

FINAL REPORT:

Lake Connewarre Values Project: IWC and Habitat Hectare Assessments, Bellarine Peninsula, Victoria

ON BEHALF OF:

Corangamite Catchment Management Authority

April 2008



Ecology Partners Pty Ltd

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Cover Photo: Remnant vegetation within the study area. (photos by Ecology Partners Pty. Ltd.)

The following Ecology Partners Pty. Ltd. employees either undertook the field assessments and/or contributed to the preparation of the final report: Andrew Hill and Luke Hynes.

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EXECUTIVE SUMMARY

Introduction

Ecology Partners Pty. Ltd. was commissioned by the Corangamite Catchment Management Authority to undertake aquatic and terrestrial vegetation assessments within the Lake Connearre Complex (LCC), utilising the two assessment techniques known as the 'Index of Wetland Condition' (IWC) and the 'Habitat Hectare' (HH) methodology, respectively.

Twenty-six assessments consisting of a combination of 13 terrestrial and 13 aquatic assessments were undertaken around the Lake Connearre Complex (LCC) which includes Reedy Lake, Hospital and Salt Swamps and the lower Barwon River. The assessment locations are broadly correlated with microscopic fauna survey sites which are being conducted by Deakin University.

Methods

Field assessments were undertaken in July 2007, to obtain the dominant flora species present, and to complete standard IWC and HH field assessment sheets at each site. An area of 1600 metres squared was assessed at each site. Quadrats were 40 metres by 40 metres for IWC and HH assessments where possible, varying quadrat lengths to accommodate for linear strips of vegetation less than 40 metres wide. Dominant flora species were recorded and the overall condition of vegetation noted. The general extent of the vegetation in the local area was also noted.

Ecological Vegetation Classes (EVCs) within the study sites were determined by reference to DSE pre-1750, extant EVC mapping (www.dse.vic.gov.au), Oates and Taranto (2001) and CVRFASC 2000.

Results

Vegetation within the assessed quadrats is considered to be of poor to good condition. Large areas of relatively intact vegetation were observed to the south of Lake Connearre, Reedy Lake, and the lower Barwon. Generally, low levels of cover for introduced species and moderate levels of indigenous species diversity were observed across quadrats for both IWC and HH assessments.

Large portions of land adjacent to the LCC are currently grazed with high density residential areas in Barwon Heads. Low to moderate density residential areas exist on the northern boundary of the LCC.

Conclusion

The present assessments reveal that large areas within the LCC comprise remnant indigenous vegetation suggesting that important ecological processes are still present. However, clearing, high nutrient runoff, continued hydrological disturbance, increased recreational use, sedimentation and urbanisation are some of the continuing threats to the integrity of the indigenous vegetation within the LCC that need to be monitored and mitigated against.

1 INTRODUCTION

1.1 Background

Ecology Partners Pty. Ltd. was commissioned by the Corangamite Catchment Management Authority to undertake aquatic and terrestrial vegetation assessments within the Lake Connewarre Complex (LCC), utilising the two assessment techniques known as the ‘Index of Wetland Condition’ (IWC) and the ‘Habitat Hectare’ (HH) methodology, respectively.

Twenty-six assessments consisting of a combination of 13 terrestrial and 13 aquatic assessments were undertaken from around the Lake Connewarre Complex (LCC) which includes Reedy Lake, Hospital and Salt Swamps and the lower Barwon River. The assessment locations are broadly correlated with microscopic fauna survey sites which are being conducted by Deakin University.

1.2 Scope of Assessment

The following tasks were undertaken in the course of the assessments:

- Thirteen locations were selected, based on existing Ecological Vegetation Class (EVC) mapping from the Department of Sustainability and Environment (DSE), and spread around the LCC, in order to assess mapped EVCs;
- At each location (40 m x 40 m, where appropriate), a habitat hectare assessment within an appropriate terrestrial environment was undertaken, completing the field assessment sheet, and in a nearby aquatic environment an IWC assessment (with completion of the field assessment sheet);
- MGA co-ordinates of each corner of each sample site were recorded;
- A map was created indicating locations of all the IWC and habitat hectare assessment sites;
- The general condition of each site was noted, including dominant species and any other relevant ecological value;
- One photo-point photo of each site with a GPS location was provided;
- The general condition of the aquatic and terrestrial environs assessed through the site assessment process was briefly discussed; and,
- Liaisons with Deakin University and any other key stakeholders (e.g. DSE, Parks Victoria, local government), were undertaken as required.

1.3 Study Area

The study area is located on the Bellarine Peninsula, approximately 80 kilometres south west of Melbourne comprising an extensive estuarine and saltmarsh system drained by the Barwon River. It includes a large permanent freshwater lake, a deep freshwater marsh, several semi-permanent saline wetlands and an estuary. The LCC is a high value wetland for its ecological, recreational and scientific features and is the largest area of native vegetation remaining on the Bellarine Peninsula. It incorporates the lower Barwon River, Reedy Lake, Hospital Swamp and Lake Connewarre. The study area and site locations are provided in Figure 1.

The LCC is acknowledged as an important refuge for bird species, listed as part of the *Port Phillip Bay (Western Shoreline) and Bellarine Peninsula* Ramsar site (Department of the Environment and Water Resources [DEW] website). It is also given a National level of importance in the *Directory of Important Wetlands in Australia* as it comprises diverse vegetation and flora species with 45 of the 53 salt marsh species, which occur in Victoria, previously recorded within the study area, and a diverse avifauna (DEW website). In addition, Lake Connewarre has the western-most occurrence in Victoria of the White Mangrove *Avicennia marina* ssp. *australasica*.

The LCC is managed by Parks Victoria and falls within the City of Greater Geelong and Corangamite Catchment Management Authority management boundaries. It is listed as a State Wildlife Reserve, classified in parts as State Game Reserve and in parts as Nature Conservation Reserve, with some margins under private ownership. The Reserve has a variety of social and ecological uses such as nature conservation, fishing, duck hunting, windsurfing, boating and education. Surrounding areas are used for grazing, residential and camping purposes with an airfield adjoining the south western corner.

According to DSE's Biodiversity Interactive Map (www.dse.vic.gov.au) the study area is within the Otway Plain Bioregion, with the southwestern border of the LCC adjacent to the Victorian Volcanic Plain Bioregion. The Otway Plain Bioregion extends from the southern suburbs of Geelong to Warrnambool in the west and includes the Bellarine Peninsula.

2 METHODS

2.1 Nomenclature

Common and scientific names of vascular plants follow the Flora Information System (FIS 2005 version of the Department of Sustainability and Environment - DSE) and the Census of Vascular Plants of Victoria (Walsh and Stajsic 2007). Vegetation community names follow the DSE Ecological Vegetation Classes (EVC) Benchmarks (www.dse.vic.gov.au).

2.2 Literature Review

Information from the EVC Benchmarks for the study area and other relevant literature such as Yugovic (1985), CVRFASC 2000, DEW website and Oates and Taranto (2001) were reviewed.

2.3 Vegetation Assessment

Field assessments were undertaken in July 2007, to obtain the dominant flora species present, and to complete standard IWC and HH field assessment sheets at each site. An area of 1600 metres squared was assessed at each site. Quadrats were 40 metres by 40 metres for IWC and HH assessments where possible, with varying quadrat lengths to accommodate linear strips of vegetation less than 40 metres wide. Dominant flora species were recorded and the overall condition of vegetation noted. The general extent of the vegetation in the local area was also noted.

Modelled original (pre European) EVCs within the study sites were determined by reference to DSE pre-1750, extant EVC mapping (www.dse.vic.gov.au), Oates and Taranto (2001) and CVRFASC 2000.

2.3.1 *Index of Wetland Condition (IWC) Assessment*

Wetland vegetation within the study sites was assessed according to the Index of Wetland Condition – Assessment of Vegetation methodology (DSE 2006b) and scored against the Department of Sustainability and Environment’s wetland vegetation benchmarks. An example of an IWC and Habitat Hectare EVC benchmark is attached as Appendix 5.

The current published wetland vegetation assessment component of the IWC methodology utilises a similar approach to the habitat hectare methodology, but with the exception of the ‘lack of weeds’, different attributes were required. The wetland vegetation score is calculated using four components: critical life form groupings, lack of weeds, indicators of altered processes, and vegetation structure and health (DSE 2006b). Each component is listed on the Vegetation Quality Field Assessment Sheet (DSE Website).

2.3.2 *Habitat Hectares (HH) Assessment*

Terrestrial vegetation within the study sites was assessed according to the Habitat Hectare methodology (DSE 2004, Parkes *et al.* 2003, DSE website) and scored against the Department of Sustainability and Environment's terrestrial vegetation benchmarks.

