

Conservation Management Plan

Moonlit Sanctuary Wildlife Conservation Park

July 2026



Mark Shepherd
Ecological Consulting

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Glossary

Biodiversity	The biological diversity of lifeforms is commonly regarded as comprising three components: — Genetic diversity — the variety of genes (or units of heredity) in any population. — Species diversity — the variety of species. — Ecosystem diversity — the variety of communities or ecosystems.
Bioregion (region)	A bioregion defined in a national system of bio-regionalisation based on landscape-based variation in climate, geomorphology, lithology and vegetation.
Department of Energy, Environment and Climate Action (DEECA)	This department was formerly known as: — Department of Environment, Land, Water & Planning (DELWP) — Department of Environment and Primary Industries (DEPI). — Department of Planning, Local Government, and Property and Land Titles (DTPLI).
Ecological community	An assemblage of species (both flora and fauna, including microorganisms) that are interacting in a unique habitat. The structure, composition and distribution of ecological communities are determined by environmental factors such as climate, geomorphology and lithology.
Ecological Vegetation Class (EVC)	A type of native vegetation classification that is described through a combination of its floristics, life form and ecological characteristics, and through an inferred fidelity to particular environmental attributes. Each EVC includes a collection of floristic communities (i.e. lower level in the classification that is based solely on groups in the same species) that occur across a bio-geographic range, and although differing in species, have similar habitat and ecological processes operating.
Environmental weed	Any plant that is not native to a local area that has invaded native vegetation.
Exotic	Introduced from another geographic location (typically outside of Australia). Used in the context of this report to refer to species (both flora and fauna) that have been introduced from overseas.
GIS	Geographic Information System. A computer software-based information system that can store, edit, analyse, share, and display geographic information.
GPS	Global Positioning System developed by the United States government. Provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

Habitat	An area or areas occupied (either permanently, periodically or occasionally), by a species, population or ecological community. Includes all biotic and abiotic material components.
Indigenous	Native to the subject site (not exotic).
Introduced	Not native to the area: not indigenous. Refers to both exotic and non-indigenous Australian native species of plants and animals.
Non-indigenous native	A plant species that is native to Australia that has been introduced to the subject site.
Noxious weed	An introduced species listed under the <i>Catchment and Land Protection Act 1993</i> . Under the Act, noxious weeds have specific control measure and reporting requirements.
Patch	A patch of native vegetation is an area of vegetation where at least 25 per cent of the total perennial understorey plant cover is native, or any area with three or more native canopy trees, where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy, or any mapped wetland included in the <i>Current Wetlands</i> map, available in DEECA systems and tools.
Recruitment	The natural germination or establishment of plants.
Scattered Tree	A native canopy tree that does not form part of a remnant patch.
Significant	Important; typically used to describe the importance of a species or community at local, regional, state or Commonwealth levels.
Significant species	A species listed under the EPBC Act, FFG Act as Migratory, Marine, Extinct, Regionally Extinct, Critically Endangered, Endangered, Vulnerable, Threatened.
<i>Sp.</i>	Abbreviation of species (singular)
<i>Spp.</i>	Abbreviation of species (plural)
<i>Subsp.</i>	Abbreviation of subspecies
Threatened species, populations and ecological communities	Species, populations and ecological communities listed as Vulnerable, Endangered or Critically Endangered (collectively referred to as Threatened) under the FFG Act, or EPBC Act. Capitalisation of the terms 'Threatened', 'Vulnerable', 'Endangered' or 'Critically Endangered' in this report refers to listing under the relevant state and/or Commonwealth legislation.
Weed	A plant growing where it is not wanted: often (but not necessarily) characterised by high seed production and the ability to colonise an ecosystem quickly and out-compete indigenous flora. Weeds include both exotic and Australian native species of plant naturalised outside of their natural range.

1. Introduction & background

Mark Shepherd Ecological Consulting (hereafter *Shepherd Ecological*) in collaboration with Keystone Conservation was engaged by the Moonlit Sanctuary Wildlife Conservation Park (hereafter *Moonlit Sanctuary*) in January 2026 to undertake a biodiversity assessment and to prepare a Conservation Management Plan.

This report presents the results of a biodiversity assessment undertaken within the conservation area of the Moonlit Sanctuary property parcel, defined as areas situated outside of animal enclosures, visitor facilities and operational areas (hereafter *the management area*). This report also prescribes conservation management actions for a 5-year period.

This Conservation Management Plan was supported by a grant from the City of Casey Biodiversity Incentive Scheme BIS25-5.

1.1 Project background

As part of the Moonlit Sanctuary's ongoing commitment to conservation, the Sanctuary sought information and guidance from Shepherd Ecological and Keystone Conservation regarding biodiversity values and appropriate conservation management to maintain and restore biodiversity values at the site.

1.2 Objectives

The primary objectives of this report are to:

- Review background information,
- Present the findings of a biodiversity field assessment undertaken at the management area,
- Identify and document actions to maintain and restore native vegetation and habitat in a five-year conservation management plan, and
- Provide recommendations for actions, or management goals in addition to those specified in the five-year plan that are considered outside the scope of immediate management action priorities.

1.3 Site description

1.3.1 Location

The management area occupies 4.54 hectares the southern portion of a single property parcel at 550 Tyabb-Tooradin Rd, Pearcedale (Figure 1; Photographs 1 and 2). The remainder of the property comprises animal enclosures, vehicle parking, shedding and other facilities used for the operation of the Moonlit Sanctuary. The management area includes portions of roadside on Callanans Lane and Tyabb-Tooradin Rd (Figure 1).

The management area is location on the Gippsland Plain bioregion (DEECA 2026b).



Photograph 1. Management area; camera facing north-west. Date: 3/3/2026



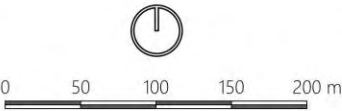
Photograph 2. Management area; camera facing north. Date: 3/3/2026



Figure 1: Management area
Moonlit Sanctuary Wildlife Conservation Park

- Management area
- Property boundaries
- Subject property
- Watercourse
- 0.5m elevation contours

Mark Shepherd Ecological Consulting
Map Version: 01
Date: 21/03/2026
Aerial photography: MetroMap
Aerial photography date: Jan 2026
Scale: 1:5,000 @A4
Coordinate system: GDA2020 MGA Zone 55



1.3.2 Landscape context

The Moonlit Sanctuary is situated within approximately 600m from estuarine environments within the internationally significant Ramsar Wetlands of Western Port Bay (Figure 2). The Sanctuary is situated within a predominately cleared agricultural landscape within which some private properties and roadsides retain tree cover or native understorey vegetation to varying degrees (Figure 2).

Native vegetation mapping undertaken by Shepherd & Garden (2025) shown in Figure 2 demonstrates the extent of native vegetation in the local area, including patterns of native vegetation retention within small rural holdings, and along roadsides and watercourses.

