extends further south to join the Little Beach Conservation Area.

It is linked by forested private land in the northwest to extensive tracts of State forest to the west. These connections greatly enhance the viability and habitat value of Henderson Lagoon and each reserve. However, connections to the southwest are limited. From the narrow coastal reserves across extensive agricultural land to the forested hills, native vegetation is largely restricted to narrow creeklines.

1.5 Importance of Henderson Lagoon

Henderson Lagoon is listed on the Register of the National Estate (Australian Heritage Database Place ID: 100502). The Statement of Significance for the Place reads:

> "The Henderson's Lagoon Coastal Site encompasses a diversity of coastal geomorphological features and associated vegetation. The geomorphological features include a single coastal dune spit, a saline peat marsh and a classic bird's foot delta all of which are unusual in Tasmania. Together with the tidal lagoons, estuary and swales, they demonstrate the results of continuing coastal processes in a very limited area.
>
> The associated vegetation communities are representative examples of coastal vegetation types including woodland, heathland, sub-mergent and emergent marshland,
>
> The heathland supports a diverse orchid flora with 35 species recorded within 74 ha. It is also habitat for four plant species classified as rare in Tasmania.
>
> The marshland provides habitat for ten species of crustaceans and molluscs which is a good representative range for Tasmanian saltmarshes. One species, the crab *Amarinus paralacustris*, has its only record for Tasmania at this place."

Henderson Lagoon is an estuary, meaning that it is a semi-enclosed coastal body of water where saltwater from the open sea mixes with freshwater draining from the land, leading to water of varying salinities at different times. Estuaries are extremely important both ecologically and for people:

- Among the most productive environments on earth.
- Fish nurseries. Many commercially valuable fish species depend on estuaries during some point in their life cycles. Henderson Lagoon is known to support juvenile Bream, Mullet, Salmon, Silver Trevally and Flathead (T. McManus, pers.comm.), and is likely to support *Galaxias maculatus* (T. Farrell, pers.comm.) and many other fish.
- Bird habitat (including here terns, migratory waders, pelicans, swans, sea-eagles, etc).
- A wide range of habitat types, including beaches, marshes and other wetlands, mud and sand flats, and seagrass meadows.
- Unique communities of plants and animals which are specially adapted for life at the margin of the sea, with varying salinities.
- Aboriginal sites are often situated along estuarine shorelines, reflecting their importance for food and cultural use.
- Recreational enjoyment for many people.
- Situated at the bottom of the catchment, estuaries often reflect impacts of human use.

An assessment of the conservation significance of the State's estuaries (G.J. Edgar *et al* 1999), which considered levels of human disturbance and proportion of catchment area under statutory protection, along with features such as exceptional invertebrate and fish species diversity or species with restricted distributions, lists Henderson Lagoon as:

> Class C. Moderate conservation significance - Estuary and associated catchment area are affected by human habitation and land clearance, but have not been badly degraded.

However there has been very little scientific study or monitoring of Henderson Lagoon. As with all estuaries, being neither freshwater nor marine, Henderson Lagoon falls somewhere between the scientific research and management interests of Tasmanian Aquaculture and Fisheries Institute, CSIRO, Inland Fisheries Service and Department of Primary Industries and Water. What information could be found is noted through this document, but much remains to be discovered.

Aboriginal heritage sites have been found in Falmouth and on the sand spit between Henderson Lagoon and the beach, which contain shell middens and artefacts (Graham, 2009).

1.6 Management authorities

The Department of Tourism, Arts and Environment is the primary responsible authority for the Henderson Lagoon ecosystem, including the Scamander Conservation Area and Four Mile Creek Conservation Area, managed through the Parks and Wildlife Service. Scamander Coastal Reserve Management Plan 1995 covers most of the area, but new management plans are currently being written for these Conservation Areas (G.Wilmott, PWS).

Break O'Day Council is responsible for a range of services in the area including roads and drainage management, rubbish collection, processing building and development applications, pet management, fire hazard abatement, and management of the toilet block at Falmouth.

The barway is, like the rest of the lagoon, managed through the Parks and Wildlife Service. Break O'Day Council maintains a separate interest in water levels in Henderson Lagoon and may intervene if infrastructure or public safety is threatened. Council needs to obtain an authority from Parks and Wildlife Service if such circumstances occur. Interim guidelines have been drafted to address any need for artificial opening of the barway, and a steering group exists to coordinate these guidelines. The "Interim Guidelines for the Artificial Opening of Henderson Lagoon Sand Barrier" are attached in Appendix 1.

Winifred Curtis Scamander Reserve is managed by a private trust, and has its own Management Plan, as outlined under its Conservation Covenant.

1.7 Stakeholders and responsibilities

There are many stakeholders who may have an interest in good environmental management of Henderson Lagoon. Only some have legislated authority, but all might become involved in certain management actions. For instance, local community groups may conduct working bees and education programs, and liaise with authorities.

Note that this plan does not determine responsibilities for actions recommended, even where suggestions are made. Any actions should involve prior consultation with all relevant management authorities. Any actions within the Conservation Areas should be consistent with the Parks and Wildlife Service Management Plans for these areas. New management plans are currently being drafted. Meanwhile, the Scamander Coastal Reserve Draft Management Plan and Site Facilities Concepts (Parks & Wildlife Service 1995) is the relevant document.

Some stakeholders relevant to this plan include:

- residents, temporary residents and visitors
- farming landholders
- private plantation leaseholders
- Falmouth Community Centre (FCC)
- Break O'Day Council
- Parks and Wildlife Service (PWS), Department of Tourism, Arts and Environment
- Winifred Curtis Scamander Reserve Trust
- Natural Resource Management in Northern Tasmania (NRM North)
- Local aboriginal community
- Other volunteers and interest groups (e.g. Greencorps, Conservation Volunteers Australia, Understorey Network)

There are also other authorities which oversee aspects of environmental management in the catchment according to legislation, such as:

- Tasmania Fire Service,
- Forest Practices Authority,
- Forestry Tasmania,
- Assessment Committee for Dam Construction
- Department of Primary Industries and Water (including determining the nature and extent of agricultural and forestry chemical pesticide usage in river catchments).

1.8 Relevant legislation and policies

Tasmanian legislation and regulations (available at www.thelaw.tas.gov.au) and other policies:

- Living Marine Resources Management Act 1995
- National Parks and Reserves Management Act 2002
- Environmental Management and Pollution Control Act 1994
- Land Use Planning and Approvals Act 1993
- Water Management Act 1999
- State Policy on Water Quality Management 1997
- Crown Lands Act 1976
- Nature Conservation Act 2002
- Threatened Species Protection Act 1995
- Aboriginal Relics Act 1975
- Historic Cultural Heritage Act 1995
- Land Use Planning and Approvals Act 1993
- Fire Service Act 1979
- Forest Practices Act 1985
- Mineral Resources Development Act 1995
- Building Act 2000
- State Coastal Policy 1996 (and State Coastal Policy Validation Act 2003*)*
- Dog Control Act 2000 and Dog Control Regulations 2001

Commonwealth legislation:

- Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

Break O'Day council:

- Proposed Break O'Day Dog Management Zones for Beaches (2008)
- Break O'Day Natural Resource Management Strategy 2003

2 Methodology

2.1 Background research

A Natural Values Report was conducted through the Natural Values Atlas (October 2008) for all threatened flora and fauna records within 5 kilometres of the site, as well as TASVEG communities and Geoconservation Sites. A search of observations in the Natural Values Atlas (October 2008) revealed records of non-threatened flora and fauna also within the study area.

Existing information was compiled from a wide range of sources (listed under References), some of which are also noted as useful resources in Appendix 7.

2.2 Field assessment

Field visits were conducted by Anna Povey and Helen Morgan of Bushways and Benjamin Dean, representing Falmouth Community Centre and with supporting local knowledge, on 10th and 11th November 2008.

Native vegetation communities were broadly confirmed according to TASVEG Version 1.0 classifications (Harris & Kitchener 2005), based on existing mapping units (Natural Values Atlas, 10/08) and referring to Coastal Values data (Northbarker Ecosystem Services, 2006). Fauna and potential fauna habitat was noted, along with other natural assets.

A survey of birds was conducted by Sarah Lloyd on 25th January 2009, during a public field day at Falmouth and the lagoon. Recordings of local bird calls were made by Benjamin Dean during the weeks preceding the field day, and identified by Sarah.

Management issues for the native vegetation and fauna of the area were noted (and adjusted following community consultation).

Locations were recorded by handheld GPS, using datum WGS84 (equivalent to GDA94).

2.3 Community and stakeholder consultation

A meeting of landholders and land managers of the area was held at Falmouth Community Centre on 9th December 2008. Land managers expressed their concerns and ideas for the area, and made suggestions for the scope of the plan.

A community workshop was held at Falmouth Community Centre on 17th January 2009, following letter drops and newspaper articles to advertise the event. Presentations were made introducing the project, summarising natural values of the study area, and exploring some of the funding options currently available. During the facilitated workshop, thirty-two participants listed issues affecting the lagoon, discussed a vision for the future of the lagoon, and decided upon objectives for the management plan. Actions to address the objectives were suggested and prioritised, with space allowed for some additional actions to be proposed by Bushways in the first draft of the plan. People who were not able to attend the workshop or had to leave early were given a form for comments. Three forms were returned, and comments were incorporated into the plan.

A Draft Henderson Lagoon Environmental Management Plan was circulated to participants, and feedback from fifteen people was incorporated into a second draft, which was again circulated by email, prior to a second and final community meeting.

A final public meeting was held on the 18th April 2009 at Falmouth Community Centre, at which this plan was endorsed. A steering group was formed to begin the implementation of the plan.

3 Natural and Cultural Values

3.1 Vegetation

Within the lagoon itself, there are areas of seagrass (Dwarf Grasswrack). These and other aquatic vegetation of the lagoon have not been mapped. Although aquatic vegetation is vital for fish and other life of the lagoon, it cannot be described here. Future work could be done to determine the vegetation within the lagoon.

The terrestrial native vegetation communities around Henderson Lagoon include:

Vegetation Community	**TASVEG code**	**Conservation Status (DPIW, 2005)**
Coastal scrub	SSC	
Coastal Wattle, *Acacia longifolia,* scrub	SAC	
Wetlands, including both: "freshwater aquatic herbland" and "freshwater aquatic sedgeland and rushland"	AWU* (AHF ASF)	V
Saltmarsh, including both: "succulent saline herbland", and "saline rushland"	AUS: (ASS ARS)	
Iron Bark, *Eucalyptus sieberi,* forest not on granite	DSO	
Black Peppermint, *E.amygdalina*, coastal forest	DAC	
White Gum-Blue Gum, *E.viminalis – E.globulus*, coastal forest	DVC*	R, V
Blue Gum, *E.globulus*, dry forest	DGL*	V
Black Gum, *E.ovata*, forest	DOV*	E
Black Peppermint, *E.amygdalina,* forest on mudstone	DAM	
Scented Paperbark, *Melaleuca squarrosa*, scrub	SMR	
Wet heathland	SHW	
Coastal grass and herbfield	GHC	

R = Rare, V = Vulnerable, E = Endangered. Others are not in a threatened category.

***Wetlands, White Gum-Blue Gum coastal forest, Blue Gum dry forest and Black Gum forest are listed as threatened native vegetation communities** (DPIW 2005). The Forest Practices Act provides that threatened native vegetation cannot be cleared or converted, except in exceptional circumstances.

The others are not listed as threatened, but have many natural values, including supporting threatened flora and fauna species.

Each community is briefly described below, within broad descriptions of different zones around the lagoon. Map 2 shows the vegetation communities as they have been broadly mapped by TASVEG (the state-wide vegetation map for Tasmania, available on The List). Note that this mapping has had limited ground-truthing, and is not necessarily accurate at a fine scale. The vegetation within 100 metres of the lagoon and coast has been mapped more accurately on the Coastal Values Atlas (NorthBarker, 2006), and is shown in Map 3.

Native plants found during this and previous surveys in the area are listed in Appendix 1, and some major and minor weeds in Appendix 2. There are over 260 native vascular plant species around Henderson Lagoon and nearby forest in the catchment, and also many bryophytes and fungi.

Map 2 Native vegetation communities (TASVEG)

Map 3 Coastal Vegetation around Henderson Lagoon

3.1.1 Lagoon fringes

Saltmarsh fringes most of the lagoon, being adapted to varying levels of brackish water. This saltmarsh varies from "**succulent saline herbland**" (TASVEG code ASS) to "**saline rushland**" (ARS). Succulent saline herbland exists at the very water's edge, and is inundated more frequently than the more landward saline rushland which intergrades with it.

Figure 2. Beaded Glasswort is the main saltmarsh plant around the lagoon. Sea Rush (at back) is also common where inundation is less frequent.

The succulent Beaded Glasswort dominates the herbland in a low mat, as do similar glassworts in saltmarshes around the world. Succulence is a feature that helps plants cope with excess salt, while the red colouration helps with highly saline and sunny environments. The small red-stemmed shrub, Southern Seablite, is another succulent common here.

Where there is a lower frequency of inundation, dark-headed Sea Rush grows, and it dominates "saline rushland" around much of the lagoon, as well as the Peat Marsh. Chaffy Sawsedge grows in places, Coastal Tussockgrass in others, and Australian Saltgrass forms tough lawn-like patches. These show the wiry, stiff leaves that help them cope with abrasion from salty winds. Succulents occur here too, including Glasswort, Seablite, and occasional Coastal Seaspurrey and Shiny Swampmat. Slender Sea-celery is a salt-tolerant herb found here.

In slightly higher, less saline or better-drained places, other plants occur, including Southern Reed, Bare Twigsedge, Knobby Clubsedge, Coarse Twinerush and Native Pigface.

Few weeds can survive in the salty wetness of saltmarsh, which is in generally good condition around the lagoon. However immediately above the saltmarsh fringe at the southern end of the lagoon there are areas of dense Gorse. The fringe is very narrow in places on the western shore (bordered by agricultural land), and in places appears affected by livestock. Parts of the saltmarsh would be vulnerable to future invasion by Seaspurge, and by salt-tolerant pasture grasses (such as Tall Fescue) and other weeds. Saltmarshes are adapted to high levels of native animal grazing, but are damaged by hard-hoofed livestock and by off-road vehicles (Harris & Kitchener, 2005).

Saltmarsh and adjacent mudflats and sandflats are important habitat for birds such as various waders, oystercatchers, terns, pelicans, swans, plovers and cormorants. Water rats are also known here (B.Dean, pers.comm.), and invertebrates would be numerous in the sediments.

3.1.2 Coastal dune spit

Containing the lagoon and fronting the ocean is a spit of sand dunes and intervening swales. The vegetation here is mostly **Coastal Wattle scrub** (TASVEG code SAC). This is dominated by hardy Coastal Wattles, over a sparse understorey of introduced Marram Grass. These plants are well adapted to the nutrient-poor and dry sand dunes, and harsh salty winds. Given some shelter by these plants, there are also Silver Banksia, Coast Beardheath, Kangaroo Apple and Sagg, as well as occasional Bower Spinach, Climbing Lignum, Knobby Clubsedge and Coast Swordsedge. This vegetation is likely to continue to change over time, as is normal in such dynamic coastal situations.

Figure 3. Marram Grass and Coastal Wattle dominate the coastal dunes, and are recovering after the 2006 fire.

In places the dominance of Coastal Wattle is shared enough with other species for the vegetation to be called **Coastal Scrub** (SSC), while an area with White Gums is **White Gum coastal forest** (DVC).

In places where there are no trees or shrubs, a "**coastal grass**" vegetation community (GHC) exists, such as at the Steels Beach front of the dune. There are some native sand-binding grasses, such as Beach Spinifex and Coast Fescue, and occasional Dune Thistle (a native that looks like sowthistle), as well as the more competitive introduced Marram Grass.

Figure 4. The trailing grass at the front of these dunes is the native Beach Spinifex.

Further north, along the drainage line from Scamander, there are areas of **Scented Paperbark scrub** (SMR) and **wet heathland** (SHW) behind the dunes.

There are some weeds on the spit, particularly Gorse and some Spanish Heath, which are currently the target of a removal program. Regeneration from seed in the soil means that weed control is likely to be an ongoing necessity. The ubiquitous weed Marram Grass is well-established here (since being introduced in the 1960s, according to community comments). Removal of Marram Grass would probably now be an impossible undertaking over such a large area, and likely to lead to unpredictable sand movements. Occasional Searockets do not currently appear to be at risk of dominating or displacing native species. This area would be very vulnerable to invasion by Seaspurge.

Beach birds nest on the sand above high tide, and bush birds utilize the scrub for feeding and nesting. Small mammal footprints were found on the dunes, which could belong to native Swamp Rats, or introduced rodents. Many other wildlife species would inhabit the sand spit.

3.1.3 Forests and woodlands

The northern part of the lagoon is surrounded by native forests and woodlands of various types, which intergrade in a patchy way, depending upon the proportions of the five major local eucalypt species and in response to varying environmental conditions. The forest is currently regenerating after the fierce wildfires of December 2006.

Much of this surrounding forest, especially in Winifred Curtis Scamander Reserve, is **coastal Black Peppermint forest or woodland** (TASVEG code DAC). This is dominated by Black Peppermints, but may include other eucalypts such as White Gums, Black Gums, Blue Gums and Ironbark. The soil is sandy and low in nutrients. The understorey is heathy, with a high diversity of legumes (such as Showy Bossia and Running Postman), heaths (such as Common Heath, White and Pink Beardheaths) and shrubs (such as several wattle species, Blue Dampiera, Twiggy Daisybush, and several guineaflowers). There are also Grasstrees, many herbs, sedges (such as Sand Swordsedge), some native grasses and lilies, as well as Bracken (particularly where fires have been frequent).

Figure 5. The floral, heathy understorey of Black Peppermint coastal woodland at Winifred Curtis Scamander Reserve.

This kind of forest supports many species of plants and animals, including many honeyeaters, and can be spectacular in flower. The endangered New Holland Mouse favours heathy habitats such as this.

Where the ground is poorly drained, there are more Black Gums, forming pockets of **Black Gum forest** (DOV); a threatened vegetation community. The understorey can include Scented Paperbarks and Prickly Moses, or be more grassy and sedgey.

In some places, where the sand is less leached, there are more White Gums and/or some Blue Gums, forming **White Gum-Blue Gum coastal forest and woodland** (DVC), another threatened vegetation community. The understorey is similar to that of the Black Peppermint coastal forest, but bracken and saggs tend to dominate, and there may be more medium to tall shrubs, such as Coast Wattle, Banksia, and Silver Wattle.

The hills west of the lagoon are mostly covered by **Ironbark forest not on granite** (DSO). There may be occasional other eucalypts present in this forest, such as Black Peppermint, White Gum, Blue Gum and Stringybark, but it is clearly dominated by Ironbark. Bulloaks, Silver Wattle and Native Cherries are some small trees which are regenerating in this forest. The understorey of this dry forest is typically open and sparse, but may be denser in wet gullies. At present the understorey is dense in many areas because of regeneration following the fires. Bracken dominates currently, but there are also eucalypt seedlings, Thatch Saw-sedge, Sand Swordsedge, Sagg, and a wide diversity of wattles, peas, daisy bushes and heaths amongst this.

Figure 6. Eucalypts in the Ironbark forest are covered in epicormic buds after the fire.

Small areas of **Blue Gum dry forest** (DGL) and **Black Peppermint forest on mudstone** (DAM) occur on suitable sites. In the upper catchment, some other types of forest are found, including **dry and wet Stringybark forests** (DOB, WOU), and small patches of **dry Gumtopped Stringybark forest**.

The condition of all these forests varies, but is generally good. Regeneration following the fires is strong, and although the fires killed some trees, many trees are covered in epicormic growth and there are also many seedlings. The distribution and density of plant and animal species have been affected by the fires, positively or negatively, in complex ways which will continue to change as time goes on. The State Forest areas have been influenced by logging, and all forests have been subjected to timber and firewood harvesting since settlement of the area. There are few big old trees remaining. Some clearing has occurred in the residential and rural-residential areas along the Tasman Highway, and this increased following the 2006 fires. Recent subdivisions have lead to clearing of some new areas, but some forests associated with these subdivisions have been protected. The agricultural area to the southwest was cleared historically. Some areas of forest in the middle of the catchment have recently been converted to plantation, which results in loss of most natural values.

Weeds are few in these forests, but there are more at the edges of the highway, residential areas (e.g. Upper Scamander Road area) and pastures. Weeds may spread into areas regenerating after the fires. Weeds include pasture grasses, Blackberry, Spanish Heath, Pampas Grass and Gorse. Many more weeds could become established in future; especially as nearby gardens and roadsides include several invasive environmental weeds.

A wide range of animals find habitat in these forests. For example, it is believed that Sea-eagles have a nest somewhere northwest of the lagoon (P.Frater, pers.comm.), from which they fly to the lagoon most days. These eagles prefer to nest in old growth trees, undisturbed, within 5 kilometres of the coast.

The connectivity of forest and other native vegetation between the large area of forest to the west and the smaller areas around Henderson Lagoon is an important consideration for wildlife in the area. The Tasman Highway, cleared areas and residential areas can be major barriers to wildlife movement and viability of populations.

3.1.4 Falmouth

The town of Falmouth was established in the mid 1800's on rural land, so has little remnant native vegetation besides the fringing coastal scrub. There are some native grasses and shrubs along the nature strips, but most trees and shrubs within the town have been planted by residents. These include non-native trees such as cypresses, "Australian natives" such as flowering gums and various mainland wattle species, as well as local natives such as sheoaks. These provide some habitat for birds (mainly wattlebirds and honeyeaters), shade and shelter from winds.

Most importantly, there is a narrow rim of remnant **coastal scrub** around the northern and eastern edges of the town. This provides habitat and a corridor for wildlife, binds sand and helps to protect Falmouth from coastal winds.

This is included within the Four Mile Creek Conservation Area, and is known locally as "The Esplanade". It is a rocky headland with overlying sandy soil, and consolidated sand dunes at the northern and southern ends of the town. Major native shrubs here are Coastal Wattle (*Acacia longifolia ssp sophorae)*, Common Boobialla (*Myoporum insulare*), Coast Beardheath, Bower Spinach and Coastal Saltbush. Unfortunately there are also major weeds here, including Gorse, Boxthorn, Mirror Bush, Blackberry, Buffalo Grass and Coastal Teatree, although these have been recently targeted for removal. Some garden plants have spread or been planted in the scrub.

Amongst the dominant shrubs can also be found occasional White Correa, Seabox, Yellow Needlebush and Smooth Riceflower. Open patches between these shrubs may be filled by Native Pigface, Coast Swordsedge, Knobby Clubsedge, Australian Saltgrass, Southern Stalksbill, Spinifex or Coast Speargrass. Sheoaks can be found in some places on the inland side of the scrub.

Figure 7. Wind-pruned scrub consists of various native shrubs, as well as some garden plants which have spread and other weeds.

The native plants which occur in this scrub are typical for such a site. While in some protected sites elsewhere forest may grow right to high water mark, in most coastal locations (such as Falmouth) the strong winds, salt and poor soils mean that only specialized coastal vegetation survives at the coastal edge (Kirkpatrick & Harris, 1999). Coastal scrub occurs in a dynamic environment and therefore provides an important stabilizing and successional function (Harris & Kitchener, 2005). In many areas it is threatened with clearance for coastal development, with associated problems such as slashing or burning to maintain sea views, and the invasion of weeds (Harris, 1991, cited in Harris & Kitchener, 2005).

In Falmouth the coastal scrub is very narrow, and is subject to ongoing removal for garden expansion, fire hazard removal, perceptions that certain species are unnatural and off-target damage from spraying of weeds. This makes it vulnerable to decline and reduces its habitat value, as well as reducing its sheltering function for Falmouth. There are gaps in places where mowing has completely removed it. Small access tracks cross the scrub from roads to the coast.

Birds are common in the coastal scrub, feeding on flowers etc and sheltering in the dense shrubs.

This scrub is a key asset of Falmouth, and vital for native vegetation connectivity in an otherwise largely cleared environment, and should be protected.