The habitat hectare is a unit of measurement, which combines both quality (relative to a published Benchmark) and quantity (EVC type) for a habitat zone. Habitat hectare assessments are only undertaken in areas of vegetation which are considered 'remnant patches', this is where the canopy layer is intact (i.e. consistent with EVC benchmark cover) and/or where the total *vegetative* understorey cover comprises at least 25% indigenous understorey cover, or where the cover of canopy species is greater than 20% (DSE 2006a). Scattered indigenous trees are also considered under the habitat hectare method comprising of canopy species and are defined as areas where the canopy cover is less than 20% or where the weed cover in the understorey, as a proportion of the total *vegetative* understorey cover, is equal to or greater than 75%. However, the value of scattered trees was not considered as part of this assessment.

The habitat score is calculated using ten components: large trees, tree canopy cover (canopy health), understorey diversity, weediness, recruitment, organic litter, logs, patch size, neighbourhood context and distance to core area. Each component is listed on the Vegetation Quality Field Assessment Sheet (DSE Website). An assessor then scores the site according to the conditions and landscape context, with some sites standardised, where for instance large trees are not present on the respective benchmark, in the case of native grasslands for instance.

It is assumed that extensive intact vegetation would have a theoretical habitat score of 100, but typically the scores vary between 10 and 90. The habitat scores are usually expressed on a scale of zero to 1, i.e. a habitat hectare point score of 67 would be typically expressed as 0.67.

2.4 Assessment Qualifications and Limitations

The survey was undertaken during a sub-optimal season for flora surveys (end of winter), which meant that many annual, and spring growing and flowering plant species would have been undetectable, dormant, and/or were not identifiable to species level. This may lead to artificially reduced habitat hectare and IWC scores in some cases.

The IWC has been designed for naturally-occurring wetlands without a marine hydrological influence and as such not all marine wetland communities have prescribed benchmarks. In these situations best fit wetland EVCs were utilised. In addition, much of the land adjacent to the LCC is highly modified with little indigenous remnant terrestrial vegetation. Where habitat hectare assessments were not able to be undertaken in a truly terrestrial environment, quadrats were located within wetland vegetation communities which have a prescribed vegetation quality assessment benchmark.

Notwithstanding the above, data collected during the field surveys, and information obtained from relevant sources (e.g. biological databases and relevant literature) were reviewed and considered sufficient to provide accurate habitat hectare and Index of Wetland Condition

assessments. The IWC assessment methodology is considered the most appropriate measure of these types of aquatic systems as it has been developed methodically by the Arthur Rylah Institute with co-operation from leading wetland ecologists, given statewide support and is the best measure of aquatic ecosystems currently available.

3 RESULTS

Vegetation within the assessed quadrats is considered to be of poor to good condition. Large areas of relatively intact vegetation were observed within Reedy Lake and surrounds, at the southern side of Lake Connewarre and the lower Barwon. Generally, low levels of cover for introduced species and moderate levels of indigenous species diversity were observed across quadrats for both IWC and HH assessments. Large portions of land adjacent to the LCC are currently grazed with high density residential areas in Barwon Heads. Low to moderate density residential areas exist on the northern boundary of the LCC.

The literature review and site assessment indicates that the site would have originally supported a variety of wetland and terrestrial EVCs from the Otway Plain bioregion. This is consistent with the extant DSE vegetation mapping for the region. A number of wetland and terrestrial EVCs were observed within quadrats during the IWC and HH assessments as listed below in Table 1.

Table 1. EVCs and their bioregional conservation status recorded within assessed quadrats.

EVC (number)	Bioregional Conservation Status
IWC EVCs	
Saltmarsh (888)	Endangered
Brackish Sedgeland (13)	Vulnerable
Brackish Grassland (934)	Endangered
Tall Marsh (821)	Endangered
Brackish Lignum Swamp (947)	Endangered
Floodplain Riparian Woodland (56)	Endangered
HH EVCs	
Mangrove Shrubland (140)	Vulnerable
Coastal Alkaline Scrub (858)	Endangered
Coastal Saltmarsh (9)	Endangered
Cane Grass- Lignum Halophytic Herbland (898)	Vulnerable
Brackish Wetland (656)	Endangered
Plains Brackish Sedge Wetland (891)	Vulnerable
Floodplain Riparian Woodland (56)	Endangered

3.1 Index of Wetland Condition Assessments

The IWC assessments resulted in a variety of scores for the assessed quadrats between 0.45 to 1. The highest scoring sites were sites 1 and 3 which comprised diverse remnants of Saltmarsh vegetation with no introduced species observed. The lowest scoring sites were Sites 6, 11 and 12 which comprised modified examples of Saltmarsh, Tall Marsh and

Floodplain Riparian Woodland vegetation. A brief discussion on each of the sub-indices used in the assessment is provided below.

Critical Life form Groupings

Both the IWC and Habitat Hectare assessment methodologies rely on the identification of Critical Life Forms in relation to the associated EVC benchmark. These life forms include categories such as; trees, shrubs, herbs, graminoides, sedges and monocots and then each of these categories is further divided into composite groups such as large trees, immature canopy trees, etc. EVC benchmarks provide details of the anticipated number of species for each life form which would be expected in a largely undisturbed vegetation community.

Only two assessed sites, Sites 1 and 3, contained vegetation with all critical life forms present in an unmodified condition. The remainder of the sites contained varying levels of critical life forms some of which were considered substantially modified. Several sites, Sites 9, 11 and 12, contained less than 50 % of the critical life forms present for the assessed EVC and at Site 7 all critical life form groupings were considered effectively absent.

Weeds

Weed cover was generally low across all sites, receiving scores between 12 and 25. The highest possible score, that is less than 5% cover of weeds was observed with no high threat weeds present, was recorded at six sites. The remainder of the sites generally contained low cover levels of introduced herbaceous and grass species such as Soursob *Oxalis pes-caprae*, Rye Grass *Lolium* spp., Clover *Trifolium* spp., Tall Wheatgrass *Lophopyrum ponticum*, Ox – tongue *Helminthotheca echioides*, Dock *Rumex* spp., Vetch *Vicia sativa*, Buck’s-horn Plantain *Plantago coronopus*, Cleavers *Galium aparine*, Wild Oats *Avena fatua*, Panic Veldt-grass *Ehrharta erecta*, Barley Grass *Hordeum* spp. and Rough Sow-thistle *Sonchus asper*. Two sites, Sites 11 and 12 were observed with 5 to 25 % cover of Toowoomba Canary-grass *Phalaris aquatica*.

Those weed species observed during site assessments which are likely to constitute the highest threat to ecological health are Tall Wheat Grass, Phalaris and Box Thorn *Lycium ferrocissum*. Other high threat weed species which have been recorded within the Lake Connemare Complex, but not necessarily encountered during this investigation include; Serrated Tussock *Nassella trichotoma* and Spartina *Spartina anglica*.

Indicators of Altered Processes

No indicators of altered ecological processes were detected during the current assessments other than when less than 50% of the critical life forms were represented. While some areas of the complex may have some altered ecological processes, quadrats assessed did not display altered processes as described in the relevant benchmarks.

Vegetation Structure and Health

The majority of sites assessed contained the benchmark cover of structural dominants and at least 30 % of the structural dominants were healthy. However, high levels (less than 30%) of structural dominant species were observed to be healthy at Sites 10 and 13. In addition, while structurally dominant species were observed to be of good health at Site 8 this quadrat was recorded as having less than 50% of the structural dominant species benchmark cover.

3.2 Habitat Hectare Assessments

The HH assessments resulted in a variety of habitat scores for the assessed quadrats of between 0.36 to 0.88. The highest scoring sites were sites 1 and 3 which comprised intact remnants of Coastal Saltmarsh and Mangrove Shrubland vegetation with no introduced species observed and adequate levels of recruitment. The lowest scoring sites were Sites 5, 8 and 12 which all scored below 0.5 and comprised modified examples of Plains Brackish Sedge Wetland, Coastal Alkaline Scrub and Floodplain Riparian Woodland vegetation. A brief discussion on each of the sub-indices used in the assessment is provided below.

Large Old Trees

This assessment component was only relevant for Site 12 where the quadrat was assessed using the EVC Floodplain Riparian Woodland. No large old trees were detected within the quadrat at this site. Large old trees were absent from all other EVC benchmarks used for the HH assessments, i.e. large old trees were not anticipated as a component of those vegetation communities.

Canopy Cover

Only three sites, Sites 2, 8 and 12, contained vegetation of the EVCs Coastal Alkaline Scrub and Floodplain Riparian Woodland, which prescribe a benchmark for this component. Vegetation within quadrats at Sites 8 and 12 was observed to have the benchmark canopy cover and of greater than 70% canopy health. Vegetation within the quadrat at site 2 was observed to be of the benchmark canopy cover however only between 30 and 70 % of the canopy was considered to be healthy.