The Koala Corridor Project is a partnership between Moonlit Sanctuary Wildlife Conservation Park and the Western Port Biosphere Foundation. The City of Casey Biodiversity Incentive Scheme grants include specific opportunity for landholder participation through the Western Port Biosphere Bio Link - Koala Habitat Project to facilitate the City of Casey to Western Port Koala Bio-corridor. The Koala Biolink Project aims, in part, to create additional and safer dispersal routes for all wildlife, including Koalas. The Moonlit Sanctuary is situated at the junction of two Koala bio-corridors, which extend north through private land in Pearcedale to the north, which provide ultimate connectivity to the Cranbourne region, including the Roal Botanic Gardens Cranbourne (Figure 2).

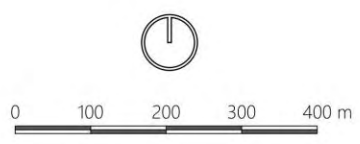
Ecology Systems (2025) nominates the management area as being located within a biolink region of *very high* importance and a potential biolink corridor of *high* importance in recognition of the sites contribution to existing and potential habitat connectivity between the Western Port Woodlands and Cranbourne Sands Woodlands biolink regions.



Figure 2: Landscape context
Moonlit Sanctuary Wildlife Conservation Park

- Management area
- Property boundaries
- Watercourse
- City of Casey Biodiversity Assessment (2025): Native vegetation
- Koala Biocorridor (Western Port Biosphere)
- Ramsar Wetland (International Significance)

Mark Shepherd Ecological Consulting
Map Version: 02
Date: 11/04/2026
Aerial photography: Google
Aerial photography date: unknown
Scale: 1:10,000 @A3
Coordinate system: GDA2020 MGA Zone 55



1.3.3 Geology, topography and watercourses

The management area is mapped as comprising Sedimentary geology (Sandstone) from the Cainozoic geological age. Publicly available geological mapping data provides the following lithographic description:

Undifferentiated consolidated Cainozoic sedimentary rocks; sandstone, limestone, conglomerate, siltstone; commonly ferruginised, silicified or poorly consolidated

A small portion of the management area in the south-western corner is mapped as comprising regolith with the following lithographic description:

Colluvium and/or residual deposits, talus, scree, sheet wash; boulder, gravel, sand; may include minor alluvial or sand plain deposits

At the site scale, the management area comprises several subtle rises in elevation which comprise sandy soils. Lower elevations that are subject to greater levels of inundation comprise darker, heavier soils. The Langwarrin Creek flows from Tyabb-Tooradin Rd in the west to the southern corner of the management area (Figure 1; Photographs 3 and 4).

The management area has been subject to significant historic mechanical alterations to levels and hydrology, including the creation of a deep channel to accommodate the Langwarrin Creek. Evidence of the former natural channels are evident throughout low-lying areas, which suggests that the original creek may have been a series of interconnected channels and billabongs rather than a single watercourse.

Short sections of moderate to steep slopes indicate historic re-levelling in low-lying areas, that are likely to have been created relatively recently by City of Casey for the assumed primary purpose of flood mitigation of Tyabb-Tooradin Rd, which is a *Class 2* road. Extensive recent works have been undertaken at the Tyabb-Tooradin Rd culvert, which extends into the management area. Recent spoil piles were observed in this area (Photograph 5).



Photograph 3. Culvert beneath Tyabb-Tooradin Rd (photograph date: 12/2/2026)



Photograph 4. Langwarrin Creek: north-western sector (photograph: 12/2/2026)



Photograph 5. Recent spoil pile adjacent to Langwarrin Creek colonised by Spear-thistle (photograph: 12/2/2026)

2. Methods

2.1 Database and literature review

Background information and documents were reviewed:

- Department of Energy, Environment and Climate Action (DEECA) Nature Kit (DEECA 2026a),
- The Victorian Biodiversity Atlas (VBA) (DEECA 2026b) – five-kilometre buffer of the management area
- Ecological Vegetation Class Benchmarks (DEECA 2026c),
- Shepherd & Garden (2025). *City of Casey Sites of Biodiversity Significance: Biodiversity Assessment Stage 2*.
- Ecology Systems (2025). *City of Casey Biolinks Plan 2025*. Unpublished report prepared for the City of Casey by Ecology Systems.
- High resolution current and historic aerial imagery for the local area (MetroMap; Geoscience Australia 2026),

2.2 Site assessment

Shepherd Ecological in collaboration with Keystone Conservation undertook several biodiversity assessments and site visits within the management area during February and March 2026.

The biodiversity assessment at the management area comprised the following methods:

- Categorisation of vegetation in accordance with Victoria's. *Guidelines for the removal, destruction or lopping of native vegetation* (hereafter *the Guidelines*) (DELWP 2017),
- Determination of Ecological Vegetation Classes (EVC) of vegetation patches and scattered trees,
- A flora assessment, including an assessment of the site's potential to support significant flora species,
- An assessment of current and future management considerations.

Herbarium specimens were collected under a *Flora and Fauna Guarantee Act 1988* Permit to Take Protected Flora (Permit # 10010500) to aid in the identification of plants.

2.2.1 Categorising vegetation within the management area

Field validation of DEECA (2026c) EVC mapping was undertaken to determine the site-specific classification of vegetation at the management area.

Vegetation was classified into one of three categories based on the DELWP (2017) *Guidelines* definitions.

Patch

A patch of native vegetation is:

- an area of vegetation where at least 25 per cent of the total perennial understorey plant cover¹ is native, or
- any area with three or more native canopy trees², where the drip line³ of each tree touches the drip line of at least one other tree, forming a continuous canopy, or
- any mapped wetland included in the *Current Wetlands* map, available in DEECA systems and tools.

Scattered Tree

A scattered tree is:

- a native canopy tree that does not form part of a patch.

Native vegetation that is neither a patch nor a scattered tree:

- areas where native vegetation has largely been replaced by exotic species (for example pasture grasses), planted vegetation for amenity purposes, or non-vegetated areas.

The location and extent of native vegetation patches were recorded in the field using a GPS enabled computer tablet running Quantum GIS (QGIS) software, and ground-truthed to recent aerial imagery for the site.

2.2.2 Targeted flora survey

A targeted survey for threatened flora species was not specifically undertaken at the management area.

Targeted survey undertaken at different times of the year would be required to determine the likelihood of occurrence of a range of threatened flora with the potential to occur with greater certainty (refer to Limitations Section 2.4).

2.2.3 Conservation Management & weed mapping

Shepherd Ecological walked the site for a duration of approximately eight hours with bushland restoration specialist Michael Sommer of Keystone Conservation over several site assessments. During the site inspections, management issues were identified and appropriate management actions were workshopped.

Weed infestations were mapped as polygons when the total cover of the infestation met or exceeded approximately 10m². Smaller infestations or single plants were mapped incidentally as point locations.

¹ Plant cover is the proportion of the ground that is shaded by vegetation foliage when lit from directly above.

² A native canopy tree is a mature tree (it is able to flower), that is greater than 3 metres in height and is normally found in the upper layer of the relevant vegetation type.

³ The drip line is the outermost boundary of a tree canopy (leaves and/or branches) where the water drips on to the ground.