3.1.5 Farmland

Most of the nearby farmland was cleared long ago. More recently, substantial areas of eucalypt plantations have been established on previously and newly cleared land. Very little native vegetation remains on low lying areas southwest of the lagoon. Native forest vegetation remains in narrow bands along some creeks, but with limited understorey and generally not across the low lying flats around the lagoon. Creeks have become eroded, and are affected by reduced rainfall and dams. Some creeks have been fenced along one side to begin to address these issues (M. Graham, pers.comm.). The Peat Marsh and native forest at the northwestern side of the lagoon have been recently fenced and covenanted by the landholder and stock removed.

Figure 8. Potatoes are irrigated, while the Peat Marsh and surrounding forest has been fenced off and covenanted.

A large freshwater wetland exists on a creek near Glencoe homestead. It supports many native aquatic plants, such as Waterribbons, and many frogs, including threatened Green and Golden Frogs. However this wetland is unfenced and vulnerable to stock impacts when water levels are low.

Figure 9. Glencoe wetland has many Waterribbons, making it ideal habitat for Green and Golden Frogs.

Two irrigation dams have been constructed on the farmland in recent years.

3.2 Threatened flora

Nineteen species of threatened flora have been recorded within 5 km of the lagoon (see Appendix 3). These occur in a variety of habitats, from the wooded hills to heathlands and even bare ground under exotic trees. The locations of threatened flora records are shown on map 4. (N.B. Some records may appear in unexpected locations on the map, due to the large accuracy range of the record supplied or because they are derived records from observations.)

Winifred Curtis Scamander Reserve has many records, including of Tasmanian Smokebush, Twiggy Guineaflower, Juniper Wattle and Mauvetuft Sun-orchid. These are well protected by the reserve, although phytophthora rootrot could become a threat if it spreads (e.g. guineaflowers are susceptible to this disease).

Of particular interest are weedy-looking Soft Peppercress and Shade Peppercress, which occur under exotic trees in farmland near Falmouth, as they require bare soil free from competition from other groundcovers. Devils Creek Bridge at Falmouth is a key site for Soft Peppercress.

Figure 10. Vulnerable Lesser Guineaflower, Hibbertia calycina*, is only found around Scamander and St Helens.*

The lagoon and Scamander area is also a key site for Tasmanian Smokebush, Lesser Guineaflower and Juniper Wattle. Juniper Wattle on one property in the northwest is known to have increased in numbers since the 2006 fires (V.Legg, pers.comm. 4/09). Several records exist northwest of the lagoon, in the native vegetation which is under threat from urban development and associated clearing. This area also has known phytophthora rootrot records. Both clearing and phytophthora are threats to these threatened species. Native vegetation should be protected in this area as much as possible, and thorough surveys conducted before any development activities.

These and other threatened flora may be found with more thorough searching.

Map 4 Threatened Flora and Fauna

3.3 Habitat for threatened fauna

There is abundant habitat in and around Henderson Lagoon for many species of fauna, including threatened species and others of conservation significance (Lawrence 2004). Appendix 4 lists those threatened fauna that may occur on or near the lagoon, with brief comments on their habitat. Threatened fauna that are known to occur within 5km include:

- White-bellied Sea-Eagle
- Little Tern
- Fairy Tern
- Swift Parrot
- Tasmanian Devil
- Spotted-tailed Quoll
- Green and Golden Frog
- Australian Grayling
- Giant Velvet Worm
- Leathery Turtle (washed up from sea, unusual)

Figure 11. Green and Golden Frogs like to sunbake, and can be heard calling from Glencoe wetland.

Others may also occur, but have not been recorded due to difficulties of observation. For instance, heathy environments like Winifred Curtis Scamander Reserve would be ideal for the New Holland Mouse. It is hoped that this species will be found with surveys currently underway (T. Dudley, pers.comm.).

Habitat for these threatened species must be maintained, and vegetation connectivity is also important for dispersal. Important habitat features include:

- Big old trees (White-bellied Sea-eagle and Wedge-tailed Eagle)
- Old trees with large hollows (Masked Owl, Swift Parrot)
- Wetlands, especially with aquatic vegetation, such as Glencoe wetland (Green and Golden Frog)
- Wet forest with decaying logs (Velvet Worms)
- Large areas of healthy native vegetation (all species)
- Undisturbed beach and sandbars (Little and Fairy Terns)
- Free movement between freshwater streams and the sea (Australian Grayling)

Shorebirds

Many delightful shorebirds favour Henderson Lagoon and Steels Beach for foraging and nesting. These include threatened Fairy and Little Terns, as well as Hooded Plovers (not listed as threatened, but populations in decline). Breeding populations of these three species have decreased rapidly in recent years, with fewer than 250 pairs of Fairy Terns and fewer than 10 pairs of Little Terns known in Tasmania (Woehler and Park, 2008).

Figure 12. Fairy Terns, like Little Terns, nest on a simple scrape in the sand. (Photo courtesy of Liz Znidersic.)

Both of these terns forage at Henderson Lagoon, and both Little and Fairy Terns have been recorded breeding near the mouth of the lagoon and southern end of Steels Beach (Rounsevell, 1983; E.Woehler, pers.comm. 18/2/09; OSRA shorebird sightings sb1103, Listmap). **This is one of the few places in the state where Little Terns are known to nest.** Most years both of these terns breed at the Scamander River mouth, whereas they do not always nest at Falmouth (E.Woehler, pers.comm. 18/2/09). All potential breeding sites are extremely important to conserve for these threatened species, as unknown conditions determine where they will breed each year. As it is very difficult to see the nests, it should be assumed that they may be breeding here during summer.

Fairy and Little Terns are very similar, both being tiny and slender, white terns with similar habits. They often forage together, and in fact they are known to form mixed pairs (E.Woehler, pers.comm. 18/2/09). They are sometimes referred to as Sea Swallows because of their graceful fluttering (Green, 1995), which is followed by a plummeting dive for fish. With closer viewing they are distinguished in breeding plumage by the precise extent of the black crown, and the Little Tern has a black tip to its paler yellow bill (more orange in the Fairy Tern).

Figure 13. Little Tern (left) and Fairy Tern (right).

Little and Fairy Terns nest on the beach and sandbars, as do (non-threatened) Pied and Sooty Oystercatchers, Red-capped and Hooded Plovers. Nests are a simple scrape in the sand (or shingles in the case of Sooty Oystercatchers), just above the high tide mark, which makes these species extremely vulnerable to use of the beach by dogs, people and vehicles. They are also vulnerable to predation by feral and domestic cats and dogs. It is vital that nests should not be approached, even for observation or monitoring, as birds may abandon the nest.

Migratory birds

Migratory birds such as various waders are protected under JAMBA and CAMBA agreements with Japan and China, as habitats in both hemispheres must be conserved. Some that have been recorded around Henderson Lagoon include Bar-tailed Godwit, Red-necked Stint and Caspian Tern.

3.4 Other fauna

The lagoon area is obviously very important to many birds, with magnificent Pelicans a common sight, as well as Great, Black-faced and Little Pied Cormorants, delicate Fairy Terns and Little Terns, Sea-eagles, Masked Lapwings, Pied Oystercatchers, Australian Shelducks, Bar-tailed Godwits and others utilizing the sandbars and water for foraging.

Water Rats are known to occur around the lagoon (B.Dean, pers.comm.). Not often seen, they have beautiful, glossy, dark fur with a white-tipped tail. They forage for fish, crustaceans and other prey in fresh or brackish water such as this estuary, and shelter in tunnels in banks (Watts, 1993). Remains of their prey may be found at their "dining tables" on flat rocks or stumps near water.

Penguins are not currently known here but could find habitat along the spit as regeneration proceeds. They are well known from nearby east coast sites, including Bicheno.

Marine, brackish and freshwater fauna would also include a huge range of fish and invertebrates. Galaxid fish have been seen in the creeks draining into the lagoon (B.Dean, pers.comm.), which may be *Galaxias maculatus* (T.Farrell, pers.comm.). "Tremendous numbers" of juvenile mullet, salmon, silver trevally, flathead and bream are commonly seen in the lagoon, as well as thousands of soldier crabs (T. McManus, pers.comm.). However soldier crabs have only recently reappeared after the lagoon was closed for a long period in 2001, and sea hares (a kind of mollusc without an obvious external shell, which did occur in the lagoon) have not been seen since then (T. McManus, pers.comm.). A species of crab, *Amarinus paralacustris*, also occurs in the area, which is its only known location in Tasmania (National Estate Register).

Edgar *et al* (1999) found 34 species of benthic invertebrates at Henderson Lagoon, including 12 crustacea, 2 gastropods, 5 bivalves and 10 polychaete worms.

The native vegetation surrounding Henderson Lagoon and into the hills of the catchment provides habitat for a huge range of native fauna, including mammals, birds, frogs, fish, numerous invertebrates, lizards and others. For example, the highly conservation-significant Eastern Quoll forages over the forest, heathland and farmland, and is particularly fond of pasture pests such as cockchafer and corbie grubs. Long-nosed Potoroos have been recorded, and prefer thick groundcover and light sandy soils (Watts, 1987).

The fauna that have previously been recorded in the area are listed in Appendix 5. Some 102 native species are listed, of which 66 are birds. Many more are likely to occur here, including hundreds or thousands of invertebrate species. For example, a survey of spiders in coastal heathland at four 90m x 90m plots in northeast Tasmania found 130 species, of which 88% had not yet been described scientifically (Churchill, 1996).

Figure 14. There are many unrecorded invertebrates in native vegetation, such as this spider found in Falmouth's coastal scrub.

Native fauna need native plants for habitat. (While some generalist species such as wattlebirds can use garden plants, many more species prefer local native plants for food, nesting or shelter.)

Key habitat elements include:

- lagoon, sandbars and undisturbed beach areas
- big old trees with hollows,
- understorey (varying from dense shrubbery to more open areas),
- riparian vegetation,
- fallen logs and leaf litter
- wetlands.

A variety of vegetation types provide habitat for a wide variety of creatures. For instance, the large diversity of plants in heathland, such as that of Winifred Curtis Scamander Reserve, supports a

large diversity of animals (Visoiu and Lloyd, 2003). A year-round supply of nectar, pollen and seeds attracts birds and many insects, along with predators of these. It is possible that threatened New Holland Mice live here. Other likely species include various lizards, Bettong, White-footed Dunnart and Little Pygmy Possum.

Another example is freshwater wetlands, which are vital habitats for many creatures, including frogs, fish, wetland birds and invertebrates. Threatened Green and Gold Frog are found in Glencoe wetland near Falmouth, as well as Banjo Frogs. Black Swans are numerous here, and there are also Great Egrets, White -faced Herons, and Chestnut Teal easily seen here. Other frog species recorded in the area include Brown Froglet, Tasmanian Froglet, Spotted Marsh Frog and Southern Toadlet.

Forests and woodlands have structural and floral complexity that provides a huge range of habitat, with trees, shrubs and understorey all important features. For instance, various bats may roost in tree hollows and under bark, and forage for insects over wetlands and in woodlands. Eagles, Dusky Woodswallows and other predators perch on dead branches to look for prey. Other birds, reptiles, mammals, and innumerable invertebrates occupy various niches throughout the forest.

Animals do best in large areas of native vegetation, where there is room for their foraging needs, and with vegetated connections for dispersal to other areas of habitat (Visoiu & Lloyd, 2003). Healthy populations need room for many individuals of a species, to recover from events such as fire or drought, and so that they have enough genetic diversity to avoid becoming inbred.

3.3 Geoconservation

The geomorphological features of Henderson Lagoon contribute to its listing on the Register of the National Estate (Australian Heritage Database Place ID: 100502).

> "The geomorphological features include a single coastal dune spit, a saline peat marsh and a classic bird's foot delta all of which are unusual in Tasmania. Together with the tidal lagoons, estuary and swales, they demonstrate the results of continuing coastal processes in a very limited area."

The Falmouth Lacustrine System, which includes Henderson Lagoon and surrounding areas, is listed as regionally significant on the Tasmanian Geoconservation Database (Natural Values Atlas, October 2008). The database describes it as a

> "robust example of a Pleistocene old river course with veined quartz gravel and cobble lags. In places some lags intercalate with, and in other places are overlain by, an intact aeolian Quaternary sequence incorporating beach, coastal dune spit, low wave energy lagoon."

Geoconservation aims to preserve the natural diversity of our non-living environment (our geodiversity). This means protecting significant examples of bedrock features, landforms and soil features and processes, as well as maintaining natural rates and magnitudes of change in those features and processes.

Sand landforms are generally inherently sensitive to disturbance and easily destabilised, and most particularly so in the windy local environment. Management should aim to retain the integrity of this geoconservation site. For example, vegetation cover is important for maintaining the stability of dunes, and should be retained.

The Peat Marsh and lunette on the north western side of the lagoon is on private land and was historically drained and cultivated for agriculture (McManus, 1993). It is now covered in native Sea Rush, and has been placed by the landholder under a Conservation Covenant, fenced to exclude livestock and will be managed for protection.

3.4 Cultural Heritage

3.4.1 Aboriginal heritage

A rich Aboriginal history is evident in the Scamander Conservation Area (Parks & Wildlife Service, 2009):

> "Middens and the presence of tools and stone assemblages indicate that Aboriginal people used this part of the coast extensively. Mussel, abalone, rock whelk and warrener appear to have been the most commonly eaten shellfish. Small quantities of seal and macropod (kangaroo or wallaby) bone are also found in the middens."

Henderson Lagoon falls within the territory of the Oyster Bay nation (G. Andrews, pers.comm.).. The Oyster Bay tribe consisted of ten bands, producing a total population of between seven and eight hundred, making it the largest tribe in Tasmania (Ryan, 1996). It is uncertain which of the bands would have lived around Henderson Lagoon, but it may have been the Leetermairremener from St Patrick's Head (Ryan 1996).

> "The major elements of their diet were shellfish from estuarine beds, kangaroo and possum from the open forests and plains, and a variety of vegetable foods. ….. Each winter would find (them) on the coastal areas of their territories living on shellfish and marine vegetables until the end of July, when swans and ducks arrived in lagoons and riverine areas to lay their eggs and bring up their young. …Between August and October (they) congregated at rich food-source areas like Moulting Lagoon and Schouten Island, where there were seasonally heavy concentrations of birdlife. At the end of October they moved inland, up the St Pauls

> and Break o'Day rivers to the Ben Lomond Tier….The north Oyster Bay people often spent the summer in these areas. Those in the Ben Lomond Tier returned to the coast at the end of January for sealing and muttonbirding, moving to the Midlands in March for kangaroos, wallabies and possums…. until they returned to the coast in June."

It is likely that Henderson Lagoon, with its shellfish, swans and other birdlife, was an important source of food for the Oyster Bay people, and the coast provided marine vegetables, shellfish, seals etc in both winter and summer.

Less happily, when the Black Line was in progress, Aborigines hid in caves on St Patricks Head (G. Andrews, pers.comm.).

An Aboriginal Heritage Survey and Report have been provided for this management plan (Graham 2009). The field inspection identified the presence of nine Aboriginal heritage sites identified within the study area around Falmouth and Henderson Lagoon. The sites, six in Falmouth and three on the sand spit between Henderson Lagoon and the beach, contain shell middens and artefacts. The sites were mapped and recommendations for management made. More sites may exist which have not yet been located.

An Indigenous Place (place ID 16091) is listed on the Register of the National Estate, but no details are available.

The diversity of native vegetation in this area is seen as a contemporary cultural resource, providing bush tucker, medicines, and craft materials, as well as being a socially and historically familiar and supportive environment for Aboriginal people (Graham, 2009).

3.4.2 Historic heritage

European settlement of Falmouth pre-dates the larger municipal towns of St. Helens and St. Mary's. The current township was originally laid out in 1833 and was surveyed in 1846. In the 1840s Falmouth was a centre for coastal transport and a settlement for the soldiers and convicts who built the St Mary's Pass. During this time, a convict gaol was constructed on the western side of the corner of Stieglitz and Legge Streets. Enduring buildings and trees provide a sense of history within the town (Falmouth Settlement Strategy, 2007).

The area was first settled by Doctor John Henderson, who took up his land around today's Falmouth area in 1829. William Steel was allocated land north of Dr Henderson's in 1830, and both landowners commenced immediately to establish paddocks and livestock. However, appropriately for today's holiday house culture, the first known permanent European residence was a "shack" (in current day terminology). Dr Alexander Thomson built "Thomsonville" on unassigned land near the coast as a retreat and then consulting room in the late 1820's.

A rudimentary port was used here for some time. Rural enterprises expanded from the 1860's, and Falmouth became a busier hamlet with a court house, shop, hotel and church. It was already known as an attractive holiday destination, for bathing, fishing, hunting and relaxing. Falmouth became quieter, gradually losing many services through the 1900's, although still appreciated by those who lived there, until a revival after the late 1970's saw many new residents. Many details of the history of Falmouth are recorded in "Thanks to Providence" (McManus, 1993), from which these few notes were taken.

Stone remains of the Old Coach Road (from the 1860's) still exist in places along the western side of the sand spit and in Winifred Curtis Scamander Reserve, although some has fallen into the lagoon. A waterhole used to water the horses still remains (T.McManus, pers.comm.). This Coach Road between Scamander and Falmouth was "a rudimentary, treacherous track behind and parallel with the coastal dunes. Even though the marshy ground had been stoned in the worst places, coaches frequently became bogged", and lagoons and rivers had to be forded at barways at low tide (McManus 1993). A rickety bridge was used to cross Devils Creek below Falmouth Inn.

Posts remain from original duck hides, some 70 or 80 years old, at the northern end of the lagoon (T. McManus, pers.comm.).

These historic remains are mainly protected within the conservation area and Winifred Curtis Scamander Reserve.

Enstone Park and Glencoe homesteads are both listed on the Tasmanian Heritage Register (ID numbers 553, 554; www.heritage.tas.gov.au).

3.4.3 Social and recreational values

The lagoon is greatly valued for low intensity recreational use – swimming, walking, relaxing, picnicking, enjoying the view, some fishing, boating and prawning, etc - as well as for the diversity of nature found here. Duck shooting is permitted on Henderson Lagoon (PWS, 1995), but has declined in recent years (M.Luttrell, pers.comm.)

The area is valued for its tranquil and pleasant coastal landscape, backed by forested hills.

Falmouth itself is felt to have "a unique character of a quiet 'hamlet' created by its physical location and the evolution of its built environment,…... surrounded by water, farmland and the eastern highlands" (Falmouth Settlement Strategy, 2007).

Figure 15. The lagoon and beach is hugely popular with everyone at Falmouth.

4 Management Objectives

The following were synthesised from the community workshop at Falmouth Community Centre on 17/1/09, and confirmed at the public meeting on 18/4/09, to guide this management plan and future works.

4.1 Vision for Henderson Lagoon

Through exemplary stewardship, Henderson Lagoon will be an ecologically healthy habitat supporting an abundance of native plants, animals and natural features and providing for human activities that treasure its heritage, beauty and tranquillity.

4.2 Objectives

- Improve the condition, integrity and connectivity of native vegetation, aquatic environments and wildlife habitat.
- Improve water quality to ensure ecological health of lagoon and catchment.
- Allow natural variability of water levels and maintain adequate water inflows for ecological health of the lagoon, balanced with avoiding damaging extreme high and low levels.
- Control pests, weeds and disease and prevent introduction of new ones.
- Identify and protect aboriginal and historical heritage sites.
- Recognise and foster good land-use practices within the catchment.
- Foster a sense of stewardship for the lagoon amongst the community.
- Support advocates for the lagoon in planning and other decision-making processes.
- Maintain recreational access without loss of natural values.
- Retain the landscape character of the area.
- Encourage environmentally sustainable management of waste.

5 Management issues and actions

Management issues and actions recommended here are the result of community consultation, compilation of data from various experts, and the consultants' findings. Note that many management issues and actions overlap. Duplication is avoided here, so some cross-referencing may be necessary. All actions are consolidated into a table in Appendix 8.

5.1 Pests, weeds and disease

These can have particularly large impacts, even compared to issues such as pollution and wildfires, as they are living creatures which aim to reproduce and spread as far as they can into the future. Impacts include loss of plant and animal diversity, reduced habitat value, loss of agricultural productivity and long-term control costs.

5.1.1 Aquatic pests, weeds and disease

Several pest animals have already become established in the lagoon, which have impacts on its natural ecology through predation and competition:

- **European Green Crab or Shore Crab**, *Carcinus maenus*. Well established in the lagoon and elsewhere in northern and eastern Tasmania (Thresher *et al,* 2003). They survived the closing of the lagoon in 2001 (Proctor & McManus, 2001) and they are still about in small numbers (T.McManus, pers.comm. 18/2/09).
- **Northern Pacific Seastar**, *Asterias amurensis.* Discovered in the lagoon in 2001; a significant expansion of its range in Tasmania. Eradication efforts were made by the community with CSIRO and Parks and Wildlife Service. Decreasing salinity and increasing stratification in the closed lagoon was followed by a sudden change in salinity when the barway was opened, which seemed to eradicate the seastars (Proctor & McManus, 2001). However no specific surveys have been done since 2001 (C.Proctor, CSIRO, pers.comm. 12/08). No seastars were seen during a 2006 Green Crab survey (R. Thresher, pers.comm. 12/08), and they have not been seen recently (T. McManus, pers.comm. 2/09).
- **New Zealand Screwshell,** *Maoricolpus roseus.* Abundant in the ocean near the lagoon, and elsewhere in Tasmania.

Freshwater wetlands, such as that on Glencoe near Falmouth, may be affected by weeds and disease, although no such survey was conducted for this project. For example, **chytrid fungus** is a disease that affects frogs in many wetlands throughout Tasmania.

5.1.2 Terrestrial pests, weeds and disease

Feral and domestic **cats** and **dogs** may affect local wildlife, both by hunting and by inadvertent disturbance (e.g. of nesting shorebirds). Cats may also spread the disease *Toxoplasmosis.* **Rabbits** and developing **fox** populations may also heavily impact native vegetation and wildlife. Dogs are subject to council management zones (see Wildlife, below).

Known **weed** occurrences are marked on map 5. These are mapped only approximately, as a full weed survey was not conducted. Weeds found in the area, with some prioritisation and treatment suggestions, are listed in Appendix 2. Appendix 7 lists some useful references for more detailed information on weed control.

Figure 16. Gorse is common around Falmouth and the southern end of the lagoon, and will require a control plan.

Weed infestations, especially Gorse, are densest around the southwest of the lagoon, and various weeds are established in the coastal scrub around Falmouth. The coastal spit is covered by Marram Grass. Some garden plants are invading the coastal scrub and the native vegetation

adjacent to gardens in the north and northwest. However, much of the fringe of the lagoon has relatively few weeds. Beyond the agricultural areas, the forest of the slopes is also fairly weed-free.

A weed control program by DPIW and NRM North is currently focussed on removing scattered woody weeds in the coastal spit and coastal scrub areas (contact: DPIW weeds officer, ph: 6336 5429). Some 8 hectares of dense gorse in the vicinity of the lagoon has been cleared in recent years by the local landholder, and gorse management across the property is ongoing (M. Graham, pers.comm.).

Dense weed infestations should only be tackled strategically, with long-term follow-up control, staged revegetation, and an awareness of wildlife which may be using the weeds as habitat. Removal of weeds from areas where they are currently sparse (e.g. the spit), and "containment" of dense areas of weeds (e.g. gorse at Falmouth), is a practical initial strategy. The East Coast Regional Weed Action Plan may also be consulted for strategic prioritisation. Should any new areas be fenced off around the lagoon, they should be regularly monitored so that weeds growing in the absence of stock grazing can be promptly removed.

Sea Spurge is a serious coastal weed that is not yet established in this area, although small infestations have been found nearby (P. Buchhorn, pers.comm.). It would have a serious impact on seashore and lagoon fringes and should be eradicated if found.

Phytophthora rootrot disease, *Phytophthora cinnamomi* ("Pc") is a serious threat to native vegetation, especially heathland and dry forests. It is a fungus-like pathogen which can be transported onto a site in soil carried on vehicles and footwear, and results in death of grasstrees and very many flowering shrubs and trees.

Winifred Curtis Scamander Reserve is known to have a mosaic of patches of phytophthora symptoms, with grasstrees slowly but steadily dying over some years even before the recent fire (T.Rudman, 18/2/09). Samples could be tested for confirmation of the disease in the reserve. Currently other parts of the reserve are still free of the disease, evidenced by the large number of grasstrees and other susceptible species, but are vulnerable to infection. Although spread of Pc is very slow in such deep, well drained sands, it has and will continue to reduce the populations of susceptible species in the reserve (T.Rudman, 18/2/09).
The disease is also known to be present elsewhere in the lagoon catchment, although the few records are opportunistic (see figure 17).