Understorey

Understorey scores were wide ranging across sites, varying from 5 to 25. At only two sites, Sites 1 and 3, was vegetation within assessed quadrats observed to contain greater than 90% of the benchmark life forms, none of which were considered to be substantially modified. Low scores were recorded at Sites 5, 12 and 13 where less than 50% of the benchmark life forms were observed within assessed quadrats.

Lack of Weeds

The majority of assessed quadrats contained low levels of cover for introduced species with seven sites, Sites 1, 3, 4, 5, 6, 7 and 13, observed with less than 5% cover of introduced species. Some of the cover of introduced species comprised 'high threat' weeds including Phalaris, Boxthorn and Buck's Horn Plantain *Plantago coronopus*. Assessed quadrats at two sites, Sites 2 and 11 were observed with between 25 and 50 % cover of introduced species and one site, Site 8 was observed with greater than 50% cover of introduced species. Introduced species observed within HH quadrats include: Rats Tail-grass *Sporobolus africanus*, Buffalo Grass *Stenotaphrum secundatum*, Cocksfoot *Dactylis glomerata*, Soursob *Oxalis pes-caprae*, Bridal Creeper *Asparagus asparagoides*, Ribwort *Plantago lanceolata*, Ox – tongue *Helminthotheca echioides*, Rye Grass *Lolium* spp., Clover *Trifolium* spp., Tall Wheatgrass *Lophopyrum ponticum*, Rough Sow-thistle *Sonchus asper*, Toowoomba Canary-grass *Phalaris aquatica*, Panic Veldt-grass *Ehrharta erecta*, Wild Oats *Avena fatua*, Tall Wheat-grass *Lophopyrum ponticum*, Spear Thistle *Cirsium vulgare*, Smooth Cat's-ear *Hypochoeris glabra*, Barley Grass *Hordeum* spp and Onion Grass *Romulea rosea*

Recruitment

High levels of recruitment were observed in the majority of assessed quadrats with nine sites, Sites 1, 2, 3, 4, 6, 7, 9, 11 and 13, observed with adequate recruitment for greater than 70% of indigenous woody species present. These nine sites were also recorded as displaying a high diversity of woody species present. .

Organic Matter

Seven assessed quadrats were recorded with the benchmark cover of indigenous organic litter. Remaining quadrats were variable in observed cover levels of organic litter and the proportion of indigenous organic matter. Three assessed quadrats, Sites 2, 8 and 13 were observed to be dominated by non-native organic litter

Logs

This assessment component was relevant for three sites only, Sites 2, 8 and 12. Assessed EVCs with benchmarks for log length included Coastal Alkaline Scrub (Sites 2 and 8) and Floodplain Riparian Woodland (Site 12). All quadrats assessed for log length were observed to have the benchmark log length however no large logs were recorded.

Landscape Context

Patch size and Distance to core area were assessed as being the same across all sites as all sites were considered to be contiguous, forming a 'significantly disturbed' core area, patch size of greater than 50 hectares.

Neighborhood scores were variable across the sites with some sites surrounded by relatively intact indigenous vegetation and some sites by highly modified grazing and residential areas.

The general condition of each assessed site, noting dominant species and any other relevant ecological features, are documented on the following pages. GPS co-ordinates of the corners of each site are listed in Appendix 2 along with the co-ordinates of photo points for each quadrat. Summaries of IWC and Habitat Hectares scores are listed in Appendix 3 and 4, respectively.

Site 1: Ocean Grove Golf Club

Site 1 is located within the Ocean Grove Golf Club on the Barwon River in Ocean Grove. The course adjoins the indigenous wetland vegetation and a small drainage line that runs through the golf course enters the Barwon River immediately to the north of the quadrats. Intact indigenous vegetation extends to the north of the quadrats forming a band approximately 60 metres wide between the water line and the Ocean Grove Golf Course. A concrete boat ramp and small pier are located approximately 50 metres to the south of the quadrats.

Index of Wetland Condition

EVC: Saltmarsh (EVC 888)

Quadrat Size: 40m x 40m

Vegetation within this quadrat comprises a relatively intact example of good condition Saltmarsh wetland EVC. Numerous indigenous species were observed within the quadrat such as: Shrubby Glasswort *Sclerostegia arbuscula*, Beaded Glasswort *Sarcocornia quinqueflora*, Chaffy Saw-sedge *Gahnia filum*, Austral Seablite *Suaeda australis*, Creeping Brookweed *Samolus repens*, Australian Salt Grass *Distichlis distichophylla* and the state significant Marsh Saltbush *Atriplex paludosa* subsp. *paludosa*. No introduced species were noted within the quadrat. This community extended to the north of the quadrat.



Plate 1: Photo point of Site 1 IWC assessment quadrat

Habitat Hectares

EVC: Mangrove Shrubland (EVC 140)

Quadrat Size: 80m x 20m

As there is no IWC benchmark for Mangrove Communities this area was assessed under the Habitat Hectare methodology and was considered to be of good condition. As per the EVC benchmark description the vegetation comprises an overstorey of White Mangrove *Avicennia marina* ssp. *australasica* with a sparse understorey cover of Dwarf Grass-wrack *Zostera muelleri*. No introduced species were recorded within the quadrat. This vegetation formed a band against the waters edge. Due to the linear nature of the vegetation the quadrat was marked out as an oblong shape.



Plate 2: Photo point of Site 1 HH assessment quadrat

Site 2: Sheepwash Road

Site 2 is located at the northern end of Sheepwash Road, Barwon heads adjacent to the Barwon River. This area is often used by recreational fisherman and has a car park and walking tracks alongside the river. Residential housing is located to the south of the site and grazing pasture to the east. Indigenous vegetation in this area forms a linear strip gradually widening to the north before reaching larger open expanses of wetlands. To the south intact indigenous vegetation is patchy, forming scattered patches of vegetation of poor condition.

Index of Wetland Condition

EVC: Saltmarsh (EVC 888)

Quadrat Size: 40m x 40m

This quadrat comprises indigenous vegetation of good condition, dominated by Beaded Glasswort *Sarcocornia quinqueflora* and Rushes *Juncus* spp. with scattered White Mangrove, Austral Seablite, Chaffy Saw-sedge, Streaked Arrowgrass *Triglochin striatum*, and Creeping Brookweed *Samolus repens*. No introduced species were noted within the quadrat however there was evidence of a small amount of human traffic (less than five percent cover). While only a small patch of saltmarsh vegetation was observed at the quadrat location extensive areas of saltmarsh could be seen extending to the north.



Plate 3: Photo point of Site 1 IWC assessment quadrat

Habitat Hectares

EVC: Coastal Alkaline Scrub (EVC 858)

Quadrat Size: 35m x 46m

This quadrat comprises a relatively intact example of Coastal Alkaline Scrub EVC of moderate condition. The overstorey is dominated by Moonah *Melaleuca lanceolata* with a shrub layer of various indigenous species such as Coastal Beard-heath *Leucopogon parviflorus*, Thyme Rice-flower *Pimelea serpyllifolia* subsp. *serpyllifolia* and Seaberry Saltbush *Rhagodia candolleana* subsp. *candolleana*. The groundcover comprises a mix of indigenous and introduced species. Indigenous species include Bower Spinach *Tetragonia implexicoma*, Australian Saltgrass, Wallaby Grass *Austrodanthonia* spp., Spreading Flax-lily *Dianella revoluta* var. *revoluta*, Coast Spear-grass *Austrostipa stipoides*, Swamp Crassula *Crassula helmsii* and Ruby Saltbush *Enchylaena tomentosa*. Introduced species include Rats Tail-grass *Sporobolus africanus*, Buffalo Grass *Stenotaphrum secundatum*, Cocksfoot *Dactylis glomerata*, Soursob *Oxalis pes-caprae* and Bridal Creeper *Asparagus asparagoides*. This EVC formed small linear patches along the edge of the saltmarsh communities.



Plate 4: Photo point of Site 2 HH assessment quadrat

Site 3: Koombahla Park Equestrian Centre

Site 3 is located to the southwest of the Koombahla Park Equestrian Centre, Wallington. Vegetation within this area of the wetland complex comprises Saltmarsh and scattered Mangroves along drainage lines. Land adjacent to the study site is modified grazing pasture. Some areas further west of the study site, within the wetland complex are also utilised for grazing purposes. As the area comprises only one vegetation type, both the IWC and HH method were applied to the same quadrat.

Index of Wetland Condition

Habitat Hectares

EVC: Saltmarsh (EVC 888)

EVC: Coastal Saltmarsh (EVC 9)

Quadrat Size: 40m x 40m

Vegetation within this quadrat comprises a relatively intact example of good condition Saltmarsh wetland EVC. The vegetative structure of the quadrat varies including areas of damp bare soil, puddles, open herbland and dense cover of shrubs and sedges. Vegetation included numerous indigenous species such as: Shrubby Glasswort *Sclerostegia arbuscula*, Beaded Glasswort *Sarcocornia quinqueflora*, Chaffy Saw-sedge *Gahnia filum*, Austral Seablite *Suaeda australis*, Swamp Mat *Selliera radicans*, Streaked Arrow Grass *Triglochin striatum* and Australian Salt Grass *Distichlis distichophylla*. No introduced species were noted within the quadrat. This vegetation community covers a large area of this part of the LCC, extending to the west, north and south.