2.3 Stakeholder liaison

2.3.1 Walk and talk

Shepherd Ecological and Keystone Conservation engaged Moonlit Sanctuary staff in a brief 'walk and talk' within the management area. The session facilitated knowledge sharing and the workshopping of management approaches to the site.

2.3.2 Melbourne Water & City of Casey

Contact was made with Melbourne Water to discuss management of the Langwarrin Creek who advised that historic management of the waterway within the Moonlit Sanctuary property was undertaken by Casey City Council for the purpose of road maintenance (to mitigate the flooding of the Langwarrin Creek bridge on Tyabb-Tooradin Road). City of Casey did not respond to an enquiry about the management of the Creek for road maintenance before finalisation of the report.

2.4 Limitations

2.4.1 Targeted survey

Systematic or targeted fauna survey was not undertaken during the current assessment. Methodologies such as repeated targeted flora surveys, nocturnal call-playback surveys, motion sensor camera surveys, acoustic surveys for bats, trapping and other targeted survey methodologies deployed at the management area would provide greater certainty on the presence or absence of threatened flora and fauna species at the site.

2.4.2 Environmental change over time

The results presented in this report are indicative of the environmental conditions at the time of assessment. Site conditions, including the presence or absence of significant species, and the type and quality of habitats have the potential to change over time.

2.4.3 Weed mapping

High-threat weed infestations (excluding most exotic grass species) were mapped incidentally during site assessments for the purpose of providing prospective contractors with the approximate spatial extent of weeds (for estimating weed control costs). Small infestations, such as single Blackberry plants smaller than ~2-3m² in area may not have been included in weed mapping, due to their widespread distribution over some parts of the management area.

While, not considered a significant limitation in the context of the current project, a systematic weed assessment methodology, such as a 5m grid survey would result in a more accurate and detailed record of the spatial extent of different high-threat weed species.

2.4.4 Threatened fauna species

Consideration of the management implications for threatened fauna species was limited to those recorded within the management area (or nearby) by Michael Johnson (Moonlit Sanctuary director) and on the iNaturalist database (iNaturalist 2026). A systematic analysis of the likelihood of occurrence and management implications for all threatened fauna species that have been recorded within five kilometres of the management area was outside the scope of the current assessment.

3. Results

3.1 Database and background information review

3.1.1 Modelled Ecological Vegetation Classes and bioregions

DEECA's NatureKit models the majority of the management area as comprising Swamp Scrub (EVC 53) Ecological Vegetation Class (EVC) prior to the year 1750 (DEECA 2026a).

DEECA (2026c) describes Swamp Scrub in the Gippsland Plain bioregion as:

Closed scrub to 8 m tall at low elevations on alluvial deposits along streams or on poorly drained sites with higher nutrient availability. The EVC is dominated by Swamp Paperbark Melaleuca ericifolia (or sometimes Woolly Tea-tree Leptospermum lanigerum) which often forms a dense thicket, out-competing other species. Occasional emergent eucalypts may be present. Where light penetrates to ground level, a moss/lichen/liverwort or herbaceous ground cover is often present. Dry variants have a grassy/herbaceous ground layer.

DEECA's NatureKit also models Heathy Woodland (EVC 48) and Damp Sands Herb-rich Woodland (EVC 3) to the south and north of the management area.

Swamp Scrub and Heathy Woodland were two of three EVCs recorded at the management area (Section 3.3.1).

3.1.2 Historic aerial photography and past land uses

Historic aerial photography from 1939, 1979 and 2005 (Geoscience Australia 2026; Google Earth 2026) provides an insight into the history of the site and surrounding areas. A sequence of aerial photography from 1939 to 2005 (Figures 3-5) shows extensive clearing in surrounding properties over that time-frame. However, the majority of the management area remains consistently vegetated, albeit with some changes in vegetation type and extent over the 87-year period.

Key site characteristics and differences shown in 1939 photograph (Figure 3) compared to current conditions include:

- Eucalyptus canopy cover in the northern sector appears to be more extensive compared to current cover.
- It appears that the Langwarrin Creek had already been straightened and deepened in 1939.
- A clearing or dam in the central-southern sector has since re-colonised.
- Canopy trees have since colonised the areas near current shedding in the north-eastern sector, which appears to be cleared in 1939.

Key site characteristics from the 1979 aerial photograph (Figure 4) include:

- a large proportion of the northern sector of the subject property (beyond the management area) had been cleared by that time.

- The area currently occupied by the fodder crop within the management area had also been cleared, along with some partial clearing in the north-eastern sector.
- The low resolution of the 1979 photograph makes further determinations uncertain; however, it appears that vegetation had possibly been partially cleared throughout the management area at that time, possibly due to grazing.

Key site characteristics from the 2005 aerial photograph (Figure 5) include:

- The current general extent of vegetation has remained largely unchanged since 2005, with the exception of small areas of clearing for the fodder crop and vehicle tracks.
- Willows were starting to become established on the Langwarrin Creek in the south-eastern sector in 2005, however, the infestation is substantially smaller compared to the current extent.
- Canopy Eucalypts appear to be healthier, with less canopy die-back compared to the current condition (although the resolution of the 2005 photograph is lower compared to 2026).

No major fires since 1970 are mapped as occurring within at least five kilometres of the management area, with reference to publicly available spatial data. Furthermore, no evidence of fire was observed at the site. The site is therefore assumed to be long-unburnt.