Figure 17. Phytophthora rootrot records around Henderson Lagoon. Red dots are confirmed Pc, yellow dots show Pc symptoms (T.Rudman, 4/2/09).

5.1.3 Valuable plants or weeds?

A special note is made here of some plants (marram grass, coast teatree, coast wattle, pasture grasses and garden escapes) which can be viewed as weeds or not, depending upon the situation.

Marram Grass is now a well-recognised weed, which was widely used for stabilising dunes. Marram grass has a huge impact on dune systems, stabilising previously active sand, forming taller and steeper dunes than native dune grasses would, and can almost totally exclude native dune grasses and reduce sand available to sand-nesting birds. Although it is now recommended not to plant marram grass, removal of this vigorous rhizomatous plant is very difficult.

At Henderson Lagoon it has stabilised the previously more mobile front of the sand spit. It is probably best to accept that marram grass is here to stay. At least native plants like Coast Wattle do grow amongst it, reducing its dominance and providing habitat for native wildlife. Any spread of marram grass into new areas should be controlled, and native coastal grasses should be encouraged wherever they exist.

Coast Teatree is not native in Falmouth, although it does naturally occur in parts of the north coast of Tasmania (Thorp, 2003). It is a vigorous and hardy species, which has the ability to dominate coastal scrub and heathland, and should be considered a weed in most native vegetation outside its natural range. At Falmouth it is scattered through the coastal scrub of the Esplanade. However, removal of this weed should be done carefully, to avoid excessive opening of the vegetation in this exposed site, which could lead to erosion.

Pasture and lawn grasses and **garden plants** are similar in that they are valued for their role (in productivity on farmland, or beauty in the garden), but they can cause problems in adjacent native vegetation. Many species are very hardy, and also able to spread into native vegetation, where their vigour allows them to compete with native plants. Non-native grasses can exclude native understorey plants, and are difficult to target for control in native vegetation. Some garden plants can spread widely (especially those with wind-blown seeds, or berries which birds can transport kilometres to bushland) and invade native vegetation. Mirror Bush and Butterfly Bush are just two examples. This is a particular issue in places such as Falmouth and Scamander, where gardens are in close proximity to native vegetation. Sometimes garden plants are also deliberately planted into native vegetation.

Coast Wattle, *Acacia longifolia var. sophorae* is a typical native plant in coastal situations, but some community members consider it as a weed in the sandspit and potentially a fire hazard in the coastal scrub around Falmouth. There is also some confusion over names.

This wattle is also known as Boobialla, but is different from Common Boobialla, *Myoporum insulare*, which also occurs here. Due to this confusion of common names, we will refer to this species as Coast Wattle.

*Figure 18. Coast Wattle's curly mature seedpods and rounded phyllodes ("leaves") distinguish it from introduced Sallow Wattle (*A. longifolia var longifolia *usually has straight seedpods and pointy phyllodes).*

This hardy and dense shrub does have the potential to dominate vegetation (Thorp 2003), but its dominance is often a normal part of ecological succession on coastal sands (Kirkpatrick & Harris, 1999). It may also be dominant for a period after fire, but in a mix of other species it disappears after some 30 years (Kirkpatrick & Harris, 1999). At Falmouth and the sandspit there is no indication that it is acting in any way other than is normal for these coastal situations. A photo from the 1930's (McManus, 1993) shows shrubby vegetation behind the dunes which is very likely to include Coast Wattle.

Coast Wattle is likely to be of high flammability, as are most native plants, although it is not specifically listed in the Tasmania Fire Service's pamphlet (Chladil & Sheridan, 2003). Dogwood is one of the few native plants listed with low flammability. There is no reason to target Coast Wattle as any more of a fire hazard than most other plants in the scrub. The coastal scrub occurs on the

Four Mile Creek Conservation Area and so is to be retained as native vegetation, of which Coast Wattle is a valuable part. Management would aim to prevent fire in coastal vegetation like this (Kirkpatrick & Gilfedder, 1999), but not by eliminating the scrub which is already excessively narrow. Falmouth houses should have a Building Protection Zone and Fuel Modified Buffer Zone as recommended by the Tasmanian Fire Service, within the lot boundaries.

Coast Wattle has a number of benefits. Firstly, it is a typical component of this vegetation type at the coast. It provides abundant food and dense shelter for a wide range of fauna. It is also invaluable as a hardy, salt- and wind-tolerant dense shrub, which contributes to the stability of the microclimate for coastal scrub and protects trees and houses inland of it. This is a particularly important role in a very narrow scrub fringe that suffers from "edge effect" (increased wind, sun and weed impacts around the edges).

Coast Wattle should not be removed unless it can be clearly shown to be damaging the coastal environment more than it is benefiting it.

Actions:

- Strategic control of weeds around lagoon
- Replant native groundcovers after weed control
- Consider cat and dog control program (such as soon to be trialled in Weymouth and Bellingham areas).
- Monitor feral seastars and greencrabs and liaise with CSIRO.
- Consider spread of weeds and disease in assessment of existing and new tracks.
- Monitor for and remove any infestations of Sea Spurge.
- Encourage people to remove environmental weeds from their gardens, promote community awareness of invasive garden plants and care for 'The Esplanade'.
- Provide the Coastal Weeds pamphlet to every resident for their information.
- Hold a weeds working bee/field day for a combined education-"hands on" action approach.
- Educate community on how not to spread phytophthora in soil (e.g. pamphlet, articles)
- Test samples from Winifred Curtis Scamander Reserve for phytophthora.
- Assist Winifred Curtis Scamander Reserve Trust with containment of phytophthora infections in the Reserve, if required.
- Conduct community field days for identification of native plants (for retention) vs weeds (for removal)

Figure 19. Keep watch for the blue-green foliage of Sea Spurge, and eradicate it.

Map 5 Approximate weed occurrence near Henderson Lagoon

Marks show presence in an area, rather than precise locations.

5.2 Hydrology

Natural variability of the lagoon
It is important to recognise that estuaries are naturally highly variable systems (Murphy *et al*, 2002). They are influenced by rainfall, groundwater, freshwater and marine inputs, evaporation and by the ebb and flow of the tide. They can show both vertical and horizontal stratification and can be open or closed to the sea (Murphy *et al*, 2002). Therefore at different times natural water levels may be high or low, and water relatively fresh, brackish or marine. Different species are benefited by particular conditions at different times in estuaries such as Henderson Lagoon, and it is natural for many species to recover over time from certain disturbances.

Henderson Lagoon is a naturally "intermittently closed-open lagoon" (ICOLL), fairly typical of east coast Tasmania, and these are recognised as complex for management (C.Crawford, pers.comm. 17/12/08). This is an immature wave-dominated estuary/lagoon, meaning that the estuary is blocked by sand built up by ocean waves and it receives only small fluvial discharges from the catchment (as opposed to river-dominated estuaries which have higher fluvial discharges). These are characterised by freshwater and sediment run-off, restricted entrances, poor flushing and small tidal ranges. Henderson Lagoon would probably have high sediment trapping efficiency; naturally low turbidity, salt wedge/partially mixed circulation and there is high risk of sedimentation (GeoScience Australia 2000). In recent decades, Henderson Lagoon has been primarily a tidal estuary open to the sea, but with the occasional closure of the mouth with a massive sand build-up following big easterly swells (Proctor & McManus, 2001).

Changes to lagoon hydrology
Changes in rainfall (generally declining in recent decades) and landuse in the catchment (including forestry, plantations, dams and irrigation) probably affect the amount of freshwater which ultimately reaches the lagoon, although figures are not available. In general freshwater inputs are likely to continue to be low, especially with decreasing net moisture availability due to climate change (McInnes *et al*, 2004), but there may be occasional flood events. Climate change may also affect sea level, storm and flood regimes, vegetation cover and thus water flows and sand movements, so that in the future the barway may open and close more or less and at different water levels. Little is known about groundwater, especially with regard to Henderson Lagoon, and this may change in future too.

Some concern was also expressed by locals over the adequacy and quality of freshwater reaching the lagoon from streams, with the desire that water should not be diverted from the streams so that more can reach the lagoon. It is difficult to distinguish reduced streamflow due to reduced rainfall in the catchment from that due to water diversion and land use. Gauges could be placed on the creeks to measure flow rates.

Barway issues
Historically and in recent years (most recently 2001), the barway has been artificially opened in order to lower the water level, but potential environmental impacts of such intervention have become a concern.

Within the local community, there are strong differences of opinion over what is natural or desirable in managing the water levels of the lagoon (via managing the barway). Flooding of adjacent land has occurred, which may kill vegetation if water remains for too long. This has been a concern for the local farmer, who feared loss of pasture and damage to fences (both very expensive to replace), and for the managers of Winifred Curtis Scamander Reserve, where fringing vegetation may be affected. Fringing vegetation (especially saltmarsh) has some tolerance for flooding, but damage will depend upon length of time of inundation. It is prolonged very high flood levels that are a problem; local landholders do not object to lower level or transitory floods and are not calling for the barway to be kept permanently open (S.Woods, pers.comm.).

Some community members consider that the barway should not be closed for long periods because of environmental concerns (declining water quality, lack of connection to the sea for fish breeding, loss of certain marine species from the lagoon ecosystem), and that access to the sea is important for flushing and overall ecological health (T. McManus, pers.comm.). It is also possible

that excessively low water levels, with prolonged closure and low rainfall, could lead to problems, such as mass fishkills, or drying (and acidification) of potential acid sulphate soils.

Other community members believe that natural processes should be allowed to take their course, and point out that at the time of European settlement, the barway was presumably closed for the lagoon to be named as such. There may also be special circumstances, such as the presence in 2001 of the very invasive marine pest Northern Pacific Seastar, which it was feared could spread from the lagoon to other areas such as Georges Bay.

There is insufficient information available on the ecology of the lagoon to determine the relative environmental health of the lagoon when closed or open. One study in NSW (Pollard, 1994), found 2.5 times the species diversity of fish in a permanently open coastal lagoon than in two ICOLLs, but the ICOLLs supported larger fisheries in both catch weight and value. This was the case even though the open lagoon actually had greater water surface area, and illustrates that judgement should not be made without more information on all factors.

Water levels and inflow influence water quality (Crawford, 2006), which is discussed below (section 5.3).

5.2.1 Interim Guidelines for the Artificial Opening of Henderson Lagoon Sand Barrier ("Barway Protocol")

Interim Guidelines for the Artificial Opening of Henderson Lagoon Sand Barrier ("Barway Protocol", see Appendix 7) have been drafted to address community concerns and to provide a decision-making process for artificial openings. The Protocol allows for natural opening and closing of the lagoon in general, with artificial opening where necessary to avoid prolonged flooding above king tide high water mark.

Figure 20. Markers indicate water level, for assessment of flooding risk.

The Parks and Wildlife Service (PWS) remains primarily responsible for management of the lagoon, including any opening of the barway. A request to PWS to artificially open the barway will only be considered if it would mitigate threat or damage to:

a) the health or safety of the community or general public
b) the ecological health, biodiversity or productivity of the lagoon
c) property and/or infrastructure through inundation by floodwater.

Unfortunately there is very little information currently available that could help determine the ecological health, biodiversity or productivity of the lagoon. Few studies have been done, with the main data available by Edgar *et al* (1999), who did sample Henderson Lagoon. This study, based on limited factors, tends to be then cited by other resources (e.g. the OzEstuaries Australian Government database). Without more thorough studies of the lagoon, incidental observations alone should not be used as a basis for judgement of ecological health.

Although closure may provide some environmental benefits, no evidence was found that prolonged very high water levels are necessary for ecosystem health (apart from particular circumstances such as prevention of spread of the feral Pacific Seastar). The limited evidence available suggests that natural opening and closing is generally best, but artificial opening at times of very high water levels (or for ecological health needs, such as very low water levels and acid sulphate soils) is probably not harmful, provided all factors have been considered.

The interim Barway Protocol guidelines are intended to remain in effect until the completion of this Environmental Management Plan. Although this Plan cannot provide definitive information about the hydrology and ecological heath of the lagoon, the information available supports the ongoing use of the Barway Protocol as a practical solution. This Protocol provides some certainty and shared understanding for concerned stakeholders. Further certainty, provided by finalisation of these guidelines (i.e. no longer "interim"), would allow the local farmer to invest in pasture, lagoon-side fences and revegetation (S. Woods, pers.comm.). Finalisation of the Protocol should not

preclude ongoing review and changes when necessary, as experience and information is gained. The Parks and Wildlife Service will remain the responsible authority, all factors should be considered before artificial openings, and the steering group should continue to monitor and review the Protocol, and inform the community during the process.

Actions:

- Set up community monitoring of water levels, with data recorded regularly and published on website
- Progress towards finalisation of Barway Protocol, with ongoing review and informing of community.
- Scientific monitoring of water inflow, water levels and groundwater.
- Discussions with relevant authorities regarding dam approvals.
- Establish key indicators of threats to the ecological health, biodiversity or productivity of the lagoon (such as acidification, fishkills, etc), so that monitoring can be established.

5.3 Water quality

Estuarine variability
As with hydrology, it is important to recognise that there is high natural variability in the salinity, turbidity and nutrients in estuaries, and there may be stratification (layering) at times. Seasonal changes affect rainfall and evaporation and nutrients entering the water from the catchment, while tide and wind affects mixing of freshwater with saltwater. These factors are very complex and not apparent to incidental observation. Clearly, too, water quality is related to hydrology as freshwater or saltwater movements help to flush the estuary, and bring in sediments and nutrients, and their balance affects the salinity.

Measures of water quality
Typical measures of water quality in estuaries include dissolved oxygen, pH, salinity, nutrients, toxicants, turbidity / water clarity, and water temperature. Biological aspects include animal or plant species abundance, presence / extent of litter, mass mortality events, algal blooms, chlorophyll A (a measure of algal presence), pest species and pathogen counts. Invertebrates in the sediments can be monitored as these are integrators of environmental conditions, so can reflect overall health of the estuary.

Vulnerability of estuary to catchment inputs
Estuaries naturally receive water, sediments and nutrients from the catchment, which leads to their productivity and value as wildlife habitat. They are also particularly vulnerable to human activities in the catchment. Land clearance for agriculture, forestry and urban development results in significant increases in catchment runoff, and in sediment and nutrient loads carried by the runoff (Edgar *et al,* 1999). Nitrogen and phosphorous concentrations were an order of magnitude higher in agricultural versus pristine catchments in two studies (Edgar *et al,* 1999). Runoff from urban areas, agriculture and forestry operations also contain pollutants such as oil, fuels, plastics, heavy metals and toxic organic compounds such as pesticide and herbicide residues. Pesticide levels in urban runoff can be equivalent to residues in agricultural runoff (Edgar *et al* 1999).

Henderson Lagoon has a relatively natural forested upper catchment, but also urban, forestry, road and agricultural land-uses (see section 5.6), which almost certainly change the inputs to the lagoon (likely increased sediment, nutrients, pesticides and other pollution, and modified water flow because of dams and weirs and changes to vegetation).

There is considerable local concern over chemical and fertiliser input into the lagoon, especially from aerial spraying, which is discussed further under Land-Use Impacts (section 5.7). Some chemicals can be particularly toxic to aquatic life (see 6.7).

Measurement of water quality, including toxic chemicals
Quantifying the inputs into the lagoon is not possible without extensive research. While it may be possible to record, for example, the amount of chemical and fertiliser applied to the farmland, it is not so easy to measure the amount that reaches the lagoon from this or the many other sources of chemicals in the catchment. Much of the chemicals and nutrients applied in the catchment are taken up by plants, absorbed by the soil, or broken down by bacteria, and this is broadly the aim of the land manager. Unfortunately, spraydrift, runoff and leaching of these substances is possible, and the amount reaching the lagoon is the key issue. Similarly, it is difficult to know whether there is leaching from the on-site wastewater treatment systems of Falmouth and Scamander, and whether any of this reaches the lagoon.

Some water quality measurements are possible with a coordinated community volunteer program, but some measures (especially those concerning chemical input) can only be made by qualified scientists. For example, considerable assessment work has previously been carried out on the marine environment of Georges Bay, with water quality a key community concern there, yet data is difficult to obtain and results have often been inconclusive (SEMF, 2008). A report has recently been produced advising on ways to monitor toxicants in Georges Bay, including developing a sediment and benthic macro-invertebrate monitoring program using national frameworks, and use of passive samplers (SEMF, 2008). Setting up such programs for toxicants would require extensive funding, as it is not possible for community volunteers to analyse such chemicals.

However community volunteers can make useful measurements of other aspects of water quality (discussed below).

Excessive nutrients
Eutrophication is the process of nutrient enrichment. It is manifested in excessive plant growth, nuisance and sometimes toxic algal blooms, anoxic events such as fish kills, a green appearance and general loss of amenity value. Wave-dominated systems are moderately to very highly susceptible to eutrophication, principally because poor flushing traps sediments and nutrients from the catchment (residence time of water in ICOLLs is typically greater than 100 days; Heggie, 2006) and naturally low turbidity and high light availability stimulate plant growth (Heggie, 2006), and as

Eutrophication fortunately does not seem to be a common occurrence at Henderson Lagoon, though there have been fish kills in the past. There is some concern over occasional offensive odours from the lagoon, and over occasional increased levels of algae (though it is not clear if this was macroalgae or microalgae). It is certainly a risk for the lagoon, particularly when the lagoon is closed for a long period and when rainfall is low, and may increase with greater population density over time.

Both micro- and macro-algal blooms can occur naturally and are not necessarily an indication of human impact or degradation. For example, influxes of nutrient rich southern ocean waters during winter in southern Tasmania have been observed to result in dense macroalgal mats in areas with minimal human activity (Crawford, 2006).

Local sources of nutrients would include urban runoff (possibly including nutrients from wastewater treatment systems) and agricultural use of fertilisers. The OzEstuary database notes effluent ponds as affecting Henderson Lagoon, but none are known (B.Dean, pers.comm.). It is unknown whether septic and other wastewater treatment systems at Falmouth and Scamander leach into the lagoon, although local opinion is that septic is the most suitable system for Falmouth (Falmouth Settlement Strategy, 2007). There is support for a land capability study to determine the capacity of on-site waste water disposal throughout Falmouth township (Falmouth Settlement Strategy, 2007). There is local concern that development of blocks (including increased density of dwellings and reduced area for wastewater disposal) may be exceeding the capacity of the land to deal with wastewater (M.Di Giovanni, email 31/3/09).

Denitrification by phytoplankton and microbes in the sediments can actually be a more effective process than flushing to prevent eutrophication (Heggie, 2006).

> "An appreciation by stakeholder groups of estuarine morphologies, flushing characteristics and denitrification are therefore important to enable them to develop sensible strategies to prevent eutrophication. These include limiting the discharge of sediments and nitrogen from catchments and maintaining a healthy and active benthos" (Heggie, 2006).

With this in mind, pesticides toxic to aquatic organisms should be particularly avoided.

Fishkills
Mass fish kills which have been noticed here in the past could be due to changes in salinity, low dissolved oxygen levels, disease, toxic algae, pollutant spills or uncommon weather patterns (Crawford, 2006). Without careful recording and scientific assessment it can be difficult to determine the reason for a fishkill. A standardised Mass Mortality Data Record has been produced (Crawford & Cahill, 2007) to help capture necessary information for identifying causes.

Existing water quality data
Little water quality data exists for Henderson Lagoon. Some salinity measurements have been recorded in the past (Table 1). Note that salinity in an estuary may vary up and down the estuary, between the surface and the bottom of the water, depending on whether the mouth is open or closed and how much rainfall and mixing there has been. Normal seawater is 34-36 ppt (parts per thousand).

Table 1. Salinity measured in Henderson Lagoon

Source	Salinity (ppt)	Date	Location of sample	Notes
Edgar *et al* 1999	36.0	13/11/96	Mid estuary, surface.	Mouth open.
	30.0	Winter 1997	Mid estuary, surface.	
Proctor (notes 2001)	18.1	30/5/01	Bottom	Closed since 9/3/01
	17 - 19.1	2/7/01	?	
	4.0 - 7.5	16/7/01	Surface	
	14.8		Bottom	
	12.3 - 15.3	11/8/01	surface	
	12 - 16.8		bottom	
	4.0 – 11.8	30/8/01	surface	
	8.4 – 15.6		bottom	
	16 - 26	5/9/01	Bottom	Opened since 31/8/01

There is some local concern about human health implications of any waste-water treatment systems (leaching of pathogens and nutrients) (M. Di Giovanni, email 31/3/09). Water from the lagoon is not used for drinking, so recreational use is the main concern. Break O'Day council conducts recreational water quality testing at Henderson Lagoon during summer (Break O'Day, 2008).

Last summer (2007/08), thermotolerant coliforms averaged 27 per 100 ml, and Enterococcus count averaged 10 per 100 ml. There was a brief high count in coliform numbers in early February (e.g. Enterococcus maximum 344 on 14/2/08), probably due to above average rainfall. Otherwise the microbial count was acceptable.

The Australian Guidelines for Recreational Use of Water sets the following Microbiological standards for primary contact (swimming, diving, waterskiing and surfing):

> "Faecal indicators – median value not exceeding 150 faecal coliforms per 100ml for minimum of 5 samples taken at regular intervals not exceeding 1 month[2] with 4 out of 5 samples containing less than 600 faecal coliforms per 100ml[3]."

In practice, this equates to the widely used geometrical mean level of 200 faecal coliforms per 100ml. A geometrical mean criterion of 33 Enterococci per 100ml has been used in marine waters and may be useful where pollution is suspected, but only low numbers of faecal coliforms can be detected (Break O'Day, 2008).

Current water quality testing
Sampling of Recreational Water by the council is required under the provisions of the Water Quality Guidelines as prescribed by the *Public Health Act 1997*. Recent microbial counts for the lagoon are recorded above.

Under the *State Policy on Water Quality Management 1997*, protected environmental values must be set for all Tasmanian surface waters, including estuarine and coastal waters (see Table 2). Protected environmental values (PEVs - the current uses and values of the waterways) have been documented in a consultative process and water quality objectives have been set.

Table 2. Protected environmental values relevant for Henderson Lagoon (DPIWE, 2005b)

LAND USE	PROPOSED PEVS – DORSET & BREAK O'DAY MUNICIPAL AREAS
All Estuarine surface waters	A: Protection of Aquatic Ecosystems (ii) Protection of modified (not pristine) ecosystems from which edible fish, shellfish and crustacea are harvested B: Recreational Water Quality and Aesthetics (i) Primary contact water quality (ii) Secondary contact water quality (iii) Aesthetic water quality E: Industrial Water Supply (Fish Farming – Brid Estuary) That is, as a minimum, water quality should be managed to provide water of a chemical nature to support a modified, but healthy aquatic ecosystem from which edible fish, shellfish and crustaceans may be harvested; which allows people to safely engage in activities such as swimming, boating or fishing in aesthetically pleasing waters; and to allow fish farming practices to be conducted on the Brid Estuary.

Community Water Values were collected at the St Helens Public and Stakeholder Workshop held on 18 May 2001, as part of the process leading towards Environmental Management Goals for Tasmanian Surface Waters (DPIWE, 2005b). Values relate to both water quality and water quantity, and those relating to Henderson Lagoon include maintaining healthy wildlife populations, maintaining fish populations, maintaining water quality suitable for swimming, etc.

Opening of the lagoon for ecological health

When Henderson Lagoon is open to the sea, the water is clearer and marine species are favoured. Tidal flushing helps to clear out pollutants, and water levels are roughly consistent with sealevel (so flooding is not an issue). It would be easy to assume that the lagoon is in best condition when open to the sea. However, estuaries are not simply marine systems – freshwater and the sediments and nutrients that come with it contribute to their productivity, the variety of niches within them, and the variety of life that inhabit them. For example, some animals found in estuaries are marine species, some are restricted to estuaries, some are restricted to low salinity waters associated with river flows, and some pass into or through estuaries for the purpose of spawning (Edgar *et al* 1999). Intermittently closed-open lagoons do naturally close for periods, and this is part of their essential nature, including their productivity.