Plate 5: Photo point of Site 3 IWC and HH assessment quadrat

Site 4: Belchers Road

Site 4 is located at the end of Belchers Road, Connewarre. Two EVCs were observed in this area, the majority comprising the wetland EVC Brackish Sedgeland (EVC 13) with some relatively small patches of the terrestrial EVC Coastal Saltmarsh (EVC 9). While the surrounding wetland area appeared to be relatively undisturbed, some vehicle tracks and two small mounds of disturbed soil were observed. Land adjacent to the wetland to the west and north is used for agricultural grazing.

Index of Wetland Condition

EVC: Brackish Sedgeland (EVC 13)

Quadrat Size: 40m x 40m

Vegetation within this quadrat contained relatively intact examples of low diversity Brackish Sedgeland of moderate condition. The vegetation is dominated by Chaffy Saw-sedge *Gahnia filum* with scattered understorey species Beaded Glasswort *Sarcocornia quinqueflora*, Shrubby Glasswort *Sclerostegia arbuscula* and Rounded Noon-flower *Disphyma crassifolium* subs. *Crassifolium*. No introduced species were detected within the quadrat. This vegetation community extended to the east of the quadrat site, covering a large area of the part of the LCC.



Plate 6: Photo point of Site 4 IWC assessment quadrat

Habitat Hectares

EVC: Coastal Saltmarsh (EVC 9)

Quadrat Size: 40m x 40m

Vegetation within this quadrat comprises a relatively intact example of moderate condition Coastal Saltmarsh wetland EVC with two small areas of disturbed soil that are dominated by introduced species. Areas of indigenous vegetation are relatively intact dominated by Shrubby Glasswort *Sclerostegia arbuscula* and Beaded Glasswort *Sarcocornia quinqueflora* with scattered Swamp Crassula *Crassula helmsii*, Rounded Noon-flower *Disphema crassifolium* subs. *Crassifolium* and Chaffy Saw-sedge *Gahnia filum*. Introduced species on soil mounds include Ribwort *Plantago lanceolata*, Ox – tongue *Helminthotheca echioides* and Cocksfoot *Dactylis glomerata*. This vegetation type forms a small pocket within the Brackish Sedgeland community that dominates the area.



Plate 7: Photo point of Site 4 HH assessment quadrat

Site 5: Bluestone Road

Site 5 is located to the northwest of the intersection of Bluestone Road and Lower Dundeed Road, Connewarre. Vegetation within this area of the wetland complex is generally species poor dominated by large swathes of Chaffy Saw-sedge *Gahnia filum* with scattered indigenous halophytic herbs. As the area comprised only one vegetation type, both the IWC and HH method were applied to the same quadrat with the assessments undertaken using the relevant wetland and terrestrial EVCs. During the time of survey this site contained low levels of water.

Index of Wetland Condition

Habitat Hectares

EVC: Brackish Sedgeland (EVC 13)

EVC: Plains Brackish Sedge Wetland (EVC 891)

Quadrat Size: 40 x 40

Vegetation within this quadrat is generally species poor dominated by Chaffy Saw-sedge *Gahnia filum* with scattered indigenous species Australian Salt Grass *Distichlis distichophylla*, Austral Seablite *Suaeda australis*, and Streaked Arrow Grass *Triglochin striatum*. The vegetation is considered to be of moderate condition with large amounts of indigenous Chaffy Saw-sedge organic litter observed. No introduced species were observed within the quadrat or surrounds. This vegetation type covered a large area of this part of the LCC extending to the east, west and north.



Plate 8: Photo point of Site 5 IWC and HH assessment quadrat

Site 6: Brinsmead Lane

Site 6 is located to south of Brinsmead Lane, Leopold. Vegetation within this area of the wetland complex is generally modified. There is a sandy beach with adjacent Saltmarsh vegetation approximately 20 metres wide of good condition extending to the east and west. Adjacent to this is grazing pasture and areas of revegetation. Aquatic vegetation is absent from the sandy beach and lake shallows. As the area comprises only one relatively intact type of indigenous vegetation, both the IWC and HH method were applied to the same quadrat. The assessments were undertaken using the relevant wetland and terrestrial EVCs Saltmarsh and Coastal Saltmarsh respectively.

Index of Wetland Condition

Habitat Hectares

EVC: Saltmarsh (EVC 888)

EVC: Coastal Saltmarsh (EVC 9)

Quadrat Size: 20 x 80

Vegetation within this quadrat comprises a relatively intact example of good condition Saltmarsh wetland EVC and Coastal Saltmarsh terrestrial EVC. The quadrat was dominated by indigenous vegetation including Shrubby Glasswort *Sclerostegia arbuscula* Beaded Glasswort *Sarcocornia quinqueflora* and Australian Salt Grass *Distichlis distichophylla* with scattered Rounded Noon-flower *Disphyma crassifolium* subsp. *crassifolium*, Southern Sea-heath *Frankenia pauciflora* var. *gunnii*, Austral Seablite *Suaeda australis*, Tangled Lignum *Muehlenbeckia florulenta* and the state significant Marsh Saltbush *Atriplex paludosa* subsp. *paludosa*. Scattered introduced species with a low cover score (<5%) include Soursob *Oxalis pes-caprae*, Rye Grass *Lolium* spp., Clover *Trifolium* spp., Tall Wheatgrass *Lophopyrum ponticum* and Rough Sow-thistle *Sonchus asper*.



Plate 9: Photo point of Site 6 IWC and HH assessment quadrat

Site 7: Douglas Road

Site 7 is located to the south of Douglas Road, Leopold. Vegetation within this area of the wetland complex is generally modified with private property backing onto Lake Connemara. There is a sandy beach with adjacent vegetation dominated Tangled Lignum *Muehlenbeckia florulenta* approximately 20 metres wide of moderate condition. Adjacent to this is grazing pasture and areas of revegetation. Aquatic vegetation is absent from the sandy beach and lake shallows. As the area comprised only one relatively intact indigenous vegetation community, both the IWC and HH method were applied to the same quadrat. The assessments were undertaken using the relevant wetland and terrestrial EVCs Saltmarsh and Coastal Saltmarsh respectively

Index of Wetland Condition

Habitat Hectares

EVC: Brackish Lignum Swamp (EVC 947) EVC: Cane Grass- Lignum Halophytic Herbland (EVC 898)

Quadrat Size: 20 x 80

Vegetation within this quadrat is dominated by Tangled Lignum *Muehlenbeckia florulenta* with scattered Boobialla *Myoporum insulare*, Austral Seablite *Suaeda australis* and Seaberry Saltbush *Rhagodia candolleana subsp. candolleana* and considered to be of moderate condition. Introduced species were also scattered throughout the quadrat including Toowoomba Canary-grass *Phalaris aquatica*, Ox – tongue *Helminthotheca echioides*, Panic Veldt-grass *Ehrharta erecta*, Soursob *Oxalis pes-caprae*, and Rough Sow-thistle *Sonchus asper*.



Plate 10: Photo point of Site 7 IWC and HH assessment quadrat

Site 8: Melaluka Road

Site 8 is located at the end of Melaluka Road, Leopold. Vegetation within this area of the wetland complex is generally modified with private property backing onto Lake Connewarre. Vegetation in the surrounding area is generally highly modified, dominated by various pasture species. The lake verge is lined by a sparse cover of scattered indigenous species with affinities to the wetland EVC Brackish Grassland. A band of the terrestrial EVC Coastal Alkaline Scrub is present dominated by mature Moonah *Melaleuca lanceolata* trees. Due to the narrow nature of the wetland vegetation (between one and three metres wide) a quadrat of only approximately 800 square metres was used.

Index of Wetland Condition

EVC: Brackish Grassland (EVC 934)

Quadrat Size: 2m x 150m

Vegetation within this quadrat comprises relatively intact examples of sparse Brackish Grassland of moderate condition. Indigenous species present include Beaded Glasswort *Sarcocornia quinqueflora*, Australian Saltgrass *Distichlis distichophylla*, Austral Seablite *Suaeda australis* and Round-leaf Wiltonia *Wiltonia rotundifolia*. A sparse cover of Barley Grass *Hordeum* spp. was observed in small patches within the assessed quadrat.