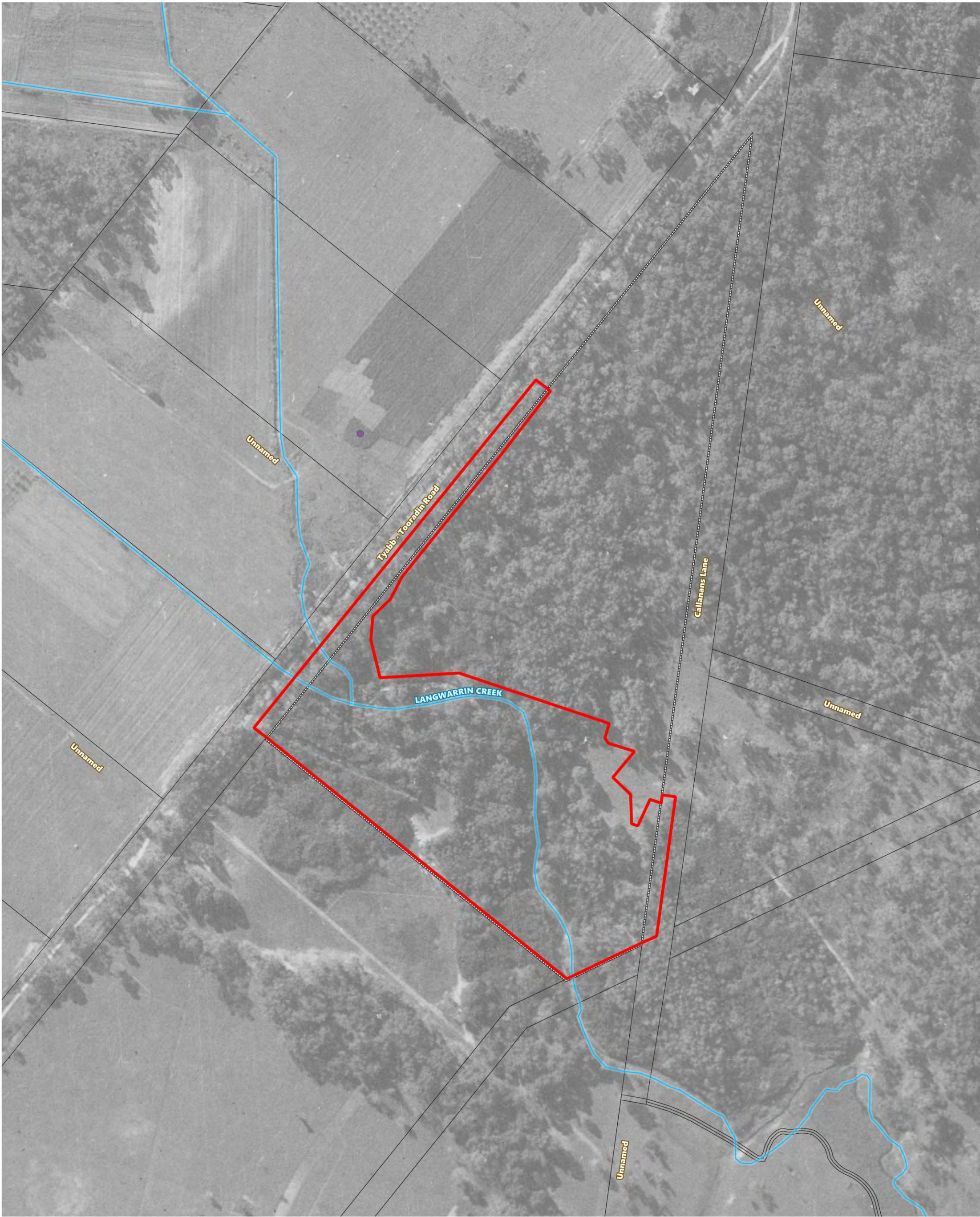


Figure 3: Historic aerial photography: 1939
Moonlit Sanctuary Wildlife Conservation Park

- Property boundaries (current)
- Management area
- Subject property
- Watercourse

Mark Shepherd Ecological Consulting
Map Version: 02
Date: 27/02/2025
Aerial photography: Geoscience Australia
Aerial photography date: 1939
Scale: 1:2,500 @A3
Coordinate system: GDA2020 MGA Zone 55

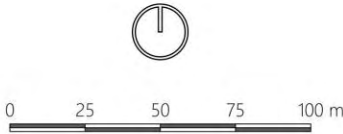




Figure 4: Historic aerial photography: 1979
Moonlit Sanctuary Wildlife Conservation Park

- Property boundaries (current)
- Management area
- Subject property
- Watercourse

Mark Shepherd Ecological Consulting
Map Version: 02
Date: 27/02/2025
Aerial photography: Geoscience Australia
Aerial photography date: 1979
Scale: 1:2,500 @A3
Coordinate system: GDA2020 MGA Zone 55

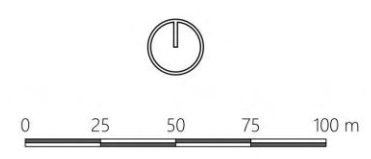
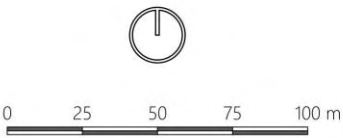




Figure 5: Historic aerial photography: 2005
Moonlit Sanctuary Wildlife Conservation Park

- Property boundaries (current)
- Management area
- Subject property
- Watercourse

Mark Shepherd Ecological Consulting
Map Version: 02
Date: 27/02/2025
Aerial photography: Google Earth
Aerial photography date: 2005
Scale: 1:2,500 @A3
Coordinate system: GDA2020 MGA Zone 55



3.2 General vegetation description

Vegetation at the management area consists of a combination of colonising and remnant native vegetation along with small areas that have been cleared of native vegetation.

The type and distribution of native vegetation is strongly associated with topography, hydrology and assumed disturbance history:

- Areas of higher elevation on sandy soils generally comprise a mature Coast Manna-gum *Eucalyptus viminalis* subsp. *pyroriana* overstorey; also evident in 1939 aerial photography, which suggests these areas comprise remnant vegetation that has not been subject to historic re-levelling / mechanical disturbance.
- Areas of lower elevation are generally dominated by Swamp Paperbark *Melaleuca ericifolia*, the majority of which are not mature trees, which suggests that this vegetation has colonised, either following disturbance, or due to hydrological changes resulting from the channelisation of the Langwarrin Creek.
- the channelised creek comprises a suite of aquatic and semi-aquatic vegetation due to consistent water availability and is associated with Blackberry **Rubus anglocandicans* and Willow **Salix* infestations, due to a combination of soil disturbance and water availability.
- Remnant Swampy Woodland comprising a mature overstorey occurs in the Tyabb-Tooradin roadside, which is likely a reflection of poorly drained soils at intermediate relative elevation, that have not been subject to historic clearing or extensive disturbance.
- Areas dominated by exotic understorey vegetation without a Eucalyptus or Melaleuca dominated overstorey have been subject to historic clearing or recent soil disturbance, including vehicular tracks, the fodder crop (southwestern corner) and spoil piles adjacent to the Langwarrin Creek near Tyabb-Tooradin Road.

Tree die-back was observed primarily on higher elevations at various locations (Photograph 6). The cause of tree die-back is unknown. Suggested management approaches to tree die-back are provided in Section 4.3.



Photograph 6. Partial tree die-back in central-northern sector. Date: 3/3/2026

3.3 Vegetation categories

3.3.1 Extant Ecological Vegetation Classes

4.536 hectares of native vegetation comprising seventeen patches of native vegetation and four Ecological Vegetation Classes (EVCs) was mapped within the management area (Table 1; Figure 6).

Table 1. Ecological Vegetation Classes (EVCs) recorded at the management area

Ecological Vegetation Class (EVC)	Bioregional conservation status	No of zones	Area (ha)
Heathy Woodland	Least Concern	5	0.443
Modified Creekline Vegetation (Aquatic Herbland)	N/a	1	0.261
Swamp Scrub	Endangered	8	3.014
Swampy Woodland	Endangered	3	0.322
Total		17	4.536

Native vegetation patches at the management area were not entirely consistent with DEECA (2026a) or Oates & Taranto (2001) EVC descriptions due to the colonising status and/or the modified condition of the vegetation. EVC delineation was therefore made with reference to a combination of site floristics, site geomorphology, and DEECA's pre-1750 modelled EVC spatial layer. Native vegetation within the colonising Langwarrin Creek is an example of vegetation that does not meet an EVC description due to its colonising status and its occurrence on a modified substrate. Vegetation in this zone is referred to as 'Modified Creekline Vegetation', which has some similarities to Aquatic Herbland EVC.