Determining when the lagoon should be opened for ecological health is very difficult. With prolonged closure, salinity may decrease (as freshwater dominates) or increase (with evaporation), and other water quality changes may occur, which may lead to death of some creatures. Even fishkills do occur naturally, and fish populations will recover if the ecosystem returns to reasonable health. Other, less obvious fauna such as invertebrates, may or may not be affected by the closure. Acidification of soils should certainly be avoided.

Possibility for community monitoring of water quality

A monitoring system could be set up for Henderson Lagoon, using as a guide 'Indicators for the condition of estuaries and coastal waters in Tasmania' (Crawford 2006). More specifically, a manual for the assessment of the health of Georges Bay has been produced (Crawford & Cahill, 2007) which highlights indicators which can be measured by community people with minimal training. Currently a community group takes monthly water quality measurements in Georges Bay. Some samples are sent off for professional testing (which requires funding), but some measures can be taken directly by the group. The need for a long time series of data means any monitoring program must address the uncertainties of funding and resources over such periods. Further guidance could be obtained from Christine Crawford (see Appendix 7), and monitoring equipment currently used on Georges Bay may be suitable and available for use on the lagoon (contact Break O'Day NRM).

Water quality data collected to necessary standards may be accepted and stored on the Water Information Systems Tasmania database (contact Debbie Searle, see Appendix 7).

Actions:

- Regular community water quality monitoring for baseline data
- Approach government, research organisations and regional bodies to conduct regular scientific monitoring of water quality and estuarine health
- Obtain funding for tests for key water quality indicators and pesticides in water and sediments
- Fence and revegetate buffer zones around water courses
- Stormwater treatment (with sediment and nutrient filters maintained)
- Information and workshops to educate community to reduce impacts on water quality
- Council to commission an independent study of land capability for on-site waste water disposal, and use it to assess development applications.

5.4 Wildlife

Shorebirds
Little and Fairy Terns, Hooded Plovers and other shorebirds, are of particular conservation priority at Henderson Lagoon and the beach. Driving, people trampling and unleashed dogs on beaches are a recognised serious threat to nesting shorebirds. Increasing human population at the coast is likely to increase these impacts. They may also be preyed upon by feral and domestic cats and dogs. Natural high tide events, sea-level rise and invasion of Seaspurge also may affect breeding success.

Dog management zones have been proposed by Break O'Day council, which would require dogs to be on lead at all times in this area (see Table 3; these controls are subject to incorporation Council's Dog Control Policy). With identification of nest sites, areas could be roped off if appropriate. As a normal practice, simply keeping dogs and people below the high tide line during summer is vital.

Local monitoring of shorebirds and any nests would be a valuable aid their protection, and guide to health of the lagoon area. Local member of Birds Tasmania, Liz Znidersic, has offered to train volunteer observers (see Appendix 10). Observation should be only from a distance, with binoculars. Nests should not be approached closer than 50 metres. If a nest is found, Birds Tasmania should be contacted immediately (eric_woe@iprimus.net.au).

Vehicles are prohibited on Steels Beach but sometimes are driven illegally.

Table 3. Proposed Break O'Day Dog Management Zones for Beaches (2008) relevant to Henderson Lagoon.

Dog Zone Number	Location Description	Current Dog Zone	Proposed Dog Zone	Reasoning
27	Byatt Court to 500m south of Scamander River (including Scamander River mouth area)	Dog on Lead	Restricted: Dog on Lead at all times except when prohibited by signage	This area has moderate environmental values, with the exception of the Scamander River mouth area which has very high values. This zoning allows for bird breeding areas to be roped off and dogs prohibited during the breeding season where necessary. Scamander mouth area also has high human usage.
28	500m south of Scamander River to Henderson Lagoon Mouth	Dog on Lead	Restricted: Dog on Lead at all times except when prohibited by signage	Moderate to high environmental values; moderate human usage at Falmouth. This zoning allows for bird breeding areas to be roped off and dogs prohibited during the breeding season where necessary.
29	Falmouth Foreshore areas	Dog on Lead	Dog on Lead	Moderate human usage; proximity to dwellings.

Waders and waterbirds
Waders and waterbirds are also of particular importance in management of Henderson Lagoon. They may be affected by dogs, cats, hunting and stock, and by food availability (influenced by water quality and quantity, etc). There may also be impacts in other parts of their range, or numbers may simply vary in each location depending upon birds' movements each year.

Waterbird numbers (of 12 selected species, mainly ducks and swans) on Henderson Lagoon and other locations are annually recorded by the Department of Primary Industries and Water with the assistance of Parks and Wildlife Service and community volunteers. Records exist since the 1980's (contact Stewart Blackhall, DPIW). Numbers tend to vary from year to year, depending

upon seasons and availability of different wetlands as birds move about, but long term trends are being monitored. Birds Tasmania also conducts various bird surveys around the state, including shorebirds, gulls, robins and swift parrots (contact Eric Woehler, eric_woe@iprimus.com.au).

Birds may be monitored by observation from a distance (especially waterbirds) or by sound recordings (especially bushbirds). Suggested waterbirds for monitoring include cormorants, pelicans, herons and lapwings. (Contact Sarah Lloyd, ornithologist). Other animals could be monitored by laser-triggered digital camera equipment.

Figure 21. Numbers of water birds, like these pelicans, could be monitored.

Duck hunting occurs here in season. Duck hunters must have a gun licence, and also apply for a hunting permit. They must pass a wildfowl identification test, and obtain permission from the landowner. The local PWS ranger is not aware of any serious illegalities in hunting on the lagoon, but is not able to patrol regularly. Numbers of hunters have declined considerably since gun licence legislation, from over 75 in previous years to less than 15 recently (M.Luttrell, pers.comm.). There may be safety issues for people near the lake when shooting is underway.

Loss of habitat
Apart from the above specific disturbance impacts on birds, the greatest threat to wildlife in general is loss of habitat (e.g. by clearing, cutting of big old trees and logs, removal of understorey, invasion by pests, weeds or disease, declining water quality and development). Associated with this is lack of connectivity of native vegetation, so that wildlife populations may not be able to move through the landscape to find suitable habitat. Together with small size of remnants, this increases the risk of reduced genetic diversity and local population extinctions.

Loss of wildlife corridors
Due to historical clearing, Falmouth and nearby agricultural land has very little native vegetation left, with coastal scrub and creeklines remaining which are narrow and poorly connected to other native vegetation. The coastal scrub strip does continue to the south but is very narrow and has some gaps where it has been cleared or mown. There are larger areas of native vegetation at the northern end of the lagoon, and in the hills of the catchment, but recently increased clearing for urban development and fire hazard control to the north and northwest of the lagoon is a threat to habitat connectivity for wildlife in this direction.

Revegetation which connects these areas (e.g. along the coastal strip, creeklines and lagoon fringes) would benefit wildlife populations of the area. Plantings of a diversity of local native plants in urban gardens would also help improve habitat value. Native vegetation connections to the northwest should be protected.

Some creeklines across the farmland have been recently fenced on one side which has reduced stock access (M.Graham, pers.comm.), and the northern part of the lagoon has been fenced, but resources and time for completing fencing are limited. A further 30 km of fencing would be required to complete fencing of the four creeks across the farmland below the highway (at an estimated cost of over $200,000, although this would depend upon the type of fencing; S.Woods, pers.comm.), so any further fencing will need to be strategic.

Impacts of infrastructure and traffic
Local wildlife are also be killed by cars (Tasman Hwy especially), dogs, domestic and feral cats and people. At Falmouth, swan collisions with powerlines have been a problem in the past, but it is hoped that recently placed markers on the powerlines will help birds to avoid them.
It is possible that strong artificial lighting (such as security lights around residences) may influence wildlife behaviour. Developments should avoid lighting natural areas of the lagoon area.

Predators and disease
Feral and domestic cats and dogs, as well as foxes, prey on wildlife. Cats can also introduce the disease toxoplasmosis to the native animal population.

Stock

Wetlands and saltmarsh can be affected by stock browsing and trampling, especially when water levels are low enough to permit access. (For example, Waterribbons are favoured eating by stock). This can greatly reduce cover of waterplants, thereby affecting species which rely on them such as Green and Gold Frogs. Cattle have sometimes crossed the lagoon to feed on the sandspit (H. Cole, pers.comm.).

Actions:

Protection of healthy aquatic ecosystems and native vegetation, with big old trees, fallen logs and other natural features is the best way to protect wildlife populations. In addition, the following could be considered:

- Re-establish habitat corridors and "stepping stones" across cleared land (e.g. fence and revegetate creeklines, the lagoon fringe and the coastal strip).
- Monitor wildlife (e.g. shorebirds, aquatic animals) and contribute data to February Waterbird Count and Birds Tasmania.
- Ensure dogs, people and vehicles do not disturb breeding shorebirds. Run education activities such as "a Dogs Breakfast". .
- Liaise with Birds Tasmania over any confirmed shorebird nest sites. (If necessary, breeding areas could be roped off during breeding season.)
- Fence habitat on lagoon edges, creeklines and wildlife hotspots (e.g. Glencoe wetland) to prevent stock access, and revegetate where necessary
- Lobby to protect existing wildlife corridors to NW (from lagoon to forested hills)
- Monitor wildlife deaths at "blackspots" such as Tasman Hwy and Falmouth Rd powerlines. Liaise with authorities to alter if necessary.
- Erect signs along the Tasman Hwy (e.g. "Dawn to Dusk" warnings to slow down for wildlife).
- Education on shorebird and other issues at field days, through pamphlets etc (see below).

5.5 Loss and degradation of native vegetation

Landscape scale
Loss and degradation of native vegetation is an ongoing threat around Henderson Lagoon from development activity such as new subdivisions and plantation establishment, together with fire hazard reduction (understandable, but at times excessive) and through cutting, mowing, spraying and "tidying up" of native vegetation around homes and roads (Falmouth and Scamander).

To the northwest of the lagoon the last remaining tract of native forest connecting the lagoon to the hinterland forests is threatened by clearing from subdivisions and building. Further impacts of gardens and pets, roads, stormwater pollution and fire hazard reduction clearing are all associated with building and subdivision.

Figure 22. Subdivisions always result in clearing of native vegetation.

Unprotected remnant vegetation, creek lines and wetlands within the catchment will continue to decline under impacts such as vehicle and stock access and itinerant clearing for firewood and views unless they are managed for protection.

Little is known about the aquatic vegetation of the lagoon, its extent or condition.

Priority vegetation for protection
There is a need for greater protection of native vegetation in the catchment, for landscape connectivity and habitat benefits, as well as maintaining water quality and the estuarine ecosystem. Opportunities exist for creating further private conservation reserves (there are some already established in the catchment) and there are programs to assist landowners with protecting and restoring native vegetation.

The vegetation on the south western side of the lagoon has been almost completely lost due to past land clearing and agricultural practices. Restoration of lagoon-edge vegetation is considered a very high priority for a wide range of environmental benefits for estuarine habitat and water quality. Landscape connectivity will further benefit from this and riparian zone protection throughout the agricultural zone.

Highest priority areas identified for protection of existing vegetation are:

1. The forested low ground and slope north west of the lagoon

Highest priority for restoration and re-planting of vegetation includes:

2. Restoring the lagoon edge vegetation on the south-western side
3. Protecting and restoring riparian and wetland areas
4. Restoring coastal scrub connectivity to south

Falmouth foreshore

"Creeping backyards", where gardens extend into areas of native vegetation, are often a feature in coastal areas such as this where boundaries between private and public land are not well defined. These usually result in loss of native vegetation, the spread of environmental weeds and degraded native habitat. Replacement of native plants with garden plants removes wildlife habitat.

Figure 23. Almost no native vegetation remains at Falmouth, with coastal scrub confined to a narrow, interrupted rim around the coast. (Photo by Rob Wall)

Garden plants and lawn grass often spread, becoming invasive environmental weeds and they are relatively barren of living creatures compared with native bush. The prettiness of daisy clumps on the seashore can be a misleading picture when they are actually taking over native habitat areas and spreading innumerable seeds to other areas in the coastal winds. The impacts of weeds have been addressed previously in this chapter (See 6.1).

Figure 24. The narrow scrub fringe is vulnerable to cutting which reduces habitat viability and exposes soil to erosion. Even weed control must allow for regeneration of native vegetation to cover soil.

It is common for people to want to "tidy up" bushland, for reasons including fire safety, ocean views, neatness and an impression that it is the right thing to do. In Falmouth, some tidying up has clearly occurred, particularly along the "esplanade" (coastal headland fringe). This has included removal of some coastal shrubs, mowing, and planting of garden plants.

Removal of trees and shrubs opens up the vegetation, increasing impacts of wind and sun on remaining plants, and may lead to dieback. Coastal areas are particularly vulnerable to dieback from strong salty winds – native vegetation is the best at resisting harsh coastal conditions and should be retained intact. Removal of vegetation can also disturb middens and other aboriginal relics. Removal or cutting of trees for the sake of one household's view is disrespectful of everyone else's right to enjoy trees and a natural coast, and also opens the vegetation to dieback. (For example, recently a sheoak valued by many for shade at the carpark was cut back illegally to improve someone's view). This issue is common to coastal areas around Australia. In some places, the council replaces cut vegetation with a large sign about the illegality of the cutting, large enough to obscure the view.

Conversely, planting natives into gaps in the coastal vegetation and alongside it, and in areas throughout Falmouth would enhance existing vegetation and allow for corridors and "stepping stones" for birds etc to move through the area. There are many beautiful examples of local native plants, and some are listed in Appendix 7.

Figure 25. Native plants like Pinkbells can be beautiful in the garden.

Actions:

- Work with landholder to fence and restore the lagoon edge vegetation on the south-western side
- Work with landholder to fence riparian and wetland areas, and revegetate where necessary.
- Improve the effectiveness of land clearing management using the existing planning scheme, and strengthen the planning scheme where necessary.
- Lobby for greater protection of vegetation in catchment, especially the native vegetation "corridor" northwest of the lagoon.
- Develop/promote fire hazard management guidelines to minimise impacts (e.g. erosion, excessive damage to vegetation). .
- Encourage vegetation protection and restoration activities with community workshops (e.g. workshops through the Understorey Network), funding programs for fencing etc.
- Use local natives for revegetation or landscaping of public areas (e.g. Appendix 6 has some examples), especially adjacent to existing native vegetation.
- Encourage the use of local native plants for gardens (bearing in mind principles for fire retardant gardens).
- Revegetate gaps in coastal scrub along Falmouth foreshore.
- Survey aquatic vegetation.

5.6 Fire management

Fire is a critical concern, especially wherever there is native vegetation in close proximity to people and property. The wildfires of 2006 were severe in this area, and locals are keen to avoid any future loss of life or property to fire. Fire hazard management is important for safety of people and property, as well as for biodiversity. Both are dependant upon many complex factors, and unfortunately it is not possible to eliminate the risk of fire. It is important to lower risk, while maintaining natural values.

Fire hazard reduction
Fire management is an issue of concern for residents, although views conflict over what is required. Concern was expressed by some locals over Coast Wattle as a fire hazard. In fact, most native plants have high flammability (see 6.1.3, above), and any vegetation has the potential to burn (TFS, 2006). The Tasmania Fire Service (TFS, undated) recommends that flammable materials around houses be minimised, and that a Building Protection Zone (measured from the external walls of the building) be maintained, with a Fuel Modified Buffer Zone beyond that. The distance recommended for each zone varies from 10 to 50 metres, depending upon slope and vegetation. It is not necessary to remove all vegetation from these zones, but it is recommended to select suitable species and/or modify the vegetation and other possible fuel.

Figure 26. Typical urban gardens with low fire hazard but loss of connectivity of native vegetation.

Other locals are concerned over increasing vegetation clearance for hazard reduction, which is reducing the extent and connectivity of native vegetation. This is occurring around semi-urban areas and new developments northwest of the lagoon, as well as beyond private boundaries onto the coastal scrub of the Four Mile Creek Conservation Area at Falmouth; both areas already have limited native vegetation and are vital connections between the lagoon area and the rest of the landscape. Any further subdivisions or developments on bushland blocks are certain to lead to clearance for building protection.

Inappropriate hazard reduction can greatly damage biodiversity, as well as contribute to eucalypt dieback and soil erosion. For instance, clearing of coastal vegetation is likely to lead to erosion and reduced wind protection. Over-burning of the dunes in the Scamander Conservation Area is believed to have caused soil nutrient deficiencies and changes to vegetation (PWS 1995). Clearing of understorey or repeated burning can remove most of an area's plant diversity and much of the wildlife habitat, as many creatures rely on understorey, logs and leaf litter for survival.

Fire management for biodiversity
Fire can be important in some vegetation types in reducing the dominance of a few species, encouraging germination of other species and allowing a greater diversity of species to exist. For instance, heathy woodland (such as at Winifred Curtis Scamander Reserve) is generally recommended to have a fire interval of 15-30 years (Kirkpatrick & Gilfedder 1999). Burning at too high or too low a frequency can lead to losses of biodiversity.

Figure 27. Many seedlings regenerating. Running Postman grows well in the bare spaces after a fire.

However fire can damage vegetation and some vegetation (e.g. rainforest, coastal vegetation) should not be burnt at all. Fire should be excluded from saltmarsh, wetlands, paperbark scrub and in general from dry coastal vegetation (Kirkpatrick & Gilfedder, 1999).

Responsibility for fire management
Various authorities are responsible for fire hazard management, depending upon land tenure and conditions, including private landholders, Forestry Tasmania (in State Forests and Forest Reserves), Council (issues Fire Abatement Notices), Parks and Wildlife Service and the Tasmania Fire Service. It is the responsibility of all landholders to ensure vegetation management on their land reflects current fire hazard management recommendations, while maintaining natural values as much as possible.

The Parks and Wildlife Service is responsible for the management of bushfires in the Scamander Conservation Area and Four Mile Creek Conservation Area. (See website www.parks.tas.gov.au/index.aspx?base=890).

This management includes:

* control of unplanned bushfires;
* planned burning to reduce fuel loads and make fire control easier and safer;
* planned burning to help maintain biodiversity, promote regeneration of plants that depend on fire and to maintain suitable habitat for animals;
* maintaining assets that assist with bushfire control, for example, fire trails, firebreaks and waterholes.

Control burns and fire hazard control in reserves is decided through consultation between relevant authorities (e.g. Parks and Wildlife Service, Tasmania Fire Service, Forestry Tasmania). Currently no deliberate burns are conducted in the Conservation Areas here, but annual slashing is done behind some houses in Falmouth (M.Luttrell, pers.comm.). Burn planning for reserves is done in PWS, using specialist staff such as botanists and fire management experts. The PWS Fire Operations Officer can assess fire management needs where the reserve abuts residential areas, and will be assessing the Esplanade in the near future (P.Duggan, pers.comm. 6/4/09).

Winifred Curtis Scamander Reserve has a fire management plan, and patch burns are conducted according to this.

Residents are urged to contact PWS if they have concerns regarding fire issues on reserves around Falmouth. Residents should consult the Tasmania Fire Service (www.fire.tas.gov.au) for measures to protect their dwellings, including recommendations for buffer zones.

Actions:

- Education programs, with involvement of the PWS and the TFS, to improve understanding of hazard reduction and biodiversity protection practices.
- Future building and development should plan fire buffer zones and other measures within the boundary of private land, that also aim to minimize clearance of native vegetation.
- Future development should be avoided in bushland, to minimise clearing of native habitats for fire hazard reduction.

Map 6 Reserved Land around Henderson Lagoon

5.7 Land-use impacts

Estuarine systems are highly vulnerable to impacts from catchment land use as they are the last receiving area for whatever has been carried through ground and surface water flows. Land-uses in the catchment are shown in Map 7.

In this catchment various land use activities could affect the health of Henderson Lagoon, including:

- urban development (vegetation clearing, stormwater pollution, fertiliser and chemical use, garden escapes, etc) around Falmouth and Scamander north and northwest of the lagoon,
- larger subdivisions (land clearing, etc, as above) west of the lagoon,
- some plantation development (land clearing and conversion, chemical use) west and south west of the lagoon,
- agriculture (irrigation, dams, chemical and fertiliser use, cultivation, livestock) adjacent to and west of the lagoon, and
- roads (stormwater runoff, pollutants like oil, impeded movement of wildlife, roadkills).

Assessment of the water inputs, nutrients, chemicals and sediment coming from different landuses in the catchment would require complex analysis. No such data is available at this stage.

Figure 28. West of the lagoon from saltmarsh fringe, across agricultural land, to plantations and forested hills.

Natural areas

Although the lagoon catchment is not pristine (which led Edgar *et al*, 1999 to classify the lagoon as of "moderate conservation significance"), it is nevertheless in a largely natural state, especially considering the long history of settlement here and comparing it with other estuaries in settled areas.

The majority of the creeks entering the lagoon have a high natural condition rating (see Appendix 8), especially those of the upper catchment and from the northwest. However, as they cross the farmland their rating decreases to medium or low.

The eastern side of Henderson lagoon is protected by the Winifred Curtis Scamander Reserve and the Scamander Conservation Area, and about 40% of the western shore (around the Peat Marsh) is protected by covenant (see Map 6). This however, cannot offer complete protection to the lagoon from developments occurring in the catchment between the reserves and Scamander.

Figure 29. The Peat Marsh and forested surrounds are protected by covenant.

The Scamander Conservation Area extends in a narrow strip around the lagoon on the western shore. This narrow edge provides very little buffer zone against erosion, nutrient, sediment and chemical run off that are often the result of agricultural and urban use. Some streams across Enstone Park have been recently fenced on one side, but are not yet fully protected by fencing.

Forestry
The Henderson Lagoon upper catchment area has extensive tracts of State Forest. Approximately 50% of the State Forest is protected from harvesting in the German Town Forest Reserve. In the remaining State Forest land, there are no coupes intended for logging in the current Forestry Tasmania Three Year Plan 2008/09 - 2010/2011. If and when logging operations are carried out in the future, practices will involve selective logging using natural seed fall for regeneration and no use of chemicals (pers. com. Paul Rosevear, Forestry Tasmania).

Forestry operations on both State Forest and private property retain vegetated streamside reserves between 20 and 40 metres wide on either side of class 1, 2 and 3 streams (*Forest Practices Code, 2000*). The existence of large areas of native forest in the catchment is of great benefit to the lagoon, despite some concerns about impacts of forestry. Class 4 streams have a minimum 10 metre machinery exclusion zone but may suffer some erosion due to harvesting.

Forestry activities, including conversion of native forest or grassland to plantation, may proceed on private land. Substantial areas of eucalypt plantations have been recently established on previously and newly cleared land.

Growth of regenerating forests and plantations may affect water supply into streams.

Chemicals
Many activities, such as forestry, agriculture, gardening and weed control, involve the use of chemical applications that can seriously impact the lagoon ecosystem. It is the responsibility of all chemical users to ensure that their actions are environmentally safe. There are fungicides and herbicides that can have serious effects on estuarine life. For instance Chlorothalonil (marketed as Bravo) is one fungicide that is used on nearby agricultural land, for which the DPIWE fact sheet quoted below has certain warnings against its use around waterways and in sandy soils:

> Chlorothalonil is practically non-toxic to birds, but it and its metabolites are highly toxic to fish, aquatic invertebrates, and marine organisms.
> Chlorothalonil binds well to silty clay loam soils, but is moderately mobile in sand.
> Chlorothalonil is slightly toxic to humans and it can cause severe eye and skin irritation in certain formulations.
> It is a possible carcinogen; available evidence is inconclusive. *(DPIWE February 2002)*

This fungicide was aerially sprayed three times this season (S. Woods, pers.comm. 6/4/09). Fungicides are commonly sprayed more often (e.g. 7 times/season) on potatoes in Tasmania. Local residents were concerned that the spray appeared to drift over waterways. The landholder intends that the spray should be kept 2 metres from waterways (S. Woods, pers.comm.). Codes of conduct for spraying these chemicals do not currently dictate an exclusion zone around waterways, but require that no adverse effects result (P. Lee-Archer, pers.comm. 15/4/09). Tests by the DPIW Spray Information and Referral Unit (P. Lee-Archer, pers.comm. 6/4/09) were conducted 2 hours after the most recent spray, and found no residue in the lagoon water near the site. Some residue was found in ditch water (possibly a modified creek) near the paddock, but this was standing water which was not running into the lagoon. This fungicide will only be sprayed from the ground in future, provided conditions do not make this impossible (S. Woods, pers.comm. 6/4/09). Given the warnings for aquatic organisms, it is essential to keep this chemical out of the lagoon.