Plate 11: Photo point of Site 8 IWC assessment quadrat

Habitat Hectares

EVC: Coastal Saltmarsh (EVC 9)

Quadrat Size: 100m x 15m

This quadrat comprises vegetation with affinities to the terrestrial EVC Coastal Alkaline Scrub of poor condition with an overstorey of mature Moonah *Melaleuca lanceolata* and scattered indigenous understorey species such as Weeping Grass *Microlaena stipoides* subsp. *stipoides*, Wallaby Grass *Austrodanthonia* spp. Ruby Saltbush *Enchylaena tomentosa*, Seaberry Saltbush *Rhagodia candolleana* subsp. *candolleana*, Coast Tussock-grass *Poa poiformis* and Australian Saltgrass *Distichlis distichophylla*. Introduced species are prevalent within the quadrat with the understorey dominated by a variety of herbaceous species including Wild Oats *Avena fatua*, Soursob *Oxalis pes-caprae*, Panic Veldt-grass *Ehrharta erecta* and Onion Grass *Romulea rosea*.



Plate 11: Photo point of Site 8 HH assessment quadrat

Site 9: Hospital Swamp

Site 9 is located off Lake Road, Connewarre and is within part of the wetland complex known as Hospital Swamp. This part of the LCC is classed as a State Game Reserve. Adjacent properties are used for grazing purposes with revegetation zones along property boundaries. This section of wetland comprises a variety of wetland vegetation communities and incorporates a large area of relatively intact indigenous vegetation.

Index of Wetland Condition

EVC: Tall Marsh (EVC821)

Quadrat Size: 40m x 40m

Vegetation within this quadrat comprises one indigenous species Common Reed *Phragmites australis* and is considered to be a modified example of Tall Marsh wetland EVC of poor condition.



Plate 12: Photo point of Site 9 IWC assessment quadrat

Habitat Hectares

EVC: Cane Grass- Lignum Halophytic Herbland (EVC 898)

Quadrat Size: 15m x 105m

Vegetation within the quadrat displayed affinities to Cane Grass- Lignum Halophytic Herbland of poor condition dominated by a cover of dense Tangled Lignum *Muehlenbeckia florulenta* with scattered planted River Red Gums *Eucalyptus camaldulensis*. Scattered indigenous understorey species include Beaded Glasswort *Sarcocornia quinqueflora*, Australian Salt Grass *Distichlis distichophylla*, Austral Seablite *Suaeda australis*, Round-leaf Wilsonia *Wilsonia rotundifolia* and Creeping Brookweed *Samolus repens*. The introduced, salt tolerant grass species Tall Wheat-grass *Lophopyrum ponticum* was observed forming dense swards within the quadrat.



Plate 13: Photo point of Site 9 IWC assessment quadrat

Site 10: Fitzgerald Road

Site 10 is located at the end of Fitzgerald Road, Leopold within part of the LCC known as Reedy Lake. At the time of survey, this area of the LCC was under flood conditions with the carpark and much of the surrounding wetland vegetation inundated with water. The IWC assessment was undertaken in approximately 30 cm of water, however as the water was relatively clear an accurate assessment was able to be undertaken. Low density housing is adjacent to the wetlands with bands of revegetation buffers against the wetland boundary. As the site is part of Reedy Lake, vegetation within the quadrats is part of a large area of indigenous wetland vegetation. While a variety of EVCs are present within this area the two EVCs assessed are Tall Marsh and Plains Brackish Sedge Wetland using the IWC and HH methods respectively.

Index of Wetland Condition

EVC: Tall Marsh (EVC821)

Quadrat Size: 40m x 40m

This quadrat is adjacent to the inundated carpark bearing affinities with the wetland EVC Tall Marsh and considered to be of moderate condition. The dominant species within this quadrat is Club Rush *Schoenoplectus* spp. with scattered Beaded Glasswort *Sarcocornia quinqueflora*, Creeping Brookweed *Samolus repens*, Coast Sand-spurry *Spergularia media* and Swampweed *Selliera radicans*. Introduced species scattered throughout the quadrat include Dock *Rumex* spp., Spear Thistle *Cirsium vulgare* and Buck's-horn Plantain *Plantago coronopus*.



Plate 14: Photo point of Site 10 IWC assessment quadrat

Habitat Hectares

EVC: Plains Brackish Sedge Wetland (EVC 891)

Quadrat Size: 40m x 40m

This EVC is located in a band between the Tall Marsh wetland and the revegetation buffers and is considered to be of good condition. Dominant species include Southern Sea-heath *Frankenia pauciflora* var. *gunnii*, Beaded Glasswort *Sarcocornia quinqueflora* and Australian Salt Grass *Distichlis distichophylla* with scattered Coast Sand-spurry *Spergularia media*, Common Blown-grass *Lachnagrostis filiformis* and Austral Seablite *Suaeda australis*. One introduced species, Barley Grass *Hordeum* spp. was observed within the quadrat.



Plate 15: Photo point of Site 10 HH assessment quadrat

Site 11: Barwon Weir

Site 11 is located on the northern side of the Barwon River adjacent to a small weir within Reedy Lake. Vegetation within this area comprises a band of dense Common Reed *Phragmites australis* adjacent to the river, moving into areas forming a mosaic of burnt patches dominated by Tangled Lignum *Muehlenbeckia florulenta*, Tussock Grass *Poa* spp. and introduced species. As the site is part of Reedy Lake, vegetation within the quadrats is part of a large area of indigenous wetland vegetation.

Index of Wetland Condition

EVC: Tall Marsh (EVC821)

Quadrat Size: 25m x 65m

This quadrat comprises wetland vegetation dominated by one indigenous species Common Reed *Phragmites australis* with scattered indigenous species Common Tussock Grass *Poa labillardierei* and Scrub Nettle *Urtica incisa* and is considered to be a modified example of Tall Marsh wetland EVC of poor condition. There is a sparse cover of introduced species including Spear Thistle *Cirsium vulgare*, Cleavers *Galium aparine*, and Wild Oats *Avena fatua*.



Plate 16: Photo point of Site 11 HH assessment quadrat

Habitat Hectares

EVC: Cane Grass-Lignum Halophytic Herbland (EVC 898)

Quadrat Size: 40m x 40m

This quadrat comprises vegetation dominated by indigenous species Common Reed *Phragmites australis*, Tangled Lignum *Muehlenbeckia florulenta*, Common Tussock Grass *Poa labillardierei*, Scrub Nettle *Urtica incisa* and the introduced species Toowoomba Canary-grass *Phalaris aquatica*. Introduced herbaceous species are present across the quadrat including Spear Thistle *Cirsium vulgare*, Smooth Cat's-ear *Hypochoeris glabra*, and Common Sow-thistle *Sonchus oleraceus*. Vegetation within the assessed quadrat is considered to be of moderate condition.



Plate 17: Photo point of Site 11 HH assessment

Site 12: Reedy Lake

Site 12 is located in the south west of Reedy Lake adjacent to the Barwon River Moolap. Vegetation adjacent to the river comprises an overstorey of River Red-gums *Eucalyptus camaldulensis* approximately 12 metres high which may have been planted over an understorey dominated by Common Reed *Phragmites australis*. Both IWC and HH assessments were undertaken within the River Red-gum canopy. Vegetation within this area is considered to display affinities with the EVC Floodplain Riparian Woodland, an EVC listed under both the IWC and HH benchmarks. Vegetation within surrounding area comprises large areas dominated solely by dense swards of Common Reed *Phragmites australis*. As the site is part of Reedy Lake, vegetation within the quadrats is part of a large area of indigenous wetland vegetation comprising a variety of wetland communities of varying quality.

Index of Wetland Condition

Habitat Hectares

EVC for both IWC and HH: Floodplain Riparian Woodland (EVC56)

Quadrat Size: 40m x 40m

This quadrat comprises vegetation dominated by an overstorey of River Red-gum *Eucalyptus camaldulensis* with an understorey of Common Reed *Phragmites australis* and Tangled Lignum *Muehlenbeckia florulenta*. Introduced species present within the quadrat include Toowoomba Canary-grass *Phalaris aquatica*, Spear Thistle *Cirsium vulgare*, Cleavers *Galium aparine*, Vetch *Vicia sativa*, and Common Sow-thistle *Sonchus oleraceus*. The vegetation is considered to be of moderate condition.



Plate 18: Photo point of Site 12 IWC and HH assessment quadrat

Site 13: Moolap Station

Site 13 is located to south of Moolap Station Road, Moolap. A variety of wetland EVCs were observed in this area with a large area of Saltmarsh vegetation with a Adjacent to this is grazing pasture and areas of revegetation. Aquatic vegetation is absent from the sandy beach and lake shallows. As the area comprised only one relatively intact type of indigenous vegetation, both the IWC and HH methods were applied to the same quadrat. The assessments were undertaken using the relevant wetland and terrestrial EVCs Saltmarsh and Coastal Saltmarsh respectively.