A description of EVC key site determining characteristics is presented in Table 2 below, which provides the DEECA (2026a) EVC descriptions alongside a description of site characteristics.

3.3.2 Non-native vegetation

Approximately 0.496 hectares of the management area consists of non-native vegetation comprising 0.224 ha of exotic vegetation and non-vegetated areas primarily as vehicle tracks and 0.272 ha of fodder crop (Figure 6).



Figure 6: Native vegetation

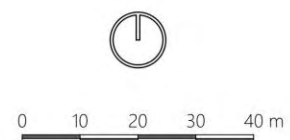
Moonlit Sanctuary Wildlife Conservation Park

- Management area
- Subject property
- Property boundaries (current)
- Watercourse
- Vehicle tracks
- 0.5m elevation contours

Native vegetation (EVC) & vegetation type

- Heathy Woodland
- Modified creekline vegetation
- Swamp Scrub
- Swampy Woodland
- Exotic vegetation / non-vegetated areas
- Fodder crop

Mark Shepherd Ecological Consulting
Map Version: 01
Date: 10/03/2026
Aerial photography: MetroMap
Aerial photography date: January 2026
Scale: 1:1,300 @A3
Coordinate system: GDA2020 MGA Zone 55



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Table 2. EVC key site determining characteristics

EVC	EVC #	DEECA (2026a) Description	Key site determining features	
Heathy Woodland	48	Spans a variety of geologies but is generally associated with nutrient-poor soils including deep uniform sands (aeolian or outwash) and Tertiary sand/clay which has been altered to form quartzite gravel. Eucalypt-dominated low woodland to 10m tall lacking a secondary tree layer and generally supporting a diverse array of narrow or ericoid-leaved shrubs except where frequent fire has reduced this to a dense cover of bracken. Geophytes and annuals can be quite common, but the ground cover is normally fairly sparse.	A woodland to 15m tall on gentle rises comprising low fertility, sandy soils dominated by mature and dead Coast Manna-gum <i>Eucalyptus viminalis</i> subsp. <i>pyroriana</i>. A generally sparse shrub cover comprised mostly Black Wattle <i>Acacia mearnsii</i>, and occasional Sweet Bursaria <i>Bursaria spinosa</i> and Cherry Ballart <i>Exocarpos cupressiformis</i>. The understorey was dominated by exotic grasses along with occasional Weeping Grass <i>Microlaena stipoides</i> var. <i>stipoides</i>, along with Spiny-headed Mat-rush <i>Lomandra longifolia</i> and Bracken <i>Pteridium esculentum</i>. Occasional understorey herbs included Kidney-weed <i>Dichondra repens</i>. Heathy Woodland at the site shares similarities to Damp Sands Herb-rich Woodland EVC, which cannot be definitely excluded due to relatively low floristic diversity making EVC determination inconclusive.	
Modified Creekline Vegetation: similar to Aquatic Herbland	653	Herbland of permanent to semi-permanent wetlands, dominated by sedges (especially on shallower verges) and/or aquatic herbs. Occurs on fertile paludal soils, typically heavy clays beneath organic accumulations.	Colonising wetland vegetation, comprising a limited suite of common wetland plants that readily colonise artificial substrates, including Slender Knotweed <i>Persicaria decipiens</i>, Pale Knotweed <i>Persicaria lapathifolia</i>, Common Reed <i>Phragmites australis</i>, Rush <i>Juncus</i> spp. and Small Loosestrife <i>Lythrum hyssopifolia</i>. A dense cover of floating Duckweed <i>Lemna</i> sp. occurred throughout some areas of standing water. This vegetation does not meet the description of any DEECA (2026c) EVC description. Aquatic Herbland is considered the nearest analogue, given the presence of permanent water and that herbaceous lifeforms comprise a substantial proportion of native cover.	

EVC	EVC #	DEECA (2026a) Description	Key site determining features	
Swamp Scrub	53	Closed scrub to 8 m tall at low elevations on alluvial deposits along streams or on poorly drained sites with higher nutrient availability. The EVC is dominated by Swamp Paperbark <i>Melaleuca ericifolia</i> (or sometimes Woolly Tea-tree <i>Leptospermum lanigerum</i>) which often forms a dense thicket, out-competing other species. Occasional emergent eucalypts may be present. Where light penetrates to ground level, a moss/lichen/liverwort or herbaceous ground cover is often present. Dry variants have a grassy/herbaceous ground layer.	Highly variable EVC within the site. Defined primarily on the presence of Swamp Paperbark <i>Melaleuca ericifolia</i> in the overstorey, either without Eucalypts or with occasional emergent Eucalypts. Swamp Scrub was highest in quality in areas of lowest elevation, including in assumed historic Langwarrin Creek drainage channels, which intermittently hold water. These areas included mature Swamp Paperbark, and occasional herbs, sedges and rushes, such as <i>Juncus</i> spp., Swamp Club-sedge <i>Isolepis inundata</i>, Tall Sword-sedge <i>Lepidosperma elatius</i>, Angled Lobelia <i>Lobelia anceps</i>, Bare Twig-sedge <i>Machaerina juncea</i> and Swamp Crassula <i>Crassula helmsii</i>. Swamp Scrub on higher elevations was ecotonal with Heathy Woodland and included a dense cover of introduced grasses in the understorey along with a wide range of understorey species that are more tolerant of drier conditions.	
Swampy Woodland	937	Open eucalypt woodland to 15 m tall with ground-layer dominated by tussock grasses and/or sedges and often rich in herbs. Occurs on poorly drained, seasonally waterlogged heavy soils, primarily on swamp deposits but extending to suitable substrates within some landscapes of sedimentary origin.	A woodland to 15m tall dominated by Swamp Gum <i>Eucalyptus ovata</i> in the overstorey. A sparse middle storey included Cherry Ballart <i>Exocarpos cupressiformis</i> and Swamp Paperbark. The understorey comprised occasional Spiny-headed Mat-rush <i>Lomandra longifolia</i> and few other native species. A dense Kikuyu infestation <i>Cenchrus clandestinus</i> occupied approximately one-third of the understorey in the largest Swampy Woodland Patch (SW1).	

3.3.3 Scattered trees

No scattered trees were recorded within the management area (all trees recorded were classified as *trees within patches*).

3.4 Fauna

3.4.1 Fauna species

Species recorded by Michael Johnson

Fauna species were not recorded during the current assessment. However, comprehensive fauna survey has been undertaken by Moonlit Sanctuary director and zoologist; Michael Johnson between 1999 and 2025 throughout the broader Moonlit Sanctuary property (including the management area) and adjacent properties. The Johnson surveys have resulted in 234 records comprising:

- Six amphibians,
- 116 birds,
- Two fish
- 88 invertebrates
- 15 mammals, and
- Seven reptiles,

Appendix 1 lists fauna species recorded by Michael Johnson.

A significant proportion of the 116 birds recorded by Johnson are wetland specialists, which are likely to have been recorded within the wetland in the Moonlit Sanctuary complex (outside of the management area), and for which there is marginal habitat within the management area for the majority of these species.