For weed control work Glyphosate is the only herbicide registered for use around waterways. Other herbicides are too mobile and residual around water to be safe.

Practical solutions

Even without detailed knowledge of land use impacts in the catchment, there are practical actions which can greatly reduce impacts on waterways and the lagoon.

Fencing out stock is one of the easiest ways to improve waterway health. A filter strip of grass 6 metres wide along a waterway can reduce the amount of sediment entering the waterway by 99%, and reduce phosphorous by 59% (Hairsine 1996, cited by Lovett & Price 1999a). The wider the filter strip the better (at least 10 metres; Lovett & Price 1999b), to ensure the filtering out of most pollutants (as well as to provide a viable wildlife corridor if revegetated). Allowing for sealevel rise, the buffer needs to be wider still. Dense grass is a particularly effective filter, so simply fencing off a filter strip would be very worthwhile.

Figure 30. A wider, protected and vegetated filter strip would help to protect the lagoon from agricultural impacts.

Revegetating with native trees and groundcovers along the stream/lagoon bank improves other aspects of waterway health (such as shade, shelter and wildlife habitat), but an edge of grass inside the fence should be retained as well.

Water Sensitive Urban Design can greatly improve urban water runoff by better managing the urban water cycle across a whole development (e.g. Derwent Estuary Group, 2006). Sediment and nutrient filters maintained in urban areas can improve stormwater quality.

Actions:

- Work with Enstone Park landholder to fence a filter strip and restore the lagoon edge vegetation on the south-western side
- Work with Enstone Park landholder to fence riparian and wetland areas, and revegetate where necessary.
- Detailed mapping of whole catchment (land tenure, hydrology, roads, land-use, vegetation, natural values)
- Develop a detailed assessment of risks to the lagoon (e.g. fire, salinity, spraydrift, fertiliser, potential acid-sulphate soils, sewerage, stormwater)
- Break O'Day Council to recognise this Environmental Management Plan
- Stormwater treatment in urban areas (with sediment and nutrient filters maintained) and Water Sensitive Urban Design in new developments
- Work with all local landowners to mitigate impacts, improve conservation values (e.g. conservation covenants)
- Clarify on-ground boundaries of Scamander Conservation Area and Four Mile Creek Conservation Area if necessary.

Map 7 Land Use in the Catchment

5.8 Acid sulphate soils

There is a "high probability of occurrence" of acid sulphate soils in the lagoon and in surrounding low-lying land (as assessed by the Australian Soil Resource Information System: www.asris.csiro.au/mapping/viewer.htm). The Henderson Lagoon area has not been sampled, but has all the landscape and geology features necessary for acid sulphate soils (R. Moreton, pers.comm.).

Potential acid sulphate soils are naturally occurring soils that contain iron sulfides. These remain stable when buried under anoxic waterlogged environments. They have been found in Tasmania between near the surface and 2 metres depth at some sites (Mitchell, 2007). When these soil layers are exposed to air by drying out, drainage or soil disturbance, they can oxidise to form sulfuric acid. If released, this acid can lead to massive fish kills and loss of habitat, and can be extremely damaging to the environment, to farm productivity, to infrastructure and to human health. Such damage may be long-lasting and expensive or impossible to reverse.

For any acid sulphate soils – keep them wet, keep them anaerobic, and do not disturb them.

In the lagoon itself, risks of soil acidification would increase if the lagoon dries out when the barway is closed. When the barway is open, tidal seawater provides waterlogging of soils and natural buffering.

Advice for establishing a monitoring program may be sought from Rob Moreton, DPIW (ph: 6336 5441). Acid sulphate soils in Tasmania are further explained by Mitchell (2007). Guidelines from NSW exist for managing land with acid sulphate soils (Johnstone *et al*, 2003).

Actions:

- Identify any acid sulphate soils in the area. (A simple analysis can be done with test pits and hydrogen peroxide – contact Rob Moreton for advice).
- Monitor pH (acidity) in the lagoon and waterways.
- Any significant excavation or drainage works in potential acid sulphate soils should be done with caution and in consultation with relevant authorities.

5.9 Climate change

Estuarine ecosystems around Tasmania are likely to change markedly over the next century as a consequence of climate change (Edgar *et al* 1999), and Henderson Lagoon is probably no exception. Climate change can affect estuarine ecosystems through three mechanisms (Edgar *et al* 1999):

- **increased water temperature**. Because of the position of Tasmania at the southern extremity of Australia, a relatively slight increase in water temperature may result in species extinctions because of the lack of a land mass further south into which species adversely affected by warm water can retreat.
- **modified rainfall patterns**. Increased rainfall in some areas of the state will reduce salinity in local estuaries, while decreased rainfall in other areas will allow saline water to penetrate further up estuaries and promote barrier formation. Net moisture availability is likely to decrease in eastern Tasmania (McInnes et al, 2004).
- **sea level rises**. Rising sea levels will flood low lying areas within estuarine basins.

In time, with sea level rise, substantial areas around the lagoon may be flooded (see figure 31).

Figure 31. Coastal vulnerability to flooding has been estimated for the year 2100 (Sharples 2006)

The vulnerability to climate change of the coastline around Henderson Lagoon and Falmouth has been assessed (Sharples & Mowling, 2006).

- The lagoon edge has “Re-entrant sandy shore backed by soft sediment plain – potential erosion and shoreline recession vulnerability”.
- Steels Beach has “Open sandy shore backed by soft sediment plain - potential erosion and shoreline recession vulnerability”
- The Falmouth lagoon shore below Falmouth Road has “sloping hard rock shores – minimal vulnerability to flooding or erosion”
- The coastline on the eastern side of Falmouth also has “sloping hard rock shores – minimal vulnerability to flooding or erosion”
- Henderson Point has “Exposed cliffs – potential for rockfalls, collapse or slumping of rock faces”.

Figure 31. Erosion of soft lagoon edges is more likely under climate change, especially if there is little vegetation protecting them.

There is little that can be done under this Environmental Management Plan to address climate change, but awareness of the potential issues may influence prioritisation of other actions. For example, protection of the lagoon and beach shores with vegetation is even more important given their vulnerability to erosion. With reduced water coming from streams, it is even more important to protect their water quality (such as by fencing and revegetating).

5.10 Access

Public access to the beach is possible from Scamander for vehicles and by foot and from Falmouth by foot across the barway. Vehicles are not permitted on the beach, and rarely use it (M.Luttrell, pers.comm.).

The lagoon is accessible from the Tasman Highway at the Scamander end and through the Winifred Curtis Reserve and from Falmouth. Boats can be launched from these sites.

Informal tracks can become a problem causing erosion, degrading vegetation (opening the ground cover and spreading weeds) and disturbing habitat. At present problems are limited, probably due to relatively low numbers of people. The track from the parking area to the beach has the most serious erosion issue, with a shortcut formed (although an attempt has been made to block this with branches), and likely ongoing issues. Other tracks from houses and roads to the coast are maintained by locals through the coastal scrub, and these may widen, erode and proliferate over time.

Figure 32. Natural-looking rock steps to beach, with informal shortcut blocked by branches.

There is local desire for an "esplanade" walking track along the rocky foreshore at Falmouth. This could be a beautiful addition to the community life at Falmouth. However, the track should be planned to avoid further cutting of native vegetation, and correct identification of weeds to kill and natives to avoid is necessary. There are several middens along here that require respect and should not be disturbed. (See 6.11) The route should follow areas of rock where possible, to avoid impacts on vegetation or middens. The potential spread of weeds and phytophthora should always be considered in assessment of existing and new tracks.

For many people dogs are important companions and the beach and walking tracks are wonderful for exercise and enjoyment. Appropriate dog control in these areas is necessary (covered under the Break O'Day dog management zones, Table 3) and further seasonal guidelines may be considered to protect habitat at sensitive times of the year, such as nesting times for the threatened Little and Fairy Terns (see 6.4).

Interpretation signage to assist with correct access, usage and care of the natural and cultural values along tracks would be beneficial.

Consultation and approval by PWS is necessary for all access works over reserves.

Actions:

- Build soft-surface and/or natural stonework paths and steps from parking area to beach.
- Rehabilitate eroded informal tracks back to natural state.
- Maintain existing headland and other paths, with consideration for public safety and protection of heritage and aesthetic values.
- Make esplanade continuously accessible to public (ie construct path where necessary).
- Create seating and table under a shady tree, viewing lagoon.

5.11 Recreational use

Maintenance of low-impact recreational use (such as swimming, walking, etc) is desirable. Some fishing and boating occurs, some prawning and some duck hunting in season (see 6.4 above). The lagoon is technically an "Inland Water". It is gazetted as a Bream Water, which means that people can fish for bream without a licence (under the *Inland Fisheries Act 1995*). Marine fish can be taken without a licence, within size and bag limits. (Up-to-date information can be obtained from the DPIW website). For the taking of salmoniids, a licence is required (here Brown Trout may occur). There is a possession limit for prawns of 2kg.

Some fish skeletons have been left on the banks of the lagoon, which should be addressed with signage.

Boats are not used a lot on the lagoon, with some canoes and dinghies used occasionally. However, the number and frequency of boats being launched in the lagoon at Falmouth is believed to have increased in recent years, and this is causing some localised erosion at high water mark (M. Di Giovanni, 31/4/09). The possibility of fuel and oil spills is a concern wherever there are boats, and is addressed by the *Tasmanian marine oil pollution contingency plan (TASPLAN)* (DPIWE, 2001). Jetskiers usually make their way slowly out from the lagoon to the ocean before speeding up. Some locals would prefer that only non-motorised watercraft be allowed on the lagoon, but others value the use of their dinghies.

At this stage there do not seem to be any serious environmental management issues regarding recreational use of the lagoon (M.Luttrell, pers.comm.), although some increase in usage has been noted and "management to protect the lagoon and beach" is desired (Falmouth Settlement Strategy, 2007). Major management issues are mainly those (e.g. dog control, access tracks, etc) mentioned earlier. Increases in population in the area could increase issues in future.

Figure 33. Locals use canoes and dinghies on the lagoon.

5.12 Heritage values (aboriginal, historical, landscape)

The landscape of Henderson Lagoon and its surroundings are highly valued by locals, for the views of sea, lagoon and mountains, and for the relaxed atmosphere. The community feels that expansion of Falmouth is not warranted, and would erode the contained character of the town. They feel that low-rise, low-density development is preferable, which maintains access for all to views (Falmouth Settlement Strategy, 2007).

Aboriginal and historical heritage may be damaged inadvertently by developments, removal of native vegetation, and by foot- or vehicle-traffic. At present, it is thought that historic heritage is not vulnerable to impacts, with the Old Coach Road and other relics largely protected in the Conservation Area and Winifred Curtis Reserve. However Aboriginal middens may be vulnerable to clearing of coastal scrub around Falmouth, and to exposure by weed control if not done carefully. Generally aboriginal heritage sites are not advertised by detailed maps, in case of vandalism. Aboriginal Heritage Tasmania (AHT) can be contacted (ph: 6233 6613) for any queries regarding the management and protection of Aboriginal heritage values. In order to protect aboriginal heritage sites, once located, they should usually be avoided and left alone.

Figure 34. Middens may be inadvertently exposed by weed control or other works.

According to the *Aboriginal Relics Act 1975*, as contained under Section 14 (1):

> Except as otherwise provided in the Act, no person shall otherwise than in accordance with the terms of a permit granted by the Minister on the recommendation of the director—
> (a) destroy, damage, deface, conceal, or otherwise interfere with a relic.

A relic is defined under the Act, and includes:

> (a) any artefact, painting, carving, engraving, arrangement of stones, midden, or other object made or created by any of the original inhabitants of Australia or the descendants of any such inhabitants;
> (b) any object, site, or place that bears signs of activities of any such original inhabitants or their descendants; (etc)

The St Helens History Room can be contacted (ph: 6376 1744) for any queries regarding general historical values.

Actions:

- Develop a statement of landscape character and implement through Break O'Day planning policy
- Detailed map of heritage sites (if appropriate)
- Provide information on how to protect heritage sites
- Educational signage
- Refer to the Aboriginal Heritage Survey and Report for this area (Graham, 2009), and contact Aboriginal Heritage Tasmania before conducting any works (including weed removal), to ensure known heritage sites are avoided.
- Any working party identifying Aboriginal cultural heritage material, such as shells or shell fragments, or rock material such as chert, cherty-hornfels, quarts & quartzite, should cease works and liaise with the office of AHT

5.13 Litter and greenwaste dumping

Currently there are no facilities for proper disposal of greenwaste. Greenwaste dumping often leads to weed invasion, as many cuttings and seeds survive then spread.

Actions:

- Remove council fee for greenwaste
- Establish recycling service
- Monthly greenwaste collection service
- Sustainable living workshop
- Community cleanup of litter

5.14 Improving information and awareness

Many of the issues raised above require more information for better management. Some of this information may be gathered by the community, with monitoring and observation (e.g. bird presence and nesting; presence of acid sulphate soils. See Section 6). Further scientific research is desirable to better assess hydrology, water quality and ecological health of the lagoon under different conditions.

Increased awareness and knowledge of the natural values and management issues by all stakeholders would greatly assist management of the lagoon area. Information networks should be developed, and community skills developed through practical working bees, field days, organised walks, distribution of pamphlets etc. (For example, the Understorey Network runs workshops to develop skills and knowledge about native plants.) Information signage, plant walks and birdwatching occasions could be used to improve local knowledge and enjoyment of nature. Stakeholders should be encouraged to become involved in management activities, and a stewardship ethic promoted. Residents and visitors should be consulted and involved wherever possible.

As much as possible, this awareness-raising should be phrased positively. The natural wonders and beauty of Henderson Lagoon lead naturally to appreciation and pride by all locals and visitors.

Actions:

- Include copy of EMP and environmental weeds pamphlet in new residents' kit issued by Break o'Day Council.
- Working bees to involve groups and individuals and provide practical skills.
- Conduct a Sustainable Living workshop
- Install educational signage for heritage values, flora, fauna, etc at access points such as the beach, boat launching areas, near wetlands, near Peat Marsh, etc
- Involve PWS and Tasmania Fire Service in community education programs to improve understanding of hazard reduction and biodiversity protection practices.
- Encourage vegetation protection and restoration with funding programs for fencing, promotion of covenanting programs, community workshops, etc.
- Run field days to encourage the use of local native plants for gardens (bearing in mind principles for fire retardant gardens) and to avoid planting of invasive garden plants.
- Provide an illustrated booklet to aid identification of local native species
- Conduct field days for identification of native plants vs weeds
- Hold a weeds working bee/field day for a "hands on" action approach to the removal of environmental weeds.
- Run "*Dogs Breakfast*" activities for increasing dog owner awareness of nesting bird issues.
- Bird walks and rockpool rambles
- Hold workshop to educate community to reduce impacts on water quality
- Educate community on how not to spread phytophthora in soil (e.g. pamphlet)
- Articles in newspapers and local newsletters
- Conduct workshops on monitoring techniques (e.g. weeds, water quality, invertebrates and birds)

6 Community monitoring program

Community monitoring of the ecological health of the lagoon is necessary, in particular to assess threats which may require removal of the sand barrier (see interim barway opening protocol, Appendix 1), but also to evaluate and guide other actions. Monitoring and evaluation of all activities can improve the successful outcomes of the EMP and also help to attract funding and to prove good management.

The determination of indicators, and any subsequent monitoring using those indicators, needs to take into account the natural variability of estuaries.

NRM North and other organisations (see Appendix 8 for resources) may be able to assist with monitoring and evaluation techniques. Local knowledge is also invaluable for this. Volunteers could assist PWS, Break O'Day NRM, DPIW, Birds Tasmania and NRM North with various existing projects (e.g. waterbird counts, weed control in the conservation areas).

Many factors could be monitored, but require further investigation and/or scientific involvement and funding (e.g. toxicants in water, groundwater levels, detailed hydrology). There is no one factor that can be a single indicator of health in a complex estuary, and detailed scientific studies would be necessary to guide the choice of a few. Nevertheless, much could be learnt about the lagoon by measuring the following factors. These have been initially identified as key indicators which may be monitored by community volunteers:

- Existence and locations of **shorebird nests** (especially Little and Fairy Terns, Hooded Plovers). Monitor by distance observation during summer, liaise with Birds Tasmania.
- **Numbers of waterbirds** (e.g. swans, pelicans, cormorants) using the lagoon. Participate in February Waterbird Count (contact Steward Blackhall, DPIW).
- Test to identify any **acid sulphate** soils in the area. (Contact Rob Moreton, DPIW).
- **Water levels**, using existing water height markers, with data recorded regularly and published on website. (Information will assist with future review of the barway opening protocol.
- **Water quality** monitoring for baseline data (temperature, salinity, dissolved oxygen, **turbidity, pH, as outlined in the manual for monitoring Georges Bay; Crawford & Cahill,** 2007)). Training and standard procedures are important for data reliability. With funding for the analysis of samples, nutrients in the water column, pathogens and chlorophyll-a could also be monitored.
- **Fishkills**. Use the standardised Mass Mortality Data Record for fish and other creatures (Crawford & Cahill, 2007)
- Algal blooms, shoreline position, litter, extent of seagrass beds (and other aquatic habitats), and invertebrates in sediments could also be monitored as measures of estuarine condition (Crawford & Cahill, 2007).
- **Northern Pacific Seastars**, European Green Crab and other invasive species (liaise with CRIMP, CSIRO. See Crawford & Cahill, 2007)
- **Sea spurge –** conduct identification workshops, identify and eradicate any infestations.
- **Major environmental weeds (e.g. gorse, Spanish heath)** – map current extent, conduct identification workshops, identify any new populations for eradication.
- **Native vegetation** health could be monitored with photopoints.
- Monitor **wildlife deaths** at "blackspots" such as Tasman Hwy and Falmouth Rd powerlines. Liaise with authorities to alter if necessary
- **Phytophthora rootrot**. Conduct training in identification of Pc symptoms, then report any symptoms of disease to Tim Rudman, DPIW.
- **Review** effectiveness of EMP and update as required

For these measures to be useful, the data needs to be evaluated so that actions can result. Where existing databases and authorities are known, they have been mentioned. Overall, a "lagoon management group" needs to be formed, to coordinate such monitoring and actions that may result from it.

7 Key on-ground works

The initial step towards co-ordinating community involvement and action will be to form a Falmouth and Henderson Lagoon Environmental Management "steering group" to drive this plan.

While many of the management suggestions at the consultation workshops involved changes in behaviour of specific (other) landholders, desired changes to legislation and planning, and more data on land-use and impacts, in practice these things can be difficult to achieve, and expensive. It is beyond the scope of this (non-statutory) environmental management plan to oblige any landholders or authorities to change, although it is hoped that community interest in this plan will encourage stewardship actions from all stakeholders. Where changes are necessary, lobbying can be very effective.

Fortunately, there are also a great many actions which can make real differences to the health of the lagoon area, and which can be commenced immediately by interested community members. Monitoring of key indicators could also be conducted by the community, and these can be quite "hands-on" (e.g. testing for acid sulphate soils), but these are listed above (section 6). Many valuable activities can also be conducted for improving information and awareness (e.g. workshops and field days, "Dogs Breakfast", distribution of pamphlets, etc), but these are listed above (section 5.14). Actual on-ground works are below. Actions with highest priority for natural values are highlighted in yellow.

Funding sources vary over time, but currently include NRM North, Caring For Our Country and other Australian Government programs. Partnerships and sponsorships are possible. Contact Break O'Day NRM for assistance with applications for any funding programs.

Action	Potential participants	Timeline
Continue strategic control of weeds around lagoon, with native revegetation where necessary.	NRM Weeds Facilitator, Greencorps & CVA teams, local community	Immediate and ongoing
Fence and revegetate buffer zones around lagoon edge, Glencoe wetland and water courses. (Funding support and labour may be needed)	Landowners and managers, local community, NRM North and Break O'Day NRM,	1 to 5 years
Revegetate gaps in coastal scrub along Falmouth foreshore	Local community, PWS.	1 to 10 years
Eradicate any infestations of Sea Spurge as they appear.	NRM Weeds Facilitator, local community	Immediate and ongoing
Build soft-surface and/or natural stonework paths and steps from parking area to beach	Local community, PWS, Break O'Day Council	1 year
Rehabilitate eroded informal tracks back to natural state	Local community, PWS	1 to 5 years
Construct Esplanade track where necessary to allow continuous access (while avoiding impacts on scrub and middens).	Local community, PWS	1 to 5 years
Landscape public areas with local natives.	Break O'Day council, local community	5 – 10 years
Create seating and table under shady tree, viewing lagoon	Local community, Break O'Day Council	5 – 10 years
Install and improve stormwater treatment in urban areas (with sediment and nutrient filters maintained).	Break O'Day Council	1 to 5 years
Install educational signs at access points (beach, NW boat access, near wetlands, near Peat Marsh).	PWS, local community, Break O'Day NRM.	1 year
Community cleanup of litter (e.g. Cleanup Australia Day)	Local community.	Annual

Best practice guidelines for works include:

1. Check Aboriginal Heritage database, and locations of historic heritage (e.g. Old Coach Rd).
2. Any working party identifying Aboriginal cultural heritage material, such as shells or shell fragments, or rock material such as chert, cherty-hornfels, quarts & quartzite, should cease works and liaise with the office of AHT.
3. Consider during planning how to avoid spreading Phytophthora and weeds.
4. Wash down all machinery and tools before entering new areas and after works.
5. Don't open up new areas for erosion (e.g. avoid opening vegetation to erosion, avoid driving vehicles in wind-prone or soft sand\areas).
6. Do not disturb nesting birds.
7. Large scale weed works should be done in stages, with allowance for fauna habitat and revegetation.
8. Major works in conservation areas will require a Reserve Activity Assessment from PWS.

8 Plan revision

This Environmental Management Plan should be revised, with community and expert input, in five years' time. It should be assessed for changes in management issues or any other matter, and whether actions have been successful in meeting objectives.

In the mean time, the community should use this EMP as a reference and record achievements gained through on-ground works and the monitoring and education programs.

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10 Appendices

Appendix 1. Interim Guidelines for the Artificial Opening of Henderson Lagoon Sand Barrier.

Tasmania

DEPARTMENT *of*
TOURISM, ARTS *and* ENVIRONMENT
PARKS AND WILDLIFE SERVICE

INTERIM GUIDELINES FOR THE ARTIFICIAL OPENING OF HENDERSON LAGOON SAND BARRIER

INTRODUCTION

Henderson Lagoon is a tidal estuary that is normally open to the ocean through a naturally occurring barway at Falmouth on Tasmania's East Coast. During certain weather, tidal and sea conditions, the barway fills with sand and Henderson Lagoon becomes closed off from the ocean. Damage to the Henderson Lagoon ecosystem and/or surrounding property may occur during rainfall events or otherwise if the barway is closed off for extended periods, although the risks are not yet fully understood. Historically, and in recent years, the sand barrier has been artificially opened in order to lower the water level in the lagoon during periods of actual or threatened flooding, or in response to other serious adverse environmental effects.

In consultation with the Falmouth community, these interim guidelines for opening the barway at Falmouth have been drafted to:

a) address community concerns around the circumstances of previous artificial openings;
b) increase community and other stakeholder's understanding of the relevant threats, risks and considerations; and,
c) document the decision-making process and on-ground procedures for artificial openings.

These guidelines are intended to remain in effect until a formal Management Plan for Henderson Lagoon is prepared.

RESPONSIBLE AUTHORITY

The Department of Tourism, Arts and Environment is the primary responsible authority for the Henderson Lagoon ecosystem, managed through the **Parks and Wildlife Service**.

Break O'Day Council maintains a separate interest in water levels in Henderson Lagoon and may intervene if infrastructure or public safety is threatened. Council needs to obtain an authority from PWS if such circumstances occurred.

The steering group is currently:
Chris Colley, Parks and Wildlife
David Godfrey Smith, Falmouth Community Representative
Benjamin Dean, Falmouth Community Representative
Stephen Woods, owner, Enstone Park.

REQUESTS FOR OPENING OF THE BARWAY

Any person/s may apply to PWS for a request to artificially open the Falmouth barway when it is believed a threat of damage will be mitigated by such an action.