Index of Wetland Condition

EVC: Saltmarsh (EVC888)

Quadrat Size: 40m x 40m

Vegetation within this quadrat comprises a relatively intact example of moderate condition Saltmarsh wetland EVC of low biodiversity. The dominant species is Beaded Glasswort *Sarcocornia quinqueflora* with scattered Creeping Brookweed *Samolus repens* and Swamp Crassula *Crassula helmsii*. No introduced species were noted within the quadrat.



Plate 18: Photo point of Site 13 IWC assessment quadrat

Habitat Hectares

EVC: Cane Grass-Lignum Halophytic Herbland (EVC 898)

Quadrat Size: 25m x 65m

Vegetation within this quadrat is dominated by Tangled Lignum *Muehlenbeckia florulenta* with scattered Swamp Crassula *Crassula helmsii* and is considered to be of moderate condition. Introduced species are also scattered throughout the quadrat including Toowoomba Canary-grass *Phalaris aquatic* and Soursob *Oxalis pes-caprae*.



Plate 19: Photo point of Site 13 HH assessment quadrat

4 DISCUSSION

The LCC includes a variety of aquatic and terrestrial habitats as well as large areas of open water, particularly within Lake Connewarre. Generally, the aquatic and terrestrial environs assessed were of moderate to good condition with a reasonable diversity of life forms and low cover levels of introduced species suggesting that important ecological processes are still present within the LCC.

Least disturbed examples of large areas of indigenous vegetation were observed at the southern end of the LCC and Reedy Lake. Introduced species were generally observed where disturbance had occurred in close proximity to areas of grazing and primary production. The greater part of land adjacent to the LCC is highly modified with little remnant indigenous vegetation persisting

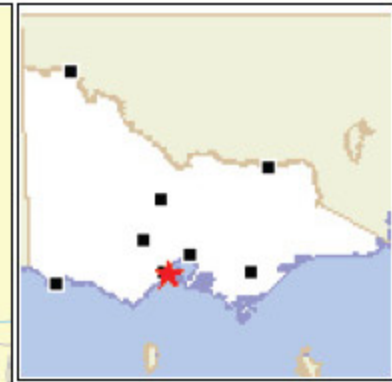
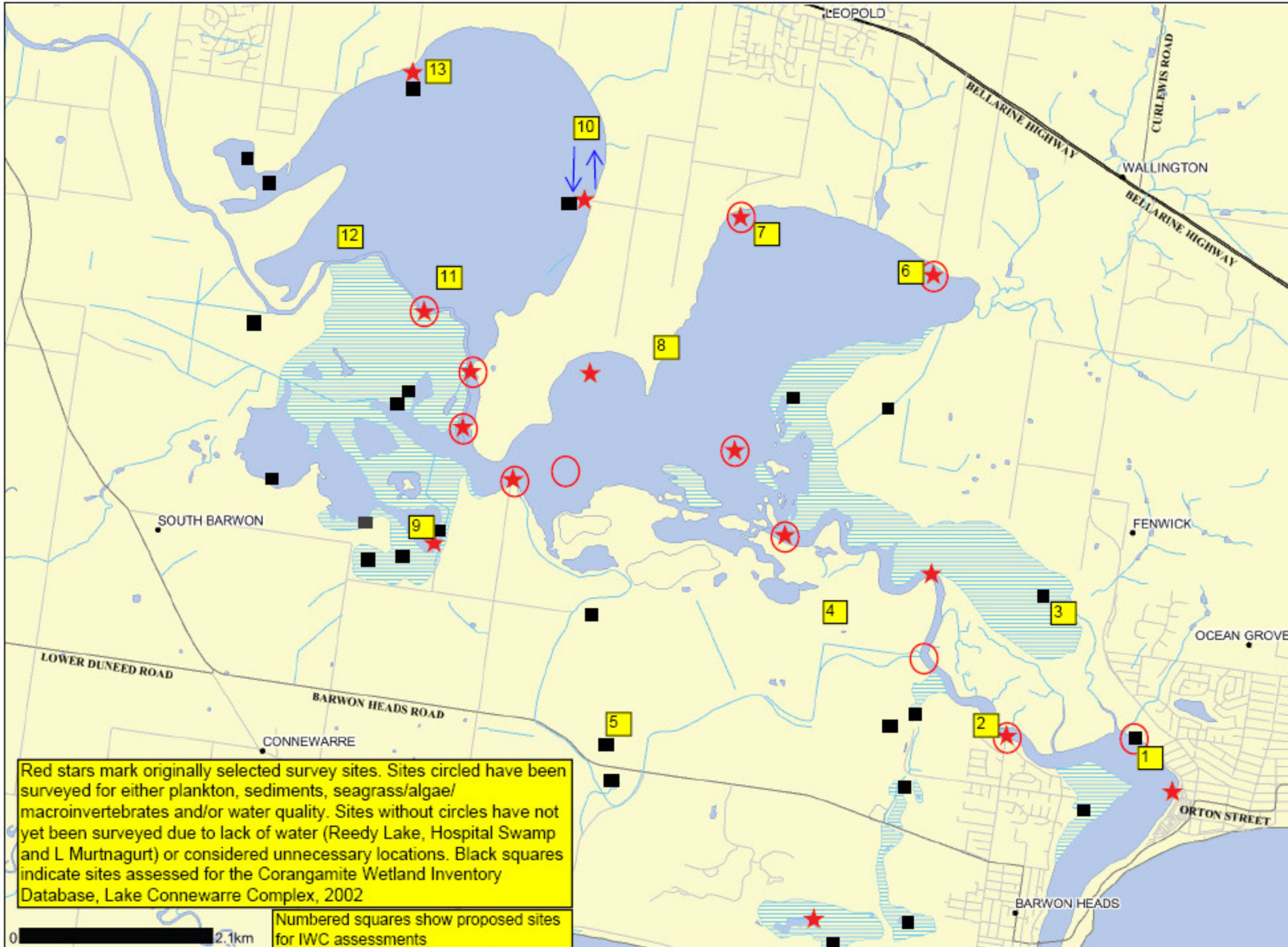
The majority of quadrats were located in areas of indigenous vegetation that extended for significant areas. However, the wetland interface on the north of Lake Connewarre was observed to be narrow with only a small band of indigenous vegetation, dividing open water and modified grazing pasture.

5 CONCLUSION

Vegetation within the assessed quadrats is considered to be of poor to good condition. Large areas of relatively intact vegetation were observed to the south of Lake Connewarre, Reedy Lake, and the lower Barwon. Generally, low levels of cover for introduced species and moderate levels of indigenous species diversity were observed across quadrats for both IWC and HH assessments.

The present assessments reveal that large areas within the LCC comprise remnant indigenous vegetation suggesting that important ecological processes are still present. However, weed invasion (including new and emerging weeds) clearing, high nutrient runoff, continued hydrological disturbance (at a local and catchment scale), increased recreational use, sedimentation and urbanisation are some of the continuing threats to the integrity of the indigenous vegetation within the LCC that need to be monitored and mitigated against. Climate change has the potential to significantly increase the stressors associated with many of these threatening processes.

FIGURE



Legend

- Minor Towns
- Minor Watercourses
- Major Watercourses
- Other Watercourses
- Minor Roads
- Freeways/Highways
- Major Roads
- Other Roads
- Waterbodies
- Permanent Waterbodies
- Wetland Area
- Island
- Victoria Boundary
- Victoria
- Other States
- Bass Strait



Red stars mark originally selected survey sites. Sites circled have been surveyed for either plankton, sediments, seagrass/algae/ macroinvertebrates and/or water quality. Sites without circles have not yet been surveyed due to lack of water (Reedy Lake, Hospital Swamp and L Murtnagurt) or considered unnecessary locations. Black squares indicate sites assessed for the Corangamite Wetland Inventory Database, Lake Connewarre Complex, 2002

Numbered squares show proposed sites for IWC assessments

0 2.1km

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APPENDICES

Appendix 1 – Significance Assessment

Defining Vegetation Condition

Table A1.1. Defining Vegetation Condition.

Criteria for defining Vegetation Condition
Good condition - Vegetation dominated by a diversity of indigenous species, with defined structures (where appropriate), such as canopy layer, shrub layer, and ground cover, with little or few introduced species present.
Moderate condition - Vegetation dominated by a diversity of indigenous species, but is lacking some structures, such as canopy layer, shrub layer or ground cover, and/or there is a greater level of introduced flora species present.
Poor condition - Vegetation dominated by introduced species, but supports low levels of indigenous species present, in the canopy, shrub layer or ground cover.

Appendix 2 – Study Site GPS Locations

All GPS locations are GDA 94.