Species records on the iNaturalist database

A further 28 fauna species records are held on the iNaturalist (2026) database for the management area, of which 17 records are attributed to Michael Johnson. Six of the 28 species recorded on the iNaturalist database are for species not recorded by Johnson:

- Common Galaxias *Galaxias maculatus* (fish),
- Carp Gudgeons *Hypseleotris* sp. (fish),
- Congolli *Pseudaphritis urvillii* (fish),
- *Sphaerium tasmanicum* (mollusc),
- Christmas Beetles (invertebrate), and
- Stern Jumping Spider *Clynotis severus* (invertebrate).

Species recorded by ANGFA

The Australian & New Guinea Fishes Association (ANGFA) undertook three aquatic surveys of the Langwarrin Creek within the management area in 2001, 2020 and 2022 (ANGFA 2022).

Twelve fish species were recorded by ANGFA over the survey period, comprising eight native species, three introduced species, and one species native to Australia but not native to the south-east Melbourne region.

- Cobbler *Gymnapistes marmoratus*
- Common Galaxias *Galaxias maculatus*
- Congolli or Tupong *Pseudephritis urvillii*
- Eastern Gambusia **Gambusia holbrooki*
- European Carp **Cyprinus carpio*
- Firetail Gudgeon ***Hypseleotris galii*
- Glassgoby *Gobiopterus semivestitus*
- Goldfish **Carassius auratus*
- Mullet *Mugil* spp.
- Short-finned eel *Anguilla australis*
- Spotted Galaxias *Galaxias truttaceus*
- Tamar Goby *Afurcagobius tamarensis*

* Introduced species (not native to Australia)

** Native Australian species not native to the south-east Melbourne area

3.4.2 Threatened fauna species

Eight threatened fauna species have been recorded by Johnson within the broader Moonlit Sanctuary property and adjacent properties (Appendix 1) comprising:

- Three wetland birds:
 - Australasian shoveler *Spatula rhynchotis* (FFG Act vulnerable),
 - Eastern Great Egret *Ardea alba modesta* (FFG Act vulnerable), and
 - Latham's Snipe *Gallinago hardwickii* (EPBC Act Vulnerable, Migratory, FFG Act vulnerable)
- Two birds of prey and one owl:
 - Little Eagle *Hieraaetus morphnoides* (FFG Act vulnerable),
 - Grey Goshawk *Accipiter novaehollandiae* (FFG Act endangered), and
 - Barking Owl *Ninox connivens* (FFG Act critically endangered),
- One amphibian; Growling grass frog *Litoria raniformis* (EPBC Act Vulnerable, FFG Act vulnerable), and

- One parrot; Orange-bellied parrot *Neophema chrysogaster* (EPBC Act Critically Endangered, FFG Act critically endangered).

One additional amphibian; Southern Toadlet *Pseudophryne semimarmorata* has been recorded by Gerry Marantelli within the Sanctuary.

Wetland birds

Three threatened wetland bird species have been recorded by Johnson throughout the wider property and adjacent properties, Australasian shoveler *Spatula rhynchotis*, Eastern Great Egret *Ardea alba modesta* and Latham's Snipe *Gallinago hardwickii*. Dense habitat around the Langwarrin Creek (including exotic vegetation), particularly in treeless areas near Tyabb-Tooradin Road could be suitable for Latham's Snipe, while Australasian shoveler and Eastern Great Egret are more likely to occur in larger wetlands, such as the wetland within the Moonlit Sanctuary facility.

Terrestrial birds

Little Eagle *Hieraaetus morphnoides*, Grey Goshawk *Accipiter novaehollandiae* and Barking Owl *Ninox connivens* have also been recorded by Johnson. The management area comprises potential hunting territory for the species, which have a large home range and are therefore unlikely to permanently occupy or regularly occur within the management area.

Orange-bellied parrot *Neophema chrysogaster* is a critically endangered and seldomly recorded species that is associated with nearby saltmarsh vegetation in Western Port Bay. The species also occurs in croplands and various other open vegetation as secondary habitat. In 2020 and 2021, Moonlit Sanctuary released captive-bred Orange-bellied parrots in Western Port Bay as part of the Mainland Release Trial (delivered by DELWP, Zoos Victoria and Moonlit Sanctuary). One of these captive bred birds was observed on the property sometime after the release, for which the Johnson record is attributed. Habitat within the management area is generally not considered suitable for Orange-bellied parrot.

Amphibians

Growling Grass Frog was recorded by Johnson within the Moonlit Sanctuary wetland in the early 2000's. Growling Grass Frog has not been recorded at the Moonlit Sanctuary again or within the region for two-three decades and is therefore considered locally extinct.

Southern Toadlet was recorded by Gerry Marantelli (Amphibian Research Centre), date and location within the sanctuary unknown.

Fish

The Carp Gudgeon *Hypseleotris* sp. record on iNaturalist is to genus level (not species level), which is likely due to the apparent difficulty in differentiating Carp Gudgeon to species level. Carp Gudgeon species include the FFG Act listed Empire Gudgeon *Hypseleotris compressa*. The species has been commonly recorded in coastal NSW Queensland, with sparse records in Victoria (the nearest record on the Atlas of Living Australia (2026) is near Maffra in East Gippsland). It is therefore assumed that the lack of records in the Melbourne area reflects the warmer climatic habitat preferences for the species. Advice from an aquatic ecologist about the likelihood of Empire Gudgeon *Hypseleotris compressa* occurring at the site (based on habitat and known distribution) could inform whether a potential survey the Langwarrin Creek could be warranted (if resources allow).

3.5 Flora

3.5.1 Flora species

A total of 93 flora species were recorded incidentally during the current assessment of which 47 species are indigenous (50%), 47 species are introduced (50%), including two native species that are occurring outside of their natural range.

Appendix 2 provides a list of flora species recorded at the management area.

3.5.2 Threatened flora species

No threatened flora were recorded at the management area. The site generally comprises low potential for threatened flora to occur due to the modified condition of the native vegetation, including the dominance of exotic grasses and woody weeds throughout the understorey of the site.

The management area includes several notable flora species of assumed local significance that are uncommon or restricted within the management area and within the Casey region more broadly. A significant proportion of these species are semi-aquatic species that occur within unique wetland or riparian habitats, such as:

- Bare Twig-sedge *Machaerina juncea*,
- Swamp Crassula *Crassula helmsii*,
- Swamp Club-sedge *Isolepis inundata*, and
- Hollow Rush *Juncus amabilis*.

Less common species that occur in more elevated areas (that aren't subject to period inundation) include:

- at least one orchid; Rosy Hyacinth-orchid *Dipodium roseum* (Photograph 7), with potential for autumn flowering orchids such as Greenhoods *Pterostylis* spp. and Mosquito Orchids *Acianthus* spp. to also occur,
- Common Apple-berry *Billardiera mutabilis*,
- Slender Sword-sedge *Lepidosperma gunnii*,
- Wattle Mat-rush *Lomandra filiformis* subsp. *coriacea*



Photograph 7. Rosy Hyacinth-orchid *Dipodium roseum* (12/02/2026)

3.6 Exotic vegetation and non-indigenous native vegetation

3.6.1 Weed species and origin

Non-native vegetation at the management includes exotic vegetation (overseas in origin) and non-indigenous native vegetation (native to Australia but not indigenous to the site).