THREATS
A request will only be considered if the removal of the sand barrier mitigates the threat or damage to:

a) the health or safety of the community or general public;

b) the ecological health, biodiversity or productivity of the lagoon as a closed lagoon ecosystem;

c) property and/or infrastructure through inundation by floodwater.

WATER HEIGHT MARKERS
There are currently two agreed markers used to measure the height of water in the lagoon and assess any consequent risk of imminent flooding:

1. The **primary marker** is at ground level at the base of a steel fence picket painted orange and placed in the mud approximately 10 metres into the tidal mudflats of the lagoon from the edge of the pasture immediately adjacent to the western edge of the lagoon within land owned by Enstone Park. The top of the picket is 940mm from the ground level; high-water mark at the peak of a king tide is the 7th hole from the top (640mm) and 300mm from the ground.
2. The **secondary marker,** indicating high water mark at the peak of a king tide, has been placed on a round treated pine fence post embedded in the lagoon immediately west of the boat launching area at Falmouth. The marker is a galvanized clout with two "v" grooves in the head 720mm from ground level and 310mm from the top of the post, which corresponds to the high-water mark on the primary marker. (The pole will be painted green, orange and red to reflect the relative heights and risk categories)

Photographs of both markers at the peak of a king tide are held by Parks & Wildlife Service, Northern Region. The agreed markers may be subject to change as more is learnt about the lagoon and situations affecting it.

ASSESSING THE RISK OF FLOODING
Where a threat from floodwater is identified the Department will take into account the following factors, alone and in combination:

RISK	**Water level in the Lagoon**
LOW	If the water level is <u>below the primary marker</u> adjacent to Enstone Park's pasture then the risk of flooding is low
MODERATE	If the water level is <u>at or above the primary marker</u> adjacent to Enstone Park's pasture but below the tidal high water mark at a king tide, then the risk of flooding is moderate.
HIGH	If the water level is <u>at the tidal high water mark at a king tide</u>, then the risk of flooding is high.
EXTREME	• High Risk conditions prevail and a severe weather event with high probability of rainfall, or other catastrophic event, is predicted. (ie where time is of the essence) • Where flooding of the pasture has occurred, with the water having exceeded the <u>tidal high water mark at a king tide</u>

FACTORS/CONDITIONS AFFECTING THE WATER LEVEL

1. Short and long-term weather forecast

For the purposes of this protocol:

- If an extreme rainfall event is predicted, in progress or has just occurred, the risk of flooding is assumed to be higher.
- If a long dry period is predicted, the risk of flooding is assumed to be lower as the high water will normally drain naturally to the ocean through the dunes.

2. Ground saturation

For the purposes of this protocol:

- If the ground within the catchment is saturated (e.g. creeks flowing stronger than normal), then run-off will normally be greater and the risk of flooding is assumed to be higher.
- If there has been a protracted dry period, it is assumed the capacity exists for the ground to absorb significant rainfalls and the risk of flooding is therefore lower.

DECISION-MAKING PROCESS

The Department may act proactively in opening the Falmouth barway. Otherwise on receipt of a request, the Parks and Reserves Manager will determine:

a) whether the threat is in agreement with the conditions of these guidelines;
b) What is the status of the risk in progressing the threat;

If Floodwater is part of the threat then:

a) whether the current water level meet or exceed tidal measurements;
b) what influence do the factors/conditions (including water levels, weather forecast and ground saturation), both immediate and expected have on the water levels;
c) where risk is moderate, PWS and steering group will monitor conditions, including water level, weather forecasts and catchment conditions.

The Parks and Reserves Manager will consult with nominated representatives of the community when assessing the need for an artificial opening. Community representatives were nominated following a public meeting at Falmouth on 26 November 2005.

In extreme circumstances, where the threat is immediate, the Department can issue a permit at short notice, without further consultation, having referenced the remainder of the protocol.

The Parks and Reserves Manager will prepare a summary of these investigations and make a recommendation to the Regional Manager.

Decisions regarding the need to artificially open the sand barrier are made by the Regional Manager.

In authorising the artificial opening of the barway, a permit will be issued that is consistent with the following legislation:

(a) National Parks and Reserves Management Act 2002

(b) Tasmanian Reserve Management Code of Practice 2003

(c) State Coastal Policy 1996

(d) Nature Conservation Act 2002

If an artificial opening is recommended and approved, appropriate notice shall be given to the Falmouth community representatives and visitors to the area:

a) At the earliest opportunity, notice shall be given by email to those who have requested such notification and provided a current email address to Parks and Wildlife Service Northern Region;

b) Public Notice is to be posted on the notice board at the Falmouth Community Centre;

c) Public Notice is to be posted at the toilet block of the lagoon car park.

Notice will include the Parks and Reserve Manager contact details should members of the community or visitors have questions or concerns regarding the proposed action.

ONGROUND PROCEDURES FOR ARTIFICIAL OPENING

If the sand barrier is to be opened, the Parks and Reserves Manager will arrange appropriate public notice and supervision, including ensuring that OH&S issues are addressed and minimal disturbance to dunes and vegetation is caused by the opening process.
On the day of the opening, notices and/or barriers will be placed at the toilet block of the lagoon car park, at the boat launching area and at the foot of Legge Street advising the presence of heavy equipment and danger to bystanders or those walking along the beach. This will be a cooperative exercise between Parks and Wildlife Service and the applicant requesting the artificial opening.

Every reasonable effort will be made to ensure members of the public walking on the beach at the time of the opening are not left stranded.

In order to prevent access by motorised vehicles and the creation of an additional pathway to the beach, damage to public land including the dunes shall be rehabilitated at the earliest opportunity.

The applicant requesting an artificial opening of the Henderson Lagoon sand barrier will be responsible for all costs.

AMENDMENTS TO THIS POLICY

Amendment to this policy shall not be made unless agreement is reached between the relevant government agencies and community representatives. The outcome of any amendments will be conveyed to the relevant government agencies and published to all known community stakeholders.

Appendix 2. Native flora species list, Henderson Lagoon area

Note: While many records exist for the area (Natural Values Atlas 31/10/08 and 2/12/08, Bushways 10th and 11th November 2008), many more species could well be found with thorough surveys. This list covers several different habitats, from saltmarsh to forested hills. Descriptions in the main text outline major species found in particular habitats.

(Dicotyledonae) BROAD-LEAFED PLANTS

Species name	Common name
AIZOACEAE	
Carpobrotus rossii	native pigface
Disphyma crassifolium	roundleaf pigface
Tetragonia implexicoma	bower spinach
APIACEAE	
Apium prostratum	sea parsley
Centella cordifolia	swampwort
Lilaeopsis polyantha	jointed swampstalks
Xanthosia pilosa	woolly crossherb
Xanthosia pilosa	woolly crossherb
Xanthosia sp.	crossherb
Xanthosia tasmanica	small crossherb
Xanthosia ternifolia	shrubby crossherb
APOCYNACEAE	
Alyxia buxifolia	seabox
ASTERACEAE	
Actites megalocarpa	dune thistle
Brachyscome graminea	grass daisy
Cassinia aculeata	dollybush
Chrysocephalum apiculatum	common everlasting
Chrysocephalum semipapposum	clustered everlasting
Cotula (Leptinella) longipes	coast buttons
Helichrysum leucopsideum	satin everlasting
Helichrysum scorpioides	curling everlasting
Lagenifera huegelii	coarse bottle daisy
Lagenifera stipitata	blue bottle daisy
Lagenophora gracilis	slender bottledaisy
Leptinella longipes	coast buttons
Olearia ericoides	heath daisybush
Olearia lirata	forest daisybush
Olearia ramulosa	twiggy daisybush
Ozothamnus thyrsoideus	angled everlastingbush
Picris angustifolia subsp. angustifolia	lowland hawkweed
Senecio hispidulus	rough fireweed
Senecio linearifolius	fireweed
Senecio quadridentatus	cotton fireweed
BRASSICACEAE	
Lepidium hyssopifolium	soft peppercress
Lepidium pseudotasmanicum	shade peppercress
CAMPANULACEAE	
Lobelia alata	angled lobelia
Wahlenbergia gracilis	sprawling bluebell

Species name	Common name
CARYOPHYLLACEAE	
Spergularia tasmanica	coastal seaspurrey
CASUARINACEAE	
Allocasuarina littoralis	black sheoak
Allocasuarina monilifera	necklace sheoak
Allocasuarina verticillata	drooping sheoak
CHENOPODIACEAE	
Rhagodia candolleana	coastal saltbush
Sarcocornia quinqueflora	beaded glasswort
Suaeda australis	southern seablite
CLUSIACEAE	
Hypericum gramineum	small st johns-wort
CONVOLVULACEAE	
Dichondra repens	kidneyweed
DILLENIACEAE	
Hibbertia acicularis	prickly guineaflower
Hibbertia calycina	lesser guineaflower
Hibbertia empetrifolia	scrambling guinea-flower
Hibbertia procumbens	spreading guineaflower
Hibbertia prostrata	prostrate guineaflower
Hibbertia riparia	erect guineaflower
Hibbertia virgata	twiggy guineaflower
DROSERACEAE	
Drosera macrantha	climbing sundew
Drosera peltata	pale sundew
Drosera peltata subsp. auriculata	tall sundew
Drosera pygmaea	dwarf sundew
EPACRIDACEAE	
Acrotriche serrulata	ants delight
Astroloma humifusum	native cranberry
Epacris impressa	common heath
Epacris obtusifolia	bluntleaf heath
Leucopogon collinus	white beardheath
Leucopogon ericoides	pink beardheath
Leucopogon parviflorus	coast beardheath
Leucopogon virgatus	common beard-heath
Monotoca elliptica	tree broomheath
Sprengelia incarnata	pink swampheath
Styphelia adscendens	golden heath
EUPHORBIACEAE	
Amperea xiphoclada	broom spurge
Poranthera microphylla	small poranthera

Continued over page….

Appendix 2 (continued). Native flora species list, Henderson Lagoon area

Species name	Common name
FABACEAE	
Aotus ericoides	golden pea
Bossiaea cinerea	showy bossia
Bossiaea prostrata	creeping bossia
Dillwynia glaberrima	smooth parrotpea
Glycine clandestina	twining glycine
Gompholobium huegelii	common wedgepea
Kennedia prostrata	running postman
Platylobium triangulare	arrow flatpea
Pultenaea dentata	swamp bushpea
Pultenaea gunnii	golden bushpea
GENTIANACEAE	
Sebaea albidiflora	white sebaea
Sebaea ovata	yellow sebaea
GERANIACEAE	
Pelargonium australe	Southern storksbill
GOODENIACEAE	
Dampiera stricta	blue dampiera
Goodenia lanata	trailing native-primrose
Selliera radicans	shiny swampmat
HALORAGACEAE	
Gonocarpus humilis	shade raspwort
Gonocarpus micranthus	creeping raspwort
Gonocarpus tetragynus	common raspwort
Gonocarpus teucrioides	forest raspwort
LAMIACEAE	
Scutellaria humilis	dwarf skullcap
LAURACEAE	
Cassytha melantha	large dodderlaurel
Cassytha pubescens	downy dodderlaurel
MENYANTHACEAE	
Villarsia exaltata	erect marshflower
MIMOSACEAE	
Acacia dealbata	silver wattle
Acacia genistifolia	spreading wattle
Acacia longifolia subsp. sophorae	coast wattle
Acacia melanoxylon	blackwood
Acacia myrtifolia	redstem wattle
Acacia stricta	hop wattle
Acacia suaveolens	sweet wattle
Acacia terminalis	sunshine wattle
Acacia ulicifolia	juniper wattle
Acacia verticillata	prickly moses
MYOPORACEAE	
Myoporum insulare	common boobialla
MYRTACEAE	
Baeckea ramosissima	baeckea or rosy heath-myrtle
Calytrix tetragona	common fringemyrtle
Eucalyptus amygdalina	black peppermint
Eucalyptus globulus	tasmanian blue gum
Eucalyptus ovata var. ovata	black gum
Eucalyptus pulchella	white peppermint
Eucalyptus sieberi	ironbark
Eucalyptus viminalis	white gum
Euryomyrtus ramosissima subsp. ramosissima	rosy heathmyrtle
Leptospermum scoparium	common teatree
Melaleuca ericifolia	coast paperbark
Melaleuca gibbosa	slender honeymyrtle
Melaleuca squarrosa	scented paperbark
OXALIDACEAE	
Oxalis perennans	grassland woodsorrel
PITTOSPORACEAE	
Bursaria spinosa	prickly box
Rhytidosporum procumbens	starry appleberry
POLYGALACEAE	
Comesperma calymega	bluespike milkwort
Comesperma ericinum	heath milkwort
Comesperma volubile	blue lovecreeper
POLYGONACEAE	
Muehlenbeckia adpressa	climbing lignum
PRIMULACEAE	
Samolus repens	creeping brookweed
PROTEACEAE	
Banksia marginata	silver banksia
Hakea nodosa	Yellow needlebush
Conospermum hookeri	tasmanian smokebush
Hakea lissosperma	mountain needlebush
Lomatia tinctoria	guitarplant
Persoonia juniperina	prickly geebung
Persoonia juniperina var. mollis	soft geebung
RHAMNACEAE	
Pomaderris apetala	dogwood
Pomaderris elliptica	yellow dogwood
ROSACEAE	
Acaena echinata	sheepsburr
Acaena novae-zelandiae	common buzzy
RUBIACEAE	
Opercularia varia	variable stinkweed
RUTACEAE	
Boronia pilosa	hairy boronia
Correa alba var. alba	white correa
Correa reflexa var. reflexa	common correa
Eriostemon verrucosus	fairy wax-flower
Eriostemon virgatus	twiggy wax-flower
Philotheca virgata	twiggy waxflower
Zieria littoralis	downy zieria
Zieria veronicea subsp. veronicea	pink zieria
SANTALACEAE	
Exocarpos cupressiformis	common native-cherry
Leptomeria drupacea	erect currantbush
SCROPHULARIACEAE	
Mimulus repens	creeping monkeyflower
SOLANACEAE	
Solanum laciniatum	kangaroo apple
STYLIDIACEAE	
Stylidium graminifolium	narrowleaf triggerplant
THYMELAEACEAE	
Pimelea glauca	smooth riceflower
Pimelea linifolia subsp. linifolia	slender riceflower
TREMANDRACEAE	
Tetratheca labillardierei	glandular pinkbells
VIOLACEAE	
Viola caleyana	swamp violet
Viola hederacea	ivy-leaf violet

Continued over page….

Appendix 2 (continued). Native flora species list, Henderson Lagoon area (Monocotyledonae) NARROW-LEAFED PLANTS

Species name	Common name
CENTROLEPIDACEAE	
Centrolepis fascicularis	tufted bristlewort
CYPERACEAE	
Baumea acuta	pale twigsedge
Baumea arthrophylla	fine twigsedge
Baumea juncea	bare twigsedge
Cyperus lucidus	leafy flatsedge
Eleocharis acuta	Common spikesedge
Ficinia nodosa	knobby clubsedge
Gahnia filum	chaffy sawsedge
Gahnia grandis	cutting grass
Gahnia radula	thatch sawsedge
Gymnoschoenus sphaerocephalus	buttongrass
Isolepis cernua	nodding clubsedge
Lepidosperma concavum	sand swordsedge
Lepidosperma filiforme	common rapiersedge
Lepidosperma gladiatum	coast swordsedge
Lepidosperma gunnii	narrow swordsedge
Lepidosperma inops	fan sedge
Lepidosperma longitudinale	pithy swordsedge
Schoenus apogon	common bogsedge
Schoenus fluitans	floating bogsedge
Schoenus nitens	shiny bogsedge
Tetraria capillaris	hair sedge
IRIDACEAE	
Diplarrena moraea	white flag-iris
Patersonia fragilis	short purpleflag
JUNCACEAE	
Juncus holoschoenus	jointleaf rush
Juncus kraussii	sea rush
Juncus pallidus	pale rush
Juncus planifolius	broadleaf rush
Juncus procerus	tall rush
Luzula densiflora	dense woodrush
JUNCAGINACEAE	
Triglochin procerum	greater waterribbons
Triglochin striatum	streaked arrowgrass
LILIACEAE	
Burchardia umbellata	milkmaids
Caesia parviflora var. parviflora	pale grasslily
Dianella brevicaulis	shortstem flaxlily
Dianella revoluta	spreading or black-anther flax-lily
Dianella tasmanica	forest flaxlily
ORCHIDACEAE	
Acianthus pusillus	small mosquito-orchid
Caladenia clavigera	clubbed spider-orchid
Caladenia dilatata	greencomb spider-orchid
Caladenia filamentosa	daddy longlegs
Caladenia latifolia	pink fairies
Caleana major	flying duck-orchid
Chiloglottis reflexa	autumn bird-orchid
Cryptostylis subulata	large tongue-orchid
Diuris pardina	leopard orchid
Diuris sulphurea	tiger orchid

Species name	Common name
Glossodia major	waxlip orchid
Microtis parviflora	slender onion-orchid
Microtis unifolia	Common onion-orchid
Petalochilus fuscatus / Caladenia fuscata	dusky fingers
Prasophyllum elatum	tall leek-orchid
Pterostylis nana	dwarf greenhood
Pterostylis pedoglossa	prawn greenhood
Thelymitra carnea	tiny sun-orchid
Thelymitra ixioides	spotted sun-orchid
Thelymitra malvina	mauvetuft sun-orchid
Thelymitra rubra	pink sun-orchid
POACEAE	
Agrostis avenacea	blown grass
Austrodanthonia setacea	bristly wallbygrass
Austrofestuca littoralis	coast fescue
Austrostipa stipoides	coast speargrass
Danthonia penicillata	slender wallabygrass
Danthonia tenuior	purplish wallabygrass
Deyeuxia monticola	mountain bentgrass
Deyeuxia quadriseta	reed bentgrass
Dichelachne inaequiglumis	loose plumegrass
Dichelachne rara	scarce plume-grass
Distichlis distichophylla	australian saltgrass
Ehrharta acuminata	swamp ricegrass
Ehrharta distichophylla	hairy ricegrass
Ehrharta stipoides	weeping grass
Hemarthria uncinata	hooked matgrass
Lachnagrostis filiformis	common blowngrass
Notodanthonia semiannularis	marsh wallabygrass
Phragmites australis	southern reed
Poa labillardierei	silver tussockgrass
Poa poiformis	blue tussock grass
Poa poiformis var. poiformis	coastal tussockgrass
Poa sieberiana	grey tussockgrass
Puccinellia stricta	saltmarsh grass
Puccinellia stricta var. stricta	australian saltmarshgrass
Spinifex sericeus	spinifex
Stipa rudis subsp. australis	austral spear-grass
Stipa semibarbata	fibrous spear-grass or barbed spear-grass
Themeda triandra	kangaroo grass
RESTIONACEAE	
Apodasmia brownii	coarse twinerush
Hypolaena fastigiata	tassel roperush
Leptocarpus tenax	slender twinerush
Restio complanatus	flat cord-rush
RUPPIACEAE	
Ruppia polycarpa	manyfruit seatassel
XANTHORRHOEACEAE	
Lomandra longifolia	sagg
Xanthorrhoea australis	southern grasstree
XYRIDACEAE	
Xyris gracilis (Xyrix tasmanica?)	Tasmanian yelloweye
ZOSTERACEAE	
Zostera muelleri subsp. muelleri (Nanozostera muelleri)	dwarf grasswrack (seagrass)

Continued over page….

Appendix 2(continued). Native flora species list, Henderson Lagoon area

(Pteridophyta) FERNS

Family	Species name	Common name
BLECHNACEAE	*Doodia australis*	common raspfern
CYATHEACEAE	*Cyathea australis subsp. australis*	rough treefern
DENNSTAEDTIACEAE	*Pteridium esculentum*	bracken
DICKSONIACEAE	*Calochlaena dubia*	rainbow fern
GLEICHENIACEAE	*Gleichenia microphylla*	scrambling coralfern
LINDSAEAECEAE	*Lindsaea linearis*	screw fern
OSMUNDACEAE	*Todea barbara*	austral kingfern
SCHIZAEACEAE	*Schizaea asperula*	rough combfern

FERN ALLIES

LYCOPODIACEAE	*Lycopodium fastigiatum*	mountain clubmoss
SELAGINELLACEAE	*Selaginella uliginosa*	swamp spikemoss

MOSSES

Family	Species name	Common name
AMBLYSTEGIACEAE	*Cratoneuropsis relaxa*	
BARTRAMIACEAE	*Bartramia ithyphylla*	
	Bartramia stricta	
BRACHYTHECIACEAE	*Chamberlainia salebrosa*	
BRYACEAE	*Bryum billardieri var. billardieri*	
	Bryum campylothecium	
	Bryum pseudotriquetrum	
DICRANACEAE	*Campylopus clavatus*	
DICRANACEAE	*Campylopus introflexus subsp. pudicus*	
DITRICHACEAE	*Ceratodon purpureus*	
FISSIDENTACEAE	*Fissidens asplenioides*	
	Fissidens pungens	
	Fissidens rigidulus subsp. rigidulus	
HOOKERIACEAE	*Achrophyllum dentatum*	
	Distichophyllum microcarpum	
HYPNACEAE	*Hypnum cupressiforme*	
LEMBOPHYLLACEAE	*Camptochaete gracilis*	
	Lembophyllum divulsum var. clandestinum	
LEPTOSTOMATACEAE	*Leptostomum inclinans*	
METEORIACEAE	*Papillaria crocea*	
MITTENIACEAE	*Mittenia plumula*	
MNIACEAAE	*Pohlia wahlenbergii*	
ORTHODONTIACEAE	*Orthodontium lineare subsp. sulcatum*	
PLAGIOTHECIACEAE	*Acrocladium chlamydophyllum*	
POLYTRICHACEAE	*Atrichum androgynum*	
	Pogonatum subulatum	
POTTIACEAE	*Barbula calycina*	
	Tortella knightii	
	Weissia controversa	
PTYCHOMNIACEAE	*Ptychomnium aciculare*	
RACOPILACEAE	*Racopilum convolutaceum*	
RHIZOGONIACEAE	*Hymenodon pilifer*	
	Rhizogonium distichum	
SEMATOPHYLLACEAE	*Sematophyllum contiguum*	
	Sematophyllum homomallum	
THUIDIACEAE	*Thuidium furfurosum*	
	Thuidium laeviusculum	

Continued over page….

Appendix 2 (continued). Native flora species list, Henderson Lagoon area

FUNGI

Family	Species name	Common name
AGARICACEAE	*Leucoagaricus sp.*	
	Nidula emodensis	
BOLETACEAE	*Austroboletus occidentalis*	
	Fistulinella mollis	
CLAVULINACEAE	*Clavulina rugosa*	
CORTINARIACEAE	*Cortinarius sinapicolor*	
	Cortinarius violaceus	
	Descolea recedens	
DACRYMYCETACEAE	*Calocera guepinioides*	jelly fungus
	Heterotextus peziziformis	jelly fungus
ENTOLOMATACEAE	*Entoloma aff. nitidum*	
	Entoloma viridomarginatum	
FOMITOPSIDACEAE	*Fomitopsis lilacinogilva*	
HELIOTIACEAE	*Bisporella citrina*	
HYDNACEAE	*Hydnum repandum*	
HYGROPHORACEAE	*Hygrocybe graminicolor*	
	Hygrocybe lewellinae	
HYMENOCHAETACEAE	*Coltricia cinnamomea*	
INOCYBACEAE	*Inocybe cystidiocatenata*	
LYCOPERDACEAE	*Calvatia lilacina*	
MARASMIACEAE	*Omphalotus nidiformis*	
MYCENACEAE	*Dictyopanus pusillus*	
	Mycena albidofusca	
	Mycena austrofilopes	
	Mycena carmeliana	
	Mycena sanguinolenta	
	Mycena subgalericulata	
	Mycena viscidocruenta	
PHYSALACRIACEAE	*Oudemansiella radicata*	
PLUTEACEAE	*Amanita ananiceps*	
	Amanita ochrophylloides	
	Amanita xanthocephala	
PYRONEMATACEAE	*Byssonectria terrestris*	
RUSSULACEAE	*Lactarius clarkeae*	
	Lactarius eucalypti	
STROPHARIACEAE	*Hypholoma fasciculare*	
TRICHOLOMATACEAE	*Collybia eucalyptorum*	
	Omphalina chromacea	

Appendix 3. Weed List

Previously recorded on the Natural Values Atlas (31/10/08) or recorded during surveys for this project (10/11/08).