* Points marked with an asterisk indicate photo points

Study Site	Assessment Type	Study Site Corners			
		NE	NW	SE	SW
1	IWC	* S38 15.713 E144 30.376	S38 15.719 E144 30.402	S38 15.730 E144 30.428	S38 15.739 E144 30.418
	HH	* S38 15.688 E144 30.404	S38 15.713 E144 30.376	S38 15.703 E144 30.422	S38 15.718 E144 30.403
2	IWC	* S38 15.575 E144 29.219	S38 15.579 E144 29.202	S38 15.582 E144 29.246	S38 15.594 E144 29.223
	HH	* S38 15.607 E144 29.213	S38 15.618 E144 29.196	S38 15.622 E144 29.237	S38 15.635 E144 29.220
3	IWC	* S38 14.828 E144 29.958	S38 14.827 E144 29.932	S38 14.850 E144 29.957	S38 14.848 E144 29.926
	HH	* S38 14.828 E144 29.958	S38 14.827 E144 29.932	S38 14.850 E144 29.957	S38 14.848 E144 29.926
4	IWC	* S38 15.000 E144 26.304	S38 14.992 E144 26.277	S38 15.020 E144 26.294	S38 15.012 E144 26.267
	HH	* S38 15.000 E144 26.251	S38 14.992 E144 26.225	S38 15.024 E144 26.226	S38 15.008 E144 26.207
5	IWC	* S38 15.799 E144 26.484	S38 15.793 E144 26.458	S38 15.820 E144 26.475	S38 15.815 E144 26.451
	HH	* S38 15.799 E144 26.484	S38 15.793 E144 26.458	S38 15.820 E144 26.475	S38 15.815 E144 26.451
6	IWC	S38 12.898 E144 28.891	* S38 12.874 E144 28.846	S38 12.906 E144 28.883	S38 12.878 E144 28.841
	HH	S38 12.898 E144 28.891	* S38 12.874 E144 28.846	S38 12.906 E144 28.883	S38 12.878 E144 28.841
7	IWC	S38 12.565 E144 27.652	* S38 12.562 E144 27.594	S38 12.567 E144 27.650	S38 12.573 E144 27.594
	HH	S38 12.565 E144 27.652	* S38 12.562 E144 27.594	S38 12.567 E144 27.650	S38 12.573 E144 27.594
8	IWC	S38 13.335 E144 26.974	* S38 13.330 E144 26.969	S38 13.379 E144 26.934	S38 13.379 E144 26.929
	HH	S38 13.324 E144 26.992	S38 13.324 E144 26.989	S38 13.379 E144 26.934	S38 13.379 E144 26.931
9	IWC	* S38 14.571 E144 25.207	S38 14.560 E144 25.186	S38 14.589 E144 25.193	S38 14.579 E144 25.171
	HH	* S38 14.540 E144 25.236	S38 14.547 E144 25.245	S38 14.590 E144 25.210	S38 14.588 E144 25.200
10	IWC	S38 12.542 E144 26.301	* S38 12.542 E144 26.273	S38 12.564 E144 26.292	S38 12.561 E144 26.263
	HH	S38 12.588 E144 26.360	* S38 12.579 E144 26.333	S38 12.606 E144 26.344	S38 12.599 E144 26.319
11	IWC	* S38 13.128 E144 25.038	S38 13.131 E144 25.025	S38 13.161 E144 25.056	S38 13.172 E144 25.045
	HH	* S38 13.122 E144 25.067	S38 13.133 E144 25.047	S38 13.142 E144 25.078	S38 13.153 E144 25.054
12	IWC	S38 12.817 E144 24.710	* S38 12.823 E144 24.680	S38 12.838 E144 24.712	S38 12.841 E144 24.679
	HH	S38 12.817 E144 24.710	* S38 12.823 E144 24.680	S38 12.838 E144 24.712	S38 12.841 E144 24.679
13	IWC	S38 11.753 E144 24.947	* S38 11.786 E144 24.923	S38 11.764 E144 24.958	S38 11.775 E144 24.917
	HH	S38 11.753 E144 24.947	* S38 11.765 E144 24.902	S38 11.764 E144 24.958	S38 11.775 E144 24.917

Appendix 3 – Index of Wetland Condition Scores Breakdown

	Max Score	1	2	3	4	5	6	7	8	9	10	11	12	13
Site Name		Ocean Grove Golf Course	Sheepwash Road	Koombahiah	Belchers Road	Bluestone Road	Brinsmead Road	Douglas Road	Melaluka Road	Hospital Swamp	Fitzgerald Road	Barwon Weir	Reedy Lake	Moolap Station
EVC		S	S	S	BS	BS	S	BLS	BG	TM	TM	TM	FRW	S
EVC Number		888	888	888	13	13	888	947	934	821	821	821	56	888
Status (Bioregional Conservation Status)		End	End	End	Vul	End	End	End	End	End	End	End	End	End
Critical life form groupings	25	25	15	25	15	15	20	0	20	5	10	5	5	10
Weeds	25	25	25	25	25	25	22	22	18	25	18	15	12	25
Indicators of altered processes	25	25	25	25	25	25	25	0	25	5	25	5	5	25
Vegetation structure and health	25	25	20	25	25	25	20	25	15	20	15	20	25	15
Total	100	100	85	100	90	90	87	47	78	55	68	45	47	75
Wetland vegetation quality score as above = #/100	1	1	0.85	1	0.9	0.9	0.87	0.47	0.78	0.55	0.68	0.45	0.47	0.75

*

*Notes: S = Saltmarsh, BS = Brackish Sedgeland, BLS = Brackish Lignum Swamp, BG = Brackish Grassland, TM = Tall Marsh, FWR = Floodplain Riparian Woodland, Vul = Vulnerable, End = Endangered.

Appendix 4 – Habitat Hectare Scores Breakdown

Site		1	2	3	4	5	6	7	8	9	10	11	12	13	
Site Name		Ocean Grove Golf Course	Sheepwash Road	Koombahlah	Belchers Road	Bluestone Road	Brinsmead Road	Douglas Road	Melaluka Road	Hospital Swamp	Fitzgerald Road	Barwon Weir	Reedy Lake	Moolap Station	
EVC Name		MS	CAS	CS	CS	PBSW	CS	CGL HH	CAS	CGL HH	BW	CGL HH	FRW	CGL HH	
EVC Number		140	858	9	9	891	9	898	858	898	656	898	56	898	
	Max Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	
Site Condition	Large Old Trees	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	
	Canopy Cover	5	N/A	4	N/A	N/A	N/A	N/A	5	N/A	N/A	N/A	5	N/A	
	Understorey	25	25	15	25	15	5	15	10	10	20	15	15	5	5
	Lack of Weeds	15	15	7	15	13	15	13	13	4	11	11	6	7	11
	Recruitment	10	10	10	10	10	0	10	10	5	10	0	10	0	10
	Organic Matter	5	N/A	2	5	5	3	5	3	2	5	5	5	5	4
	Logs	5	N/A	5	N/A	N/A	N/A	N/A	N/A	5	N/A	N/A	N/A	4	N/A
	Treeless multiplier (Site Conditions x 1.36 or 1.15)	N/A	75	44	75	58	31	58	49	36	63	42	36	23	41
Landscape value	Patch Size	10	8	8	8	8	8	8	8	8	8	8	8	8	8
	Neighbourhood	10	4	4	4	4	4	4	4	4	4	4	4	4	4
	Distance to Core	5	1	1	1	3	3	0	0	1	3	3	3	1	0
Habitat Score	100	88	57	88	73	46	70	61	49	78	57	51	36	53	
Habitat Score as above = #/100		0.88	0.57	0.88	0.73	0.46	0.7	0.61	0.49	0.78	0.57	0.51	0.36	0.53	
Bioregion		OP	OP	OP	OP	OP	OP	OP	OP	OP	OP	OP	OP	OP	
EVC Conservation Status		Vul	End	End	End	Vul	End	Vul	End	Vul	End	Vul	End	Vul	
Very High Conservation Significance	Conservation Status x Habitat Score	Very High	Very High	Very High	Very High	High	Very High	Very High	Very High	Very High	Very High	Very High	High	Very High	
	Threatened Species Rating	High	N/A	Very High	High	N/A	Very High	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	Other Site Attribute Rating	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	
	Overall Conservation Significance (highest rating)	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	
No. of Large Old Trees within Habitat Zone		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	

Notes: MS= Mangrove Shrubland, CAS = Coastal Alkaline Scrub, CS = Coastal Saltmarsh, PBSW = Plains Brackish Sedge Wetland, CGLHH = Cane Grass – Lignum Halophytic Herbland, BW = Brackish Wetland, FWR = Floodplain Riparian Woodland OP = Otway Plain, End = Endangered, Vul = Vulnerable, N/A= Not Applicable.

Appendix 5 – Examples of IWC and Habitat Hectare EVC Benchmarks

EVC/Bioregion Benchmark for Wetland Vegetation Assessment Otway Plain bioregion

EVC 13: Brackish Sedgeland

Description:

Medium to tall sedgeland, dominated by salt-tolerant sedges in association with low halophytic grassy / herbaceous ground-layer. Scattered in near-coastal and western inland areas.