The management area comprises a highly modified understorey, including extensive areas dominated by exotic grasses. Exceptions include relatively small areas of understorey that are dominated by Weeping-grass *Microlaena stipoides* and areas of indigenous semi-aquatic vegetation in low-lying areas subject to periodic inundation.

The management area also contains areas dominated by Blackberry (~2,700m²), Willow (~1,200m²) and Kikuyu (~1,000m²), which were mapped on site and displayed as 'high-threat weed polygons' in Figure 7 (Table 3). Additional high-threat weeds recorded as point locations that occur throughout the site are also shown in Figure 7. The latter records represent isolated high-threat weeds as individual plants or as small infestations (<10m²).

Non-native indigenous vegetation consists primarily of White Sallow-wattle #*Acacia floribunda*, which is native to the east coast of Australia, including East Gippsland, but is commonly cultivated and naturally colonising the Melbourne region, where it is considered non-indigenous and invasive. White Sallow-wattle is considered a high-threat weed at the management area and is therefore recommended for removal (Section 3.6.2).

3.6.2 High-threat and moderate-threat weeds

A total of 15 high-threat and 16 moderate-threat weeds were recorded incidentally at the management area (Table 3). A further 15 exotic species recorded at the management area are considered low-threat weeds (Appendix 2).

Management recommendations for high-threat and moderate-threat weeds are provided in Section 4.

Table 3. High-threat and moderate-threat weeds recorded at the management area

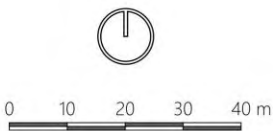
Taxon Origin	Scientific Name	Common Name	Threat status
#	<i>Acacia floribunda</i>	White Sallow-wattle	High
*	<i>Araujia sericifera</i>	White Bladder-flower	
*	<i>Asparagus asparagoides</i>	Bridal Creeper	
*	<i>Cenchrus clandestinus</i>	Kikuyu	
*	<i>Coprosma repens</i>	Mirror Bush	
*	<i>Cotoneaster glaucophyllus</i>	Large-leaf Cotoneaster	
*	<i>Crataegus monogyna</i>	Hawthorn	
*	<i>Lonicera japonica</i>	Japanese Honeysuckle	
*	<i>Malus spp.</i>	Pear	
*	<i>Phytolacca octandra</i>	Red-ink Weed	
*	<i>Rosa rubiginosa</i>	Sweet Briar	
*	<i>Rubus anglocandicans</i>	Common Blackberry	
*	<i>Salix spp.</i>	Willow	
*	<i>Tradescantia fluminensis</i>	Wandering Jew	
*	<i>Zantedeschia aethiopica</i>	White Arum-lily	
*	<i>Agrostis capillaris</i>	Brown-top Bent	Moderate
*	<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	
*	<i>Atriplex prostrata</i>	Hastate Orache	
*	<i>Cirsium vulgare</i>	Spear Thistle	
*	<i>Cynodon dactylon</i> var. <i>dactylon</i>	Couch	
*	<i>Cyperus eragrostis</i>	Drain Flat-sedge	
*	<i>Dactylis glomerata</i>	Cocksfoot	
*	<i>Ehrharta erecta</i>	Panic Veldt-grass	
*	<i>Helminthotheca echioides</i>	Ox-tongue	
*	<i>Holcus lanatus</i>	Yorkshire Fog	
*	<i>Parietaria judaica</i>	Wall Pellitory	
*	<i>Paspalum dilatatum</i>	Paspalum	
*	<i>Phalaris aquatica</i>	Toowoomba Canary-grass	
*	<i>Rumex conglomeratus</i>	Clustered Dock	
*	<i>Rumex crispus</i>	Curled Dock	
*	<i>Solanum pseudocapsicum</i>	Madeira Winter-cherry	
*	Exotic origin		
#	Native species occurring outside of its natural range		



Figure 7: Weeds
Moonlit Sanctuary Wildlife Conservation Park



Mark Shepherd Ecological Consulting
Map Version: 01
Date: 23/03/2026
Aerial photography: MetroMap
Aerial photography date: January 2026
Scale: 1:1,300 @A3
Coordinate system: GDA2020 MGA Zone 55



Mark Shepherd
Ecological Consulting

3.6.3 Weeds as habitat

Exotic and non-indigenous native vegetation in many cases provide habitats and food resources for both native and introduced fauna. Blackberry thickets such as those as shown in photograph 8 below provide a unique vegetation structure within the site that provides refuge from predators for small birds and mammals. The Blackberry fruit and flowers also provide food resources.

Other exotic species, such as Hawthorn **Crataegus monogyna*, Sweet Briar **Rosa rubiginosa* provide similar structurally complex habitat that provides refuge, while a range of other exotic species provide a broad range of habitat types and food resources.

While many exotic flora species provide habitat for native fauna, they also provide habitat for introduced species such as Red Fox **Vulpes vulpes*. Weeds also have the potential to displace native flora species, reduce floristic diversity and contribute to a range of detrimental ecological processes such as erosion, tree die-back or reduced habitat connectivity.

Recommendations for management of high-threat weeds that considers fauna impacts, including the staged removal of Blackberry thickets and replacement of Blackberry and Willow thickets with revegetation are provided in Section 4.



Photograph 8. Blackberry thicket photographed at the management area alongside native semi-aquatic vegetation

4. Conservation Management Plan

4.1 Management approach

Recommended key ecological priorities, include the control of high-threat invasive weed species and the restoration of existing indigenous vegetation communities. Management recommendations within this plan are based on ecological best practice and the strategic prioritisation of effort for optimal biodiversity and functional outcomes.

4.1.1 Hierarchical weed control

Improvements in ecological condition are directly related to the level of management effort. However, the amount of resourcing is not defined at this stage. A hierarchical weed control approach is therefore recommended, whereby high-threat invasive species are given highest priority for control efforts, followed by the strategic removal of moderate and low-threat species. This approach facilitates progressive improvement in vegetation quality that prioritises the highest threats across the site (and is commensurate to available budgets).

4.1.2 Practitioner experience

This plan operates under the assumption that personnel responsible for implementing vegetation management are suitably qualified and possess adequate knowledge of ecological processes and management techniques. Their expertise is essential to correctly identify species, to interpret seasonal variations, to adapt management to changing conditions, and to implement site-specific management methods that align with the objectives outlined in this plan.

It's also essential that management practitioners have an in-depth understanding of the native fauna species present and their habitat requirements, so as not to adversely impact existing habitat while controlling invasive plant species.

4.2 Weed management

4.2.1 Hierarchy of methods

A hierarchical approach balancing efficiency, efficacy and environmental impact is recommended to weed management (Figure 8). A particular method is deemed suitable if it is equal to or less than three times ($\leq 3X$) the resource allocation than the following method category, while effectively treating the target species.