A detailed weed management plan is not possible here, but some prioritisation of weed species is provided to facilitate immediate action. This is an indicative list of high priority environmental weeds that should be controlled wherever possible. They are high priorities here because:

- they are already dominating areas and may spread further (e.g. Gorse).
- they are very invasive (e.g. Spanish Heath);
- they are WONS (Weeds of National Significance); or
- they are currently few and easily removed (with potential to get worse if left, e.g. Sallow Wattle, Pine).

There are also other weeds (listed below), including a variety of pasture grasses and garden plants, which exist and should not be allowed to invade native bushland.

Some suggestions for treatment options are provided, but further advice should be obtained.

Family	**Scientific Name**	**Common Name**	**Treatment Suggestions**	**Similar Natives** ***Be careful to leave these!**
Trees:				
PINACEAE	*Pinus radiata*	radiata pine	Cut below lowest branch. (NB safety!)	Bulloak, sheoak and native cherry do not smell of pine.
RUBIACEAE	*Coprosma repens*	mirrorbush	Cut-and-paint	
MIMOSACEAE	*Acacia longifolia ssp. longifolia*	sallow wattle (Sydney golden wattle)	Cut-and-paint.	Coast wattle ("boobialla"), *Acacia longifolia ssp. sophorae,* has blunter "leaves" and twisted seedpods.
SALICACEAE	*Salix fragilis*	Crack willow	**WONS**. Seek specialist advice.	
Shrubs:				
ASTERACEAE	*Chrysanthemoides monilifera*	boneseed	**WONS.** Handpull, or cut-and-paint.	Boobyalla (both *Myoporum insulare* and *Acacia longifolia ssp. sophorae* resemble boneseed).
ERICACEAE	*Erica lusitanica*	Spanish heath	Cut-and-paint / spray (e.g. metsulfuron-methyl)	Many native heaths (e.g. *Epacris impressa*) feel prickly (the weed feels soft).
FABACEAE	*Chamaecytisus palmensis*	tree lucerne/ tagasaste	Cut-and-paint	Some native bushpeas, e.g. *Goodia lotifolia.*
	Genista monspessulana	canary broom	Cut-and-paint	Various native bushpeas.
	Psoralea pinnata	blue butterflybush	Cut-and-paint	
	Ulex europaeus	gorse	**WONS.** Cut-and-paint, or otherwise spray. Seek further advice.	Several native species are prickly, e.g *Daviesia ulicifolia, Melicytus dentatus.*
MYRTACEAE	*Leptospermum laevigatum*	coast teatree	Cut-and-paint. Contain spread. Balance careful removal with risk of opening up coastal vegetation.	This plant is not native in Falmouth, although it does naturally occur in parts of the north coast of Tasmania.

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Appendix 3. Weed List (continued)

Family	Scientific Name	Common Name	Treatment Suggestions	Similar Natives *Be careful to leave these!
ROSACEAE	*Rubus fruticosus*	blackberry	**WONS.** Cut-and-paint / spray (e.g. metsulfuron-methyl). NB Check for fauna usage first.	Native raspberry is similar, but generally smaller in all its parts.
	Cotoneaster glaucophyllus	cotoneaster	Cut-and-paint	Yellow dogwood is similar in leaf shape, but does not have red berries.
SOLANACEAE	*Lycium ferocissimum*	african boxthorn	Cut-and-paint / spray.	
Climbers:				
ASTERACEAE	*Senecio angulatus*	Climbing groundsel	Dig out/ cut tops/ spray.	Native climbers, e.g. Climbing Lignum, *Muehlenbeckia adpressa.*
LILIACEAE	*Asparagus asparagoides*	bridal creeper	**WONS**. Obtain specialist advice. N.B. rhizomes in soil.	Various native climbers, e.g. *Clematis microphylla*
Groundcovers:				
APOCYNACEAE	*Vinca major*	blue periwinkle	Pull or dig out small areas, or spray.	
POACEAE	*Ammophila arenaria*	marram grass	Obtain specialist advice. Aim to prevent spread. Large-scale removal would be difficult and probably impossible.	Native coast fescue, tussockgrass and spinifex.
	Cortaderia spp.	Pampas grass	Spot spray with glyphosate.	Cutting grass, *Gahnia spp*

Note: Sea spurge, *Euphorbia paralias,* is not yet known here. It is important to monitor and prevent the establishment of this vigorous coastal weed. Handpull. *BEWARE of sap – wear protective clothing and keep away from eyes.

Figure 35. Woody weeds can be cut and painted with glyphosate herbicide (dyed pink). Cuts should be as close to the ground as possible, and herbicide applied to the cut within 10 seconds.

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Appendix 3. Weed List (continued)

Many other introduced plants may not be considered weeds (e.g. pasture species, garden plants), but can spread into native vegetation. Some of these can dominate and change native vegetation, reducing habitat value, and be difficult to eradicate once established. Others are of lesser concern. Decisions to control should be made on a site-by-site basis.

Other introduced species occurring around Henderson Lagoon include:

GRASSES

Aira sp.	hairgrass
Anthoxanthum odoratum	sweet vernalgrass
Briza maxima	quaking grass
Briza minor	shivery grass
Dactylis glomerata	cocksfoot
Digitaria sanguinalis	summergrass
Eragrostis brownii	common lovegrass
Festuca arundinacea	tall fescue
Holcus lanatus	yorkshire fog
Holcus mollis	creeping fog
Lagurus ovatus	harestail grass
Paspalum dilatatum	paspalum
Sporobolus indicus var. capensis	dropseed, rushgrass or rat's tail grass
Stenotaphrum secundatum	Buffalo grass
Vulpia bromoides	squirreltail fescue

GARDEN PLANTS THAT ESCAPE

Agapanthus praecox ssp. orientalis	agapanthus
Aptenia cordifolia	heartleaf iceplant
Coleonema pulchellum	diosma
Carpobrotus edulis	yellow pigface
Gazania linearis	gazania
Kennedia rubicunda	dusky coralpea
Lupinus sp.	lupin
Malva sp.	mallow

HERBS

Acetosella vulgaris	sheep sorrel
Anagallis arvensis	scarlet pimpernel
Aster subulatus	asterweed
Beta vulgaris subsp. maritima	sea beet
Cakile maritima	searocket
Capsella bursa-pastoris	shepherds purse
Centaurium erythraea	common centaury
Cirsium vulgare	spear thistle
Conyza sp.	fleabane
Hypochoeris radicata	rough catsear
Juncus articulatus	jointed rush
Leontodon taraxacoides	hairy hawkbit
Lotus sp.	trefoil
Plantago coronopus	buck's horn plantain
Plantago lanceolata	ribwort plantain
Sisyrinchium iridifolium	blue pigroot
Spergularia media	coastal sand-spurrey (NB Native *Spergularia tasmanica* is widespread in saltmarsh.)
Spergularia rubra	greater sandspurrey
Trifolium subterraneum	subterranean clover
Vellereophyton dealbatum	white cudweed
Vicia sp.	Vetch

Appendix 4. Threatened flora recorded nearby.

Previously recorded within 5 km of site (Natural Values Atlas, 31/10/08). Habitat comments are from *Threatened Flora Listing Statements*, or from Jones, D. *et al* (1999).

Key:
Tasmanian status (*Threatened Species Protection Act 1995*):
en = Endangered; x = Presumed Extinct; v = Vulnerable; r = Rare

Commonwealth status (*Environment Protection & Biodiversity Conservation Act 1999):*
EX = extinct; CR = Critically Endangered; EN = Endangered; VU = Vulnerable.

Scientific name	Common name	Conservation Status		Comments
		State	Cwth	
Acacia ulicifolia	juniper wattle	r		Sandy coastal heaths, open forest and woodland. Scamander is a key site.
Austrostipa nodosa	knotty speargrass	r		Grassland or open forest.
Caladenia filamentosa	daddy longlegs	r		Heathy and sedgy eucalypt forest and woodland on sandy soils.
Centaurium spicatum	spike centaury	r		Varied habitats. Difficult to distinguish from introduced centauries.
Conospermum hookeri	Tasmanian smokebush	v	VU	Open coastal heathland and heathy woodland on granite or sandy, acid, low-nutrient soils. Henderson Lagoon (Winifred Curtis Scamander Reserve) is a key site.
Epilobium pallidiflorum	showy willowherb	r		Wet places, including riparian and wet herbfield habitats.
Glycine microphylla	small-leaf glycine	v		Dry sclerophyll forest and woodland. Difficult to distinguish from similar species.
Hibbertia calycina	lesser guineaflower	v		In Tasmania, is only found near Scamander and St Helens. Ridgelines and upper slopes in Ironbark forest on mudstone.
Hibbertia virgata	twiggy guineaflower	r		Sandy heaths and open woodlands.
Juncus amabilis	gentle rush	r		Moist situations, including disturbed environments. Similar to other rushes.
Lepidium hyssopifolium	soft peppercress	e	EN	Devils Creek bridge at Falmouth is a key site. Weedy looking herb, similar to other peppercresses. Habitat is bare ground in growth suppression zone beneath large trees, including exotics.
Lepidium pseudotasmanicum	shade peppercress	r		Weedy looking herb, similar to other peppercresses. Bare ground in grassland and grassy woodland.
Prostanthera rotundifolia	roundleaf mintbush	v		Riverbanks and rocky hillsides in moist well-drained soils.
Scutellaria humilis	dwarf skullcap	r		Moist, shady places. Falmouth is a key site, but record is old and inaccurate.
Thelymitra malvina	mauvetuft sun-orchid	e		Coastal heath and sedgeland on sandy or clay loams. Also heathy open forest. Winifred Curtis Scamander Reserve.
Villarsia exaltata	erect marshflower	r		Stationary or slow-moving water.
Viola caleyana	swamp violet	r		Dry sclerophyll forest (but damp sites?). Innacurate (+/- 3km) old record in this area.
Zieria littoralis	downy zieria	r		Coastal rocky shores on the central east coast.
Zieria veronicea subsp. veronicea	pink zieria	e		Sandy soil in heathy open Black Peppermint forest. Historic records around Scamander but currently only known from Mt William NP.

Appendix 5. Threatened fauna possible on site

Species that have been recorded within 5 km of the site (marked *), or that may occur based on Estimated Geographic Range (Natural Values Atlas, 4/10/07; for Masked Owls, Bell & Mooney, 2002), or which have been observed by Benjamin Dean (#, pers.comm.10/11/08). Habitat comments are from Bryant & Jackson (1999), Bell & Mooney (2002), Forest Practices Authority (undated) and Green (1995). This list includes species found in nearby forests. (Note that other species of conservation significance, though not listed as threatened, also occur here, such as Hooded Plover and Eastern Quoll.)

Common name	Scientific name	Tas. status TSPA 1995	Cwth status EPBC 1999	Comments
Leathery Turtle	*Dermochelys coriacea*	v	VU	*Oceanic, and does not breed along Tasmanian coastline. Sometimes feed in Tas waters. Sometimes found entangled or beachwashed.
Wedge-tailed Eagle (Tasmanian)	*Aquila audax*	pe	PEN	Requires old growth trees, undisturbed, for nesting. Forages in all habitats.
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	v		*Nests in old growth trees, or on sea cliffs and rock stacks, usually within 5km of coast or other large waters. May nest NW of lagoon (P.Frater, pers.comm.)
Swift Parrot	*Lathamus discolor*	e	EN	*Forage in blue gums and black gums (and sometimes in white gums). Probably forage here during migration south for breeding. Breed in hollows of oldgrowth eucalypts, but unlikely to breed here.
Little Tern	*Sterna albifrons ssp. sinensis*	e		*Breed on sand or shingle of beaches and estuaries; nest a shallow scrape. Vulnerable to disturbance of nest. Henderson Lagoon is one of few Little Tern nesting sites in Tasmania.
Fairy Tern	*Sterna nereis ssp. nereis*	v		* Breed on sand or shingle of beaches and estuaries; nest a shallow scrape. Vulnerable to disturbance of nest. Fairy Terns more common than Little Terns but appear to be decreasing (Green, 1995).
Migratory birds		Listed under JAMBA & CAMBA international agreements		Various migratory birds occur here, such as Caspian Tern and Bar-tailed Godwit. Favour sand, shingle, beaches, estuaries and mudflats.
Masked Owl	*Tyto novae-hollandiae*	e		Habitat is dry forests, woodlands and cleared land in coastal lowlands. Nest in oldgrowth tree hollows.
Eastern Barred Bandicoot	*Perameles gunnii*		VU	Prefers open grassy areas for foraging, with some dense understorey cover available. Suitable forest-pasture interface in this area.
Tasmanian Devil	*Sarcophilus harrisii*	v	VU	*Threatened by disease. Roadkill here too? May be found in most vegetation types.
New Holland Mouse	*Pseudomys novae-hollandiae*	e		Coastal heathy habitats. Likely ideal habitat around this area; e.g. Winifred Curtis Scamander Reserve (mouse has a strong association with plants *Aotus ericoides, Lepidosperma concavum, Hypolaena fastigiata* and *Xanthorrhoea spp*.)
Spotted-tailed Quoll	*Dasyurus maculatus*	r	VU	#Forest, especially with logs, rocks or dense vegetation for sheltering. Forage widely, including over farmland.
Green and Gold Frog	*Litoria reniformis*	v	VU	*Permanent freshwater, especially with diverse aquatic vegetation. Many heard calling in Glencoe wetland 11/08 (A. Povey).
Australian Grayling	*Prototroctes maraena*	v	VU	*Spawn in freshwater, live in middle and lower reaches of rivers and streams open to sea (including estuaries), and spend phase out at sea. Require free movement between freshwater and marine habitats. Known in Scamander River.
Giant Velvet Worm	*Tasmanipatus barretti*	r		*Wet forests and scrub, living usually in decaying logs. Restricted to NE Tas near Scamander.
Blind Velvet Worm	*Tasmanipatus anophthalmus*	e		Wet forests, living usually in decaying logs. Restricted to NE Tas near St Marys.

Appendix 6. Fauna recorded around Henderson Lagoon

Species that have been previously recorded within the study area (Natural Values Atlas, 2/12/08) or that were recorded during these and recent surveys (A.Povey, B.Dean, S.Lloyd, Fenton *et al,* 2008.). This includes records from the lagoon as well as the nearby area, and some unusual records (such as gentoo penguin, willy wagtail, whistling kite, pilot whale and leathery turtle).

i = introduced T = listed as threatened eT = endemic to Tasmania

Common Name	Species Name	Family
INVERTEBRATES		
giant velvet worm	*Tasmanipatus barretti*	Peripatopsidae
variable cirphula	*Cirphula pyrrhocnemis*	
Cicada	*Diemeniana euronotiana*	
Gumleaf grasshopper	*Goniea australasiae*	
Matchstick grasshopper	*Vandiemenella viatica*	
Disappearing grasshopper	*Schizobothrus flavovittatus*	
Blue ringtail (damselfly)	*Austrolestes annulosus*	
Gumtree hopper	*Eurymeloides pulchra*	
Fringed heath-blue	*Neolucia agricola*	
Meadow argus	*Junonia villida*	
Sugar ant	*Campanotus sp.*	
Jackjumper	*Myrmecia sp.*	
Tasmanian paralysis tick	*Ixodes cornuatus*	Ixodidae
FISH		
southern short-finned eel	*Anguilla australis*	Anguillidae
longfin eel	*Anguilla reinhardtii*	Anguillidae
blackfish	*Gadopsis marmoratus*	Gadopsidae
australian grayling (T)	*Prototroctes maraena*	Prototroctidae
Galaxid fish	*Galaxias sp. (*possibly *G. maculatus)*	Galaxiidae
REPTILES		
leathery turtle (T)	*Dermochelys coriacea*	Dermochelyidae
Metallic skink	*Niveoscincus metallicus*	Scincidae
FROGS		
brown tree frog	*Litoria ewingi*	Hylidae
green and golden frog (T)	*Litoria raniformis*	Hylidae
brown froglet	*Crinia signifera*	Myobatrachidae
tasmanian froglet	*Crinia tasmaniensis*	Myobatrachidae
banjo frog	*Limnodynastes dumerili subsp. insularis*	Myobatrachidae
spotted marsh frog	*Limnodynastes tasmaniensis*	Myobatrachidae
southern toadlet	*Pseudophryne semimarmorata*	Myobatrachidae
BIRDS		
gentoo penguin	*Pygoscelis papua*	Spheniscidae
Australasian grebe	*Tachybaptus novae-hollandiae*	Podicipedidae
Australian gannet	*Morus serrator*	Sulidae
Great cormorant	*Phalacrocorax carbo*	Phalacrocoracidae
Little pied cormorant	*Phalacrocorax melanoleucos*	Phalacrocoracidae
Black-faced cormorant	*Leucocarbo fuscescens*	
Australian pelican	*Pelecanus conspicillatus*	Pelecanidae
great egret	*Ardea alba*	Ardeidae
white-faced heron	*Ardea novae-hollandiae*	Ardeidae
yellow-billed spoonbill	*Platalea flavipes*	Threskiornithidae

royal spoonbill	*Platalea regia*	Threskiornithidae
Black swan	*Cygnus atratus*	Anatidae
Australian shelduck	*Tadorna tadornoides*	Anatidae
Chestnut teal	*Anas castanea*	Anatidae
Swamp harrier	*Circus approximans*	Accipitridae
whistling kite	*Haliastur sphenurus*	Accipitridae
white-bellied sea-eagle (T)	*Haliaeetus leucogaster*	Accipitridae
Brown falcon	*Falco berigora*	Falconidae
Masked lapwing	*Vanellus miles*	Charadriidae
banded lapwing	*Vanellus tricolor*	Charadriidae
hooded plover	*Thinornis rubricollis*	Charadriidae
double-banded plover	*Charadrius bicinctus*	Charadriidae
red-capped plover	*Charadrius ruficapillus*	Charadriidae
little stint	*Calidris minuta*	Scolopacidae
red-necked stint	*Calidris ruficollis*	Scolopacidae
sanderling	*Calidris alba*	Scolopacidae
bar-tailed godwit	*Limosa lapponica*	Scolopacidae
pied oystercatcher	*Haematopus longirostris subsp. longirostris*	Haematopodidae
sooty oystercatcher	*Haematopus fuliginosus*	Haematopodidae
kelp gull	*Larus dominicanus*	Laridae
Pacific gull	*Larus pacificus*	Laridae
Silver gull	*Larus novae-hollandiae*	Laridae
little tern (T)	*Sterna albifrons subsp. sinensis*	Laridae
crested tern	*Sterna bergii*	Laridae
caspian tern	*Sterna caspia*	Laridae
common tern	*Sterna hirundo*	Laridae
fairy tern (T)	*Sterna nereis subsp. nereis*	Laridae
Brush bronzewing	*Phaps elegans*	Columbidae
Green rosella (eT)	*Platycercus elegans*	Platycercidae
Pallid cuckoo	*Cuculus pallidus*	Cuculidae
Horsfield's bronze-cuckoo	*Chrysococcyx basalis*	Cuculidae
Shining bronze-cuckoo	*Chrysococcyx lucidus*	Cuculidae
laughing kookaburra (i)	*Dacelo novaeguineae subsp. novaeguineae*	Halcyonidae
southern boobook	*Ninox novaeseelandiae subsp. leucopsis*	Strigidae
White-throated needletail	*Hirundapus caudacutus*	Apodidae
Welcome swallow	*Hirundo neoxena*	Hirundinidae
Skylark (i)	*Alauda arvensis*	Motacillidae
richards pipit	*Anthus novaeseelandiae*	Motacillidae
Common blackbird (i)	*Turdus merula*	Muscicapidae
black-faced cuckoo-shrike	*Coracina novaehollandiae*	Campephagidae
Grey shrike-thrush	*Colluricincla harmonica*	Pachycephalidae
Grey fantail	*Rhipidura fuliginosa*	Rhipiduridae
willie wagtail	*Rhipidura leucophrys*	Rhipiduridae
Little grassbird	*Megaulurus gramineus*	Sylviidae
Superb fairy-wren	*Malurus cyaneus*	Maluridae
Brown thornbill	*Acanthiza pusilla*	Acanthizidae
Yellow wattlebird (eT)	*Anthochaera paradoxa*	Meliphagidae
little wattlebird	*Anthochaera chrysoptera*	Meliphagidae
Yellow-throated honeyeater (eT)	*Lichenostomus flavus*	Meliphagidae
New Holland honeyeater	*Phylidonyris novae-hollandiae*	Meliphagidae
Silvereye	*Zosterops lateralis*	Zosteropidae
White-fronted chat	*Ephthianura albifrons*	Ephthianuridae
Striated pardalote	*Pardalotus striatus*	Pardalotidae

spotted pardalote	*Pardalotus punctatus*	Pardalotidae
House sparrow (i)	*Passer domesticus*	Passeridae
common greenfinch (i)	*Chloris chloris*	Fringillidae
European goldfinch (i)	*Carduelis chloris*	Fringillidae
Common starling (i)	*Sturnus vulgaris*	Sturnidae
Dusky woodswallow	*Artamus cyanopterus*	Artamidae
Grey butcherbird	*Cracticus torquatus*	Artamidae
Grey currawong	*Strepera versicolor*	Cracticidae
Australian magpie	*Cracticus tibicen*	Cractidae
Forest raven	*Corvus tasmanicus*	Corvidae

MONOTREMES

MAMMALS

eastern quoll	*Dasyurus viverrinus*	Dasyuridae
spotted-tailed quoll	*Dasyurus maculatus*	
Tasmanian devil	*Sarcophilus harrisii*	Dasyuridae
red-necked wallaby	*Macropus rufogriseus subsp. rufogriseus*	Macropodidae
tasmanian pademelon	*Thylogale billardierii*	Macropodidae
southern brown bandicoot	*Isoodon obesulus subsp. affinis*	Peramelidae
common brushtail possum	*Trichosurus vulpecula subsp. fuliginosus*	Phalangeridae
long-nosed potoroo	*Potorous tridactylus subsp. apicalis*	Potoroidae
New Zealand fur seal	*Arctocephalus forsteri*	Otariidae
long finned pilot whale	*Globicephala melaena*	Delphinidae

FERAL ANIMALS

House sparrow (i)	*Passer domesticus*	Passeridae
common greenfinch (i)	*Chloris chloris*	Fringillidae
European goldfinch (i)	*Carduelis chloris*	Fringillidae
Common starling (i)	*Sturnus vulgaris*	Sturnidae
Skylark (i)	*Alauda arvensis*	Motacillidae
Common blackbird (i)	*Turdus merula*	Muscicapidae
laughing kookaburra (i)	*Dacelo novaeguineae subsp. novaeguineae*	Halcyonidae
rabbit (i)	*Oryctolagus cuniculus subsp. cuniculus*	Leporidae

Appendix 7. Plants suitable for planting

Some suitable native plants for revegetation around Henderson Lagoon. Many more from Appendix 1 could also be tried.

However, be aware of flammability and the importance of a fire retardant garden in bushfire prone areas (see Tasmania Fire Service pamphlet). Most native plants are of high or moderate flammability, but plant shape and maintenance can be a factor. For instance, low growing plants and groundcovers are better than shrubs (TFS, 2006), and clumps of shrubs separated by open areas is acceptable in the outer zone (TFS, undated).

Sources of plants:
The best nurseries for this site are Pulchella Nursery at Buckland (ph: 6257 5189), Taz Wild Plants at Avoca (ph 6384 2165) and Habitat at Liffey (ph 6397 3400). All provide native plants (specify local provenance), and orders can be made. Slim-line tubes, where available, will be fine and usually cost around $2. Note that some species (eg grasses) are available in cheaper hiko trays (cost around $1).

The cost of guards for plants is also significant, but depends on the method chosen, and guards are not necessary for grasses and saggs. All nurseries can advise on and provide guards. Some nurseries provide planting services.