Indicator species (some or all of these species should be present)

Scientific name	Common name	Comments
<i>Baumea juncea</i>	Bare Twig-sedge	
<i>Bolboschoenus caldwellii</i>	Salt Club-sedge	In some wetter versions
<i>Gahnia filum</i>	Chaffy Saw-sedge	
<i>Gahnia trifida</i>	Coast Saw-sedge	
<i>Schoenoplectus pungens</i>	Sharp Club-sedge	In some wetter versions

Conditions when the EVC should not be assessed

None recognised.

SCORING COMPONENT

1. CRITICAL LIFEFORM GROUPINGS

Conditions when specific critical lifeform groupings should not be assessed

None recognised.

General comments on assessing critical lifeform groupings

None.

Critical lifeform groupings and threshold values for determining if lifeform is substantially modified

Critical lifeform	No. spp.	% Cover	Comments
Medium to small herbs	5	5	
Medium to tall sedges		15	
Small to tiny monocots	3		various sedges, grasses and ephemerals.

EVC 13: Brackish Sedgeland – Otway Plain bioregion

2. WEEDS

High threat weed species

Scientific name	Common name
<i>Hordeum spp.</i>	Barley Grass
<i>Juncus acutus</i> subsp. <i>acutus</i>	Sharp Rush
<i>Leontodon taraxacoides</i> subsp. <i>taraxacoides</i>	Hairy Hawkbit
<i>Lophopyrum ponticum</i>	Tall Wheat-grass
<i>Parapholis</i> spp.	Barb Grass
<i>Phalaris aquatica</i>	Toowoomba Canary-grass
<i>Plantago coronopus</i>	Buck's-horn Plantain
<i>Puccinellia fasciculata</i>	Borrer's Saltmarsh-grass

3. INDICATORS OF ALTERED PROCESSES

Indicators	% cover	Scale of severity
Invasion of dryland species, loss of wetland component. <i>Austrodanthonia</i> spp. present at:	<5%.	Minor
	5-10%.	Moderate
	>10%.	Severe

Circumstances where some critical lifeform groupings may not be evident

None recognised.

4. VEGETATION STRUCTURE AND HEALTH

Structural dominant	Benchmark cover
Medium to tall sedges, one or more of Saw-sedge <i>Gahnia</i> spp., Salt Club-sedge <i>Bolboschoenus caldwellii</i> or Sharp Club-sedge <i>Schoenoplectus pungens</i>	30%

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EVC/Bioregion Benchmark for Vegetation Quality Assessment

Otway Plain bioregion

EVC 56: Floodplain Riparian Woodland

Description:

An open eucalypt woodland to 15 m tall over a medium to large shrub layer with a ground layer consisting of amphibious and aquatic herbs and sedges. Occurs along the banks and floodplains of the larger meandering rivers and major creeks, often in conjunction with one or more floodplain wetland communities. Elevation and rainfall are relatively low and soils are fertile alluviums subject to periodic flooding and inundation.

Large trees:

Species	DBH(cm)	#/ha
<i>Eucalyptus</i> spp.	80 cm	15 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
20%	<i>Eucalyptus camaldulensis</i> <i>Eucalyptus ovata</i>	River Red-gum Swamp Gum

Life Forms:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	1	5%	T
Medium Shrub	3	10%	MS
Large Herb	3	5%	LH
Medium Herb	4	10%	MH
Small or Prostrate Herb	3	10%	SH
Large Tufted Graminoid	2	15%	LTG
Large Non-tufted Graminoid	1	5%	LNG
Medium to Small Tufted Graminoid	5	15%	MTG
Medium to Tiny Non-tufted Graminoid	3	10%	MNG
Scrambler or Climber	1	5%	SC
Bryophytes/Lichens	na	10%	BL

LF Code

Species typical of at least part of EVC range

Common Name

MS	<i>Bursaria spinosa</i> ssp. <i>spinosa</i>	Sweet Bursaria
MS	<i>Acacia pycnantha</i>	Golden Wattle
MS	<i>Myoporum</i> sp. 1	Sticky Boobialla
LH	<i>Senecio glomeratus</i>	Annual Fireweed
MH	<i>Rumex brownii</i>	Slender Dock
SH	<i>Dichondra repens</i>	Kidney-weed
SH	<i>Crassula helmsii</i>	Swamp Crassula
SH	<i>Selliera radicans</i>	Shiny Swamp-mat
SH	<i>Hydrocotyle sibthorpioides</i>	Shining Pennywort
LTG	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
LTG	<i>Poa labillardierei</i>	Common Tussock-grass
LNG	<i>Phragmites australis</i>	Common Reed
MTG	<i>Lachnagrostis filiformis</i>	Common Blown-grass
MTG	<i>Austrodanthonia penicillata</i>	Slender Wallaby-grass
MTG	<i>Dianella revoluta</i> s.l.	Black-anther Flax-lily
MTG	<i>Bulbine bulbosa</i>	Bulbine Lily
MNG	<i>Triglochin striatum</i>	Streaked Arrowgrass
MNG	<i>Schoenus nitens</i>	Shiny Bog-sedge
MNG	<i>Distichlis distichophylla</i>	Australian Salt-grass
SC	<i>Cassytha melantha</i>	Coarse Dodder-laurel
SC	<i>Calystegia sepium</i>	Large Bindweed

EVC 56: Floodplain Riparian Woodland - Otway Plain bioregion

Recruitment:

Episodic/Flood. Desirable period between disturbances is 10 years.

Organic Litter:

40 % cover

Logs:

30 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
MS	<i>Rosa rubiginosa</i>	Sweet Briar	low	high
LH	<i>Rumex conglomeratus</i>	Clustered Dock	high	high
LH	<i>Sonchus oleraceus</i>	Common Sow-thistle	high	low
LH	<i>Rumex crispus</i>	Curled Dock	high	high
LH	<i>Helminthotheca echioides</i>	Ox-tongue	high	high
LH	<i>Aster subulatus</i>	Aster-weed	high	low
LH	<i>Cirsium vulgare</i>	Spear Thistle	high	high
LH	<i>Sonchus asper s.l.</i>	Rough Sow-thistle	high	low
LH	<i>Plantago lanceolata</i>	Ribwort	high	high
MH	<i>Hypochoeris radicata</i>	Cat's Ear	high	low
MH	<i>Plantago major</i>	Greater Plantain	high	low
MH	<i>Brassica fruticulosa</i>	Twiggy Turnip	high	high
MH	<i>Atriplex prostrata</i>	Hastate Orache	high	high
LTG	<i>Phalaris aquatica</i>	Toowoomba Canary-grass	high	high
LNG	<i>Holcus lanatus</i>	Yorkshire Fog	high	high
MTG	<i>Cyperus eragrostis</i>	Drain Flat-sedge	high	high
MTG	<i>Bromus catharticus</i>	Prairie Grass	high	low
MTG	<i>Lolium perenne</i>	Perennial Rye-grass	high	high
MNG	<i>Paspalum distichum</i>	Water Couch	high	high

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REFERENCES

References

- CVRFASC 2000. West Victoria Comprehensive Regional Assessment; Biodiversity Assessment. Commonwealth and Victorian Regional Forest Agreement Steering Committee. Commonwealth of Australia
- Department of the Environment and Water Resources (DEW) website
www.environment.gov.au
- DSE 2004. *Vegetation quality assessment manual: Guidelines for applying the habitat hectares scoring method*. Biodiversity and Natural Resources Division, Department of Sustainability & Environment, Victoria.
- DSE website (www.dse.vic.gov.au).
- DSE 2005. *Index of Wetland Condition Conceptual framework and selection of measures*. Department of Sustainability & Environment, Victoria.
- DSE 2006a. Native Vegetation. Guide for assessment of referred planning permit applications, May 2006. Department of Sustainability and Environment, Victoria, East Melbourne, Victoria.
- DSE 2006b. *Index of Wetland Condition Assessment of wetland vegetation Update – March 2006*. Department of Sustainability & Environment, Victoria.
- Oates, A. & Taranto, M. 2001. Vegetation Mapping of the Port Phillip and Westernport Region. Department of Sustainability & Environment, Victoria.
- Parkes, D., Newell, G. & Cheal, D. 2003. Assessing the quality of native vegetation: The habitat hectares approach. *Ecological Management & Restoration*. Volume 4 Supplement 29-38.
- Walsh, N.G. & Stajsic, V. 2007. *A Census of the Vascular Plants of Victoria 8th Edition*. Royal Botanic Gardens, Melbourne.
- Yugovic, J. Z. (1985) Technical Report Series No.18: *The Vegetation at Lake Connemarre State Game Reserve*. Arthur Rylah Institute for Environmental Research, Heidelberg, Victoria.