Name	Comments	Height (approx.)
TREES	**Avoid planting large trees near infrastructure and pipes. Spacing >5m looks more natural.**	
Black Peppermint, *Eucalyptus amygdalina,* White Gum, *E. viminalis,* Blue Gum*, E. globulus,* Iron Bark, *E. sieberi*	Various local eucalypts, suitable for drier sites.	> 20 m
Black Gum *Eucalyptus ovata*	White to pink bark, large wavy leaves. **Damp sites.**	> 20m
Blackwood *Acacia melanoxylon*	**Shady green tree**. Best in **moist sites** but hardy in most situations.	10 (-30) m
Silver Wattle *Acacia dealbata*	Feathery blue-grey leaves. Masses of yellow flowers a sign of spring. Dry and moist sites.	10 – 20 m
Drooping Sheoak, *Allocasuarina verticillata* and Black Sheoak, *A. littoralis*	**Hardy in dry sites**. Drooping, greyish-green foliage like pine needles. Black Sheoak is more upright and darker green.	6 - 10 m
Banksia *Banksia marginata*	Great for birds. **A favourite** with people and fauna.	6 (- 10) m
Swamp Paperbark *Melaleuca ericifolia*	Hardy, fast growing small tree with cream flowers spring/summer. **Good screen**, spreads by suckers. Can withstand **coastal** winds in **moist sites.**	4 - 6 (-12) m
SHRUBS	**Space shrubs one to two metres apart.**	
Coast Wattle ("Boobyalla") *Acacia longifolia ssp. sophorae*	The **hardiest** front-line plant for seawinds and sandy sites. Provides shelter. **Allow room** for this wide tree to spread, although pruning is possible.	2 – 5 m
Prickly Box *Bursaria spinosa*	Masses of fragrant white flowers in early summer for butterflies etc. **Prickly, hardy in many conditions**.	3 - 5 m
Dogwood *Pomaderris apetala*	Multi-stemmed dense shrub with large leaves. **Low flammability**. **Moist sites.**	3 – 8m
Native Hopbush *Dodonaea viscosa*	**Hardy in dry sites** (but not coastal dunes). Glossy green leaves, and purple-red papery fruits.	3 - 5 m
Scented Paperbark *Melaleuca squarrosa*	Yellow-cream scented flowers. **Moist sites**.	2 – 4 m
Common Boobyalla *Myoporum insulare*	**Front-line coastal** shrub in dry sites. Large green leaves, small white flowers.	2 – 3 m
Coast Beard-heath *Leucopogon parviflorus*	Hardy large shrub once established. May need to be ordered in advance. Edible berries.	1- 3 m

Continued over page…..

Appendix 7. Plants suitable for planting (continued)

SHRUBS (continued)	**Space shrubs one to two metres apart.**	
Coastal Saltbush *Rhagodia candolleana*	Scrambling dark green shrub with bright red berries. **Really hardy**, fast-growing shrub. **Dense screen**.	0.5 – 1.5 m
Sunshine Wattle *Acacia terminalis*	Creamy yellow flowers in winter, attractive feathery leaves.	2 m
Sweet Wattle *Acacia suaveolens*	Narrow blue-green phyllodes ('leaves'), winter flowers.	1 - 2 m
Redstem Wattle *Acacia myrtifolia*	Wide short leaves and red stems, with flowers in winter. Wallabies don't tend to eat it.	0.5 – 1m
Small-leaved Paperbark *Melaleuca gibbosa*	Mauve flowers, small leaves, tidy small shrub. **Moist, well-drained** sites.	0.5 – 1.5 m
Bush peas (various): Golden pea, *Aotus ericoides,* Showy Bossiaea, *Bossiaea cinerea,* and other Fabaceae species in list.	All have showy yellow-and-red pea flowers, and can be hardy once established. Benefit from light pruning.	0.5 – 1 m
Angled Everlastingbush, *Ozothamnus thyrsoideus*	Daisy bush with bunches of small white flowers, attracting butterflies and other insects. Hardy once established. **Moist sites**. (Other daisy bushes, *Cassinia, Olearia* and *Ozothamnus* species can handle drier sites).	1.5 - 2 m
Yellow Dogwood *Pomaderris elliptica*	Glossy green leaves, masses of yellow flowers. Well drained, moist soil.	2 – 4 m
White Correa *Correa alba*	Grey leaves. Small, dense shrub able to grow on coastal sands. Common Correa, *C.reflexa,* also lovely in gardens.	1 – 2 m
GROUNDCOVERS	**Plant groundcovers 0.5 to 1 metre apart, except Bower Spinach 2 m apart.**	
Native Pigface *Carpobrotus rossii*	Succulent creeper, with bright flowers, edible fruit. **Sunny sites, hardy in coastal sand**.	0.2 m
Flax-lily *Dianella revoluta* or *D. brevicaulis*	Strap leaves, blue flowers, blue berries. Spread to form clumps.	0.5 m
White Flag-iris *Diplarrena moraea*	Beautiful white iris flowers, strappy leaves **Low flammability**	1 m
Knobby Club-rush *Isolepis/Ficinia nodosa*	Fine leaves with distinctive round knobs on top. **Hardy** in variety of situations.	0.5 – 0.8 m
Sagg *Lomandra longifolia*	**Very hardy** tussock.	1 m
Poa Grass *Poa poiformis* (coastal front-line)	**Tough, drought-tolerant** tussocks.	0.5 - 1 m
Kangaroo grass *Themeda triandra*	Reddish leaves, distinctive seedheads make a feature of mass plantings.	0.5 m
Bower Spinach *Tetragonia implexicoma*	Sprawling runners of succulent green leaves. Fruit attracts birds. Allow plenty of room to spread. **Hardy** with **coastal** winds, salt, sand.	0.1 m (to 2 m spread). May climb 1-2 m
Clematis *Clematis aristata, C. microphylla*	Lovely climbers with white flowers. *Clematis microphylla* hardiest in coastal dry conditions.	To 3 m
Guinea-flowers *Hibbertia procumbens, H. empetrifolia* (and other species)	Beautiful yellow flowers, suit garden areas. Require good drainage, some moisture, part sun.	0.1 - 0.5 m
Short Purple-flag *Patersonia fragilis*	Lovely purple flowers, narrow leaves. Well-drained moist sunny sites.	0.2 - 0.5 m
Creeping Heath-myrtle *Euryomyrtus ramosissima*	Delightfully floral groundcover for garden/rockery sites. Moist, well-drained sites.	Prostrate, to 1 m wide
Running Postman *Kennedia prostrata*	Flat spreader, rounded leaflets, red & yellow flowers. Sunny, well-drained sites	Prostrate, to 1 m wide

Appendix 8 Table of actions

These have been consolidated from Falmouth community workshop 17th January 2009, together with actions since suggested by Bushways and other experts. Community priorities determined in the January workshop are shown by the number of "dots"; $ = red dot (immediate priority), # = green dot (priority within 10 years). Actions which would have considerable benefits for natural values, and/or are clearly defined and relatively easily achieved are highlighted in yellow as high priorities also. Priorities will be further refined during the second community workshop on 18th April.

HLMSG refers to a possible future Henderson Lagoon Management Steering Group. Other acronyms are listed early in this document. "Community" includes residents, visitors, land managers and relevant authorities.

Action ***(in response to Management Issues)***	**Potential participants**	**Workshop Priority**	**Refer to Section**
Pests, weeds and disease			
Weed control: • Continue strategic control of weeds around lagoon • Monitor for and remove any infestations of Sea Spurge. • Replant native groundcovers if necessary after weed control	NRM North, DPIW, PWS, community	$1 #2 #3	5.1
Test samples from Winifred Curtis Scamander Reserve for phytophthora, and assist Trust with containment of infections in the Reserve, if required.	Board of WCSR, community, DPIW		5.1
Training in identification of phytophthora symptoms, then report any symptoms of disease to Tim Rudman, DPIW.	DPIW, community		5.1, 5.14, 6
Monitor feral seastars and greencrabs and liaise with CSIRO.	Community, CSIRO		5.1, 6
Hydrology			
Set up community monitoring of water levels, with data recorded regularly and published on website	HLMSG, community, BOD NRM	$2 #2	5.2, 6
Progress towards finalisation of Barway Protocol, with ongoing review and informing of community.	Barway Protocol steering group	#1	5.2
Scientific monitoring of water inflow, water levels and groundwater.	DPIW		5.2
Discussions with relevant authorities regarding dam approvals.	Community, ACDC, DPIW		5.2
Water quality			
Regular community water quality monitoring for baseline data	HLMSG, community, BOD NRM	$6	5.3, 6
Stormwater treatment in urban areas (with sediment and nutrient filters maintained) and Water Sensitive Urban Design in new developments	BODC	#2	5.3, 5.6
Work with landholders to fence lagoon edges, creeklines and wildlife hotspots (e.g. Glencoe wetland) to prevent stock access and form filter strips, and to re-establish habitat corridors. Revegetate where necessary	Landholders, community, BOD NRM	#1, #3, $1, #2	5.3, 5.4, 5.5, 5.7, 6
Approach government, research organisations and regional bodies to conduct regular scientific monitoring of water quality, ecology, hydrology, etc.	HLMSG, CSIRO, TAFI, DPIW etc		5.2, 5.3, 6
Analysis of pesticides and key water quality indicators (e.g. nutrients in the water column, pathogens, chlorophyll-a) in water and sediment.	HLMSG, BOD NRM, funding bodies, scientists	$4 #2	5.3

Wildlife			
Monitor wildlife numbers (e.g. shorebirds, waterbirds), observe nests, and contribute data to February Waterbird Count and Birds Tasmania	Community, DPIW, Birds Tasmania	#2	5.4
Run "Dogs Breakfast" activities for education on shorebirds. Liaise with Birds Tasmania over any confirmed nest sites.	Community, BOD NRM, Birds Tasmania		5.4
Monitor wildlife deaths at "blackspots" such as Tasman Hwy and Falmouth Rd powerlines. Liaise with authorities to alter infrastructure if necessary. Erect signs along the Tasman Hwy.	Community, DIER		5.4
Consider cat and dog control program (such as soon to be trialled in Weymouth and Bellingham areas).	HLMSG,		5.1, 5.4
Loss and degradation of native vegetation			
Lobby authorities for greater protection of vegetation in catchment, especially the native vegetation "corridor" northwest of the lagoon. E.g. Strengthen land clearing restrictions in planning scheme, including bans on subdivisions in bushland (to avoid fire hazard and associated clearing).	Community, HLMSG,	#1, #1	5.4, 5.5, 5.6
Encourage vegetation protection and restoration activities with community workshops, funding programs for fencing, encouragement for conservation covenants, etc.	HLMSG, BOD NRM	#1	5.5, 5.6, 5.7, 5.14.
Revegetate gaps in coastal scrub along Falmouth foreshore, to improve habitat connectivity.	PWS, HLMSG, community, Understorey Network		5.5, 5.4
Use local natives for revegetation or landscaping of public areas, especially adjacent to existing native vegetation or to create wildlife "stepping stones".	BODC		5.4, 5.5
Encourage the use of local native plants where possible for gardens (bearing in mind principles for fire retardant gardens).	Community, HLMSG,		5.5
Survey aquatic vegetation, e.g. seagrass beds	Community, CSIRO, TAFI		5.5, 6
Fire management			
Develop/promote guidelines to minimise impacts (e.g. erosion, excessive damage to vegetation) from fire hazard management.	TFS, PWS, DPIW, community		5.5, 5.6
Future building and development should plan fire buffer zones and other measures within the boundary of private land, that also aim to minimize clearance of native vegetation.	BOD Council, TFS		5.5, 5.6
Land-use impacts			
Further detailed mapping of whole catchment (land tenure, hydrology, roads, land-use, vegetation, natural values).	HLMSG, State Gov't	4 #3	5.7
Develop a detailed assessment of risks to the lagoon (e.g. fire, salinity, spraydrift, fertiliser, potential acid-sulphate soils, sewerage, stormwater).	HLMSG, State Gov't	$5	5.7
Break O'Day Council to recognise this Environmental Management Plan.	BOD Council	$2 #2	5.7
Clarify on-ground boundaries of Scamander Conservation Area and Four Mile Creek Conservation Area if necessary.	HLMSG, PWS, surveyors		5.7
Acid sulphate soils			
Identify any acid sulphate soils in the area. (A simple analysis can be done with test pits and hydrogen peroxide – contact Rob Moreton for advice).	Community, DPIW, BOD NRM		5.8
Monitor pH (acidity) in the lagoon and waterways.	Community,		5.8, 5.3

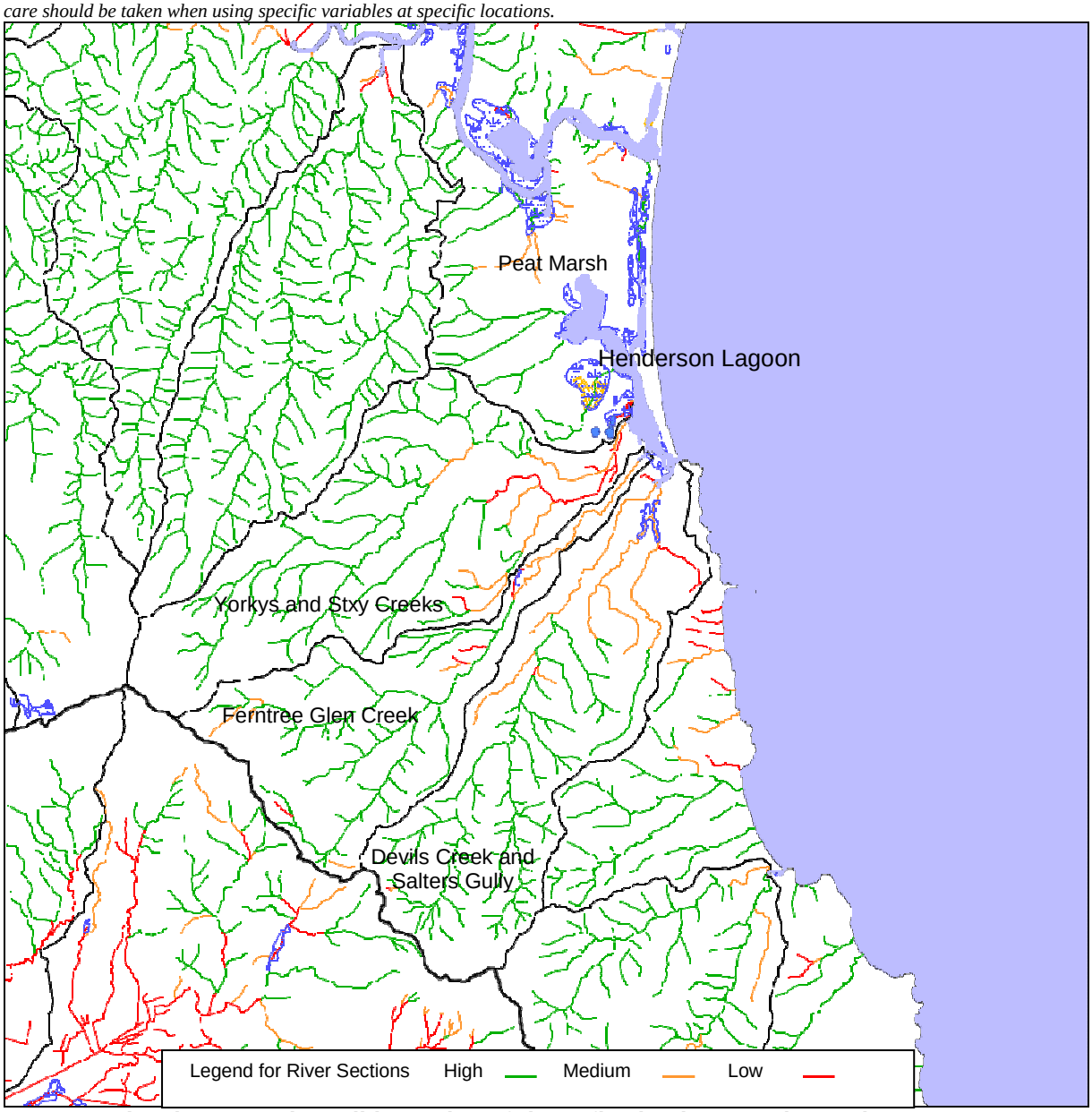
	BOD NRM		
Any significant excavation or drainage works in potential acid sulphate soils should be done with caution and in consultation with relevant authorities.	All landholders		5.8
Access			
Build soft-surface and/or natural stonework paths and steps from parking area to beach.	HLMSG, community, PWS	$1 #3	5.10
Rehabilitate eroded informal tracks back to natural state.	HLMSG, PWS, community	$1 #1	5.10, 5.5
Make esplanade continuously accessible to public (ie construct path where necessary).	HLMSG, community, PWS	#1	5.10
Maintain existing headland and other paths, with consideration for public safety and protection of heritage and aesthetic values.	HLMSG, PWS community,		5.10
Create seating and table under shady tree, viewing lagoon.	HLMSG, community, BOD Council		5.10
Heritage values			
Develop a statement of landscape character and implement through Break O'Day planning policy	BOD Council	$1 #3	5.12
Detailed map of heritage sites (if appropriate)	HLMSG, History Room, AHT	#4	5.12
Refer to the Aboriginal Heritage Survey and Report for this area (Graham, 2009), and contact Aboriginal Heritage Tasmania before conducting any works (including weed removal), to ensure known heritage sites are avoided.	All		5.12
Any working party identifying Aboriginal cultural heritage material, such as shells or shell fragments, or rock material such as chert, cherty-hornfels, quarts & quartzite, should cease works and liaise with the office of AHT	All		5.12
Litter and greenwaste dumping			
Council waste management: • Remove council fee for greenwaste • Establish recycling service • Monthly greenwaste collection service	BOD Council	$ #7	5.13
Sustainable living workshop	HLMSG, community	#1	5.13, 5.14
Community cleanup of litter	Community, BODC	$1#2	5.13
Improving information and awareness			
Education including: • Provide environmental weeds pamphlet and EMP to all residents and include in new residents' kit issued by BOD Council #2, #3 • Workshops/ nature walks (bird walks, rockpool rambles, native plant identification, weeds identification and control, shorebird issues, etc) #2 • Illustrated booklet to aid identification of native species #1 • Install interpretive signs (flora, fauna, land-use, culture, history, etc) at access points (Falmouth access tracks, NW boat access, near wetlands, near Peat Marsh, etc) $1 #2 • Articles in newspapers and local newsletters • Field days for identification of native plants (for retention) vs weeds (for removal), and to promote awareness of invasive garden plants to avoid.	HLMSG, community, BODC, PWS, BOD NRM, NRM North, TFS	$3 #7,	5.14, 5.1, 5.3, 5.4, 5.6, 6

• Weeds working bee/field day for a combined education-"hands on" action approach to weed control • Conduct workshops for learning monitoring techniques (e.g. weeds, water quality, invertebrate and birds) • Distribute pamphlet on how not to spread phytophthora in soil • Workshop on how to reduce impacts on water quality • Programs involving PWS and TFS in to improve biodiversity protection with fire hazard reduction practices.			
Review effectiveness of EMP and update as required	HLMSG	$2 #1	6

Appendix 9 Natural condition rating of rivers in catchment

Base data by CFEV, © State of Tasmania (2005). Rivers, estuaries and waterbodies - base data by the LIST, © State of Tasmania

CFEV data uses a variety of data sources as input and that some of these are modelled and are not ground-truthed. As a result care should be taken when using specific variables at specific locations.



Map showing natural condition rating of rivers flowing into Henderson lagoon

Table 4. Natural condition rating of rivers that flow into Henderson Lagoon.

Sub-Catchment	Rating	Description	% of Total
Peat Marsh	High	In near natural condition	75.79
	Med	Significantly altered from natural condition	20.38
	Low	Severely altered from natural condition	3.83
Yorkys and Styx Creeks	High	In near natural condition	78.52
	Med	Significantly altered from natural condition	13.21
	Low	Severely altered from natural condition	8.27
Ferntree Glen Creek	High	In near natural condition	78.57
	Med	Significantly altered from natural condition	16.73
	Low	Severely altered from natural condition	4.7
Devils Creek and Salters Gully	High	In near natural condition	72.88
	Med	Significantly altered from natural condition	23.98
	Low	Severely altered from natural condition	3.14

Appendix10. Some useful resources

Parks and Wildlife Service, District Office, St Helens. Ph: 6376 1550

Break O'Day NRM, St Helens. Ph: 6376 7900

NRM North (Natural Resource Management in Northern Tasmania). Ph: 6333 7777. Email: admin@nrmnorth.org.au

St Helen's History Room. Ph: 6376 1744

Aboriginal Heritage Tasmania (AHT). Ph: 6233 6613

Project Officer, Coastal and Marine Branch, Department of Environment, Parks, Heritage and the Arts. Ph: 6233 3947. Email: Coastal.Enquiries@environment.tas.gov.au

General books:
Community Coastcare Handbook – caring for the coast in Tasmania, by Veronica Thorp (2003). Tasmanian Environment Centre, Hobart. Heaps of information on all coastal topics.

Biogeography of Northeast Tasmania – Records of the Queen Victoria Museum Launceston 103 (1996). Studies of flora, fauna, vegetation, soils etc in this area.

Some useful identification resources:

A Guide to Flowers and Plants of Tasmania. By Launceston Field Naturalist Club. Published by Reed Books, Chatswood NSW (about $25 at most bookshops). New edition recently released!!

Tasmania's Natural Flora, by J. Whiting et al, 2004. ($70 many bookshops, or PO Box194, Ulverstone, 7315). Identification of heaps of plants, and cultivation hints.

The Orchids of Tasmania, 1999, By David Jones, Hans Wapstra, Peter Tonelli, Stephen Harris. Published by Melbourne University Press (about $70).

Natural History and Calls of Tasmanian Frogs. CD or tape, by Central North Field Naturalists. sarahlloyd@iprimus.com.au. Or try environment centres, museum shops, good bookshops.

Tasmanian Mammals – a field guide. By Dave Watts

Snakes and Lizards of Tasmania. By Hutchinson and others.

Some useful propagation references include:

Growing Australian Native Plants from Seed - for revegetation, tree planting and direct seeding. By Murray Ralph, 1997. Published by Bushland Horticulture, ph (03) 9517 6773. Very useful, comprehensive but simple propagation info.

Understorey Network database for propagation and seed collection info: www.understorey-network.org.au

Some useful weed references include:

NRM North Weeds Coordinator – ph: 6333 7778

DPIW Weeds Officer – ph: 6336 5429

DPIW Weeds site
For comprehensive weed control information sheets, declared weeds etc:

www.dpiw.tas.gov.au/inter.nsf/ThemeNodes/LBUN-5MC2R8?open

Various pamphlets, usually available from council or Natural Resource Management/Landcare organisations. E.g. Coastal Weeds of Tasmania.

Northern Regional Weed Management Action Plan, available from NRM North (www.nrmtas.org/regions/north/regionalStrategy.shtml)

Bush Invaders of SE Australia. By Adam Muyt, 2001. Publ. R.G. & F.J. Richardson, Meredith. (About $65, but worth it – includes control methods)

Environmental Weeds – A field guide for SE Australia. By Kate Blood, CRC Weed Management Systems, 2001. Publ. CH Jerram & Assoc., Mt Waverley.

Phytophthora rootrot

Pamphlet available from DPIW:
Are you killing Tasmania's plants?

Phytophthora rootrot advice - Tim Rudman, Senior Scientist, Department of Primary Industries & Water. Ph: 6233 3912. Email: Tim.Rudman@dpiw.tas.gov.au

Water quality monitoring
Tasmanian Aquaculture and Fisheries Institute, University of Tasmania (ph: 6227 7277). Christine Crawford – estuarine dynamics and monitoring (Christine.crawford@utas.edu.au)

Community Water Quality Monitoring Team Leader – Debbie Searle (ph: 6352 6536; dsearle@dorset.tas.gov.au).

Wildlife

Local member of Birds Tasmania – Liz Znidersic, St Helens (ph: 0409 123 322).

Consultant ornithologist – Sarah Lloyd (sarahlloyd@iprimus.com.au)

Birds Tasmania - GPO Box 68, Hobart TAS 7001 (Convenor Eric Woehler, email: eric_woe@iprimus.com.au)

Centre for Research on Introduced Marine Pests (CRIMP), CSIRO, Hobart (ph: 6232 5222).

Waterbirds and wetlands – Stewart Blackhall, Wildlife Biologist, Department of Primary Industries & Water. Email: Stewart.Blackhall@dpiw.tas.gov.au

Acid sulphate soils advice

Rob Moreton, Land Resource Assessment Officer, Department of Primary Industries & Water. Ph: 6336 5441. Email: Rob.Moreton@dpiw.tas.gov.au