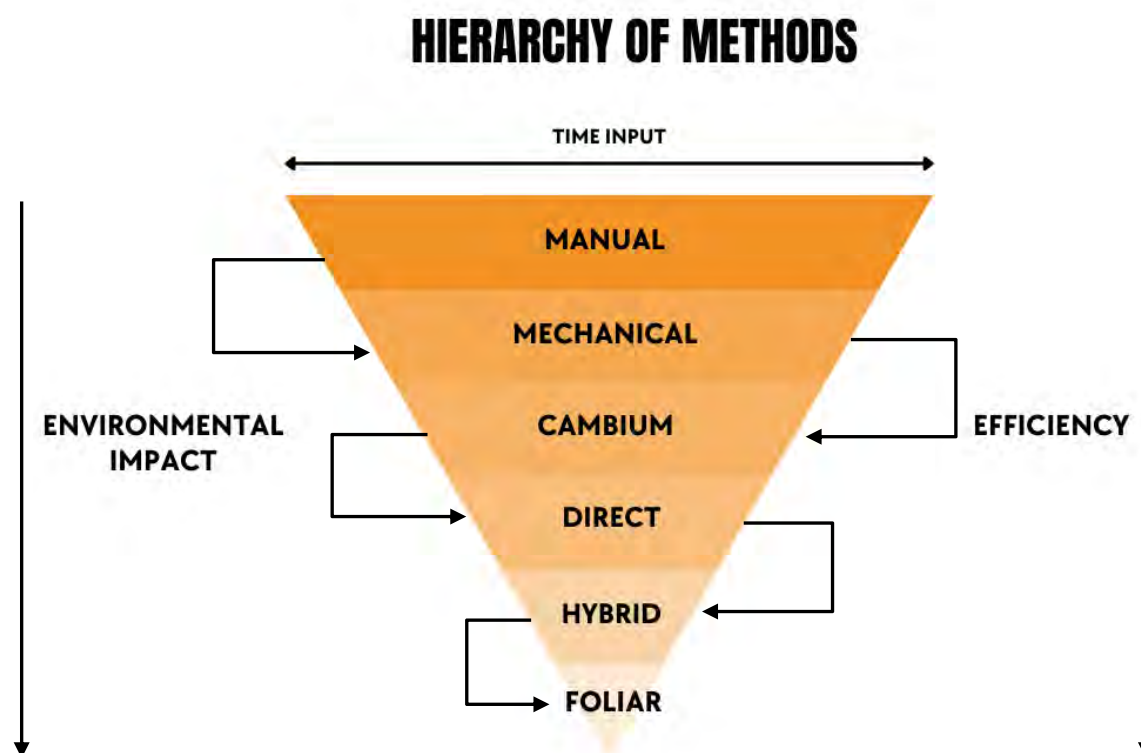


Figure 8. Hierarchy of weed management methods

The methods shown in Figure 8 in order to time input, are defined as:

Manual methods: hand weeding, skirting or excavation (via shovel or Hori Hori).

Mechanical methods: brush cutting / tri-blading, ring barking, felling

Cambium methods: capsule injection, drill & fill, frill & fill, cut & paint, scrape & paint

Direct methods: wick wiping, swiping

Hybrid methods: brush cut / tri-blade followed by foliar application

Foliar methods: foliar herbicide application via knapsack

Hybrid methods can reduce herbicide usage by ~50%, reduce the likelihood of off-target damage to indigenous species and reduce occupational health and safety risks.

4.2.2 Herbicide use

Herbicide use should be minimised wherever practical, particularly due to the proximity of vegetation within and adjacent to the Langwarrin Creek. Nonetheless, in many instances, herbicide application significantly

enhances both the efficiency and effectiveness of weed control and is therefore considered an essential component of the integrated management strategy.

Table 4 outlines relevant environmental constraints to manage risks to aquatic ecosystems, native flora and fauna, and non-target organism, as prescribed by the Australian Pesticides and Veterinary Medicines Authority (APVMA) and Agriculture Victoria (AgVic). These restraints pertain primarily to application in proximity to water and do not encompass all legal or label-specific conditions. It is assumed that all personnel responsible for herbicide application are appropriately qualified, trained and fully informed of all legislative requirements and product-specific guidelines.

Herbicides categorised by “APVMA” must be used in accordance with the general spray drift restraints issued by (APVMA & AgVic 2022). The “APVMA Coarse” classification applies specifically to Lontrel (Clopyralid), where application is only restricted by droplet size. Products listed under “Open Water” are prohibited from being applied directly into or under water, while those noted as “None” are not subject to specific buffer zone restrictions near water bodies.

While not an exhaustive inventory, the herbicides listed in Table 4 reflect the suite of chemical controls considered appropriate and necessary to achieve the vegetation management objectives at the management.

Table 4. Herbicide restraint use table

Trade name	Active constituent	Restraint	Herbicide specificity type
Lontrel	Clopyralid	APVMA (Coarse)	Asteraceae and Fabaceae selective*
Starane	Fluroxypyr	None	Broadleaf selective
Kamba-M	MCPA / Dicamba	APVMA	Broadleaf selective
Clear Up Bio 360	Glyphosate	None	General (non-selective)
MetMac600	Metsulfuron-methyl	Open Water	Geophytes and perennial dicots
Status	Clethodim	Open Water	Grass selective
Fusilade Forte	Fluazifop-P	APVMA	Grass selective
Verdict	Haloxypop	None	Grass selective
Vigilant II	Aminopyralid / Picloram	None	Woody weeds, scramblers & climbers

*Can damage numerous non-related species

4.3 Tree die-back

Tree dieback (hereafter *dieback*) occurs at various locations on higher elevations within the management area (Photograph 6). Dieback is referred to in this context as the long-term decline in tree health, often resulting in tree death. Both Eucalyptus and Acacia species appear to be suffering from dieback at the management area.

Dieback is thought to be caused by complex interactions between biotic and abiotic factors, which are generally related to climatic conditions and biological processes (often both in combination) (Jurskis, 2005). The hydrology of the management area has been significantly modified (Section 1.3.2), which may be contributing to die-back possibly due to water seepage through sandy soils from the Langwarrin Creek (the Langwarrin Creek holds permanent water, which wasn't likely prior to hydrological modifications).

Dieback can also be caused by Cinamon Fungus *Phytophthora cinnamomi*, which if the case, is likely to be affecting trees in the local area. Enquires with local land holders and over-the-fence observations would aid in determining the extent of die-back in the local area. If dieback is occurring nearby, then this may suggest that Cinamon Fungus may be a contributing factor at the site, rather than the site's hydrological alterations alone. Cinnamon Fungus can be treated, although not eliminated (see recommendations below).

Other site-specific causes of dieback at the management could include over-browsing by possums, although the precise causes may not be identified. The suggested measures below are not necessarily proven to be effective in the current context for the prevention of dieback, however, in the absence of the defined causes of tree decline, the measures below are suggested as relatively low-cost measures worthy of trialling, that will also benefit the biodiversity values at the reserve in other ways:

- The application of integrated weed control methods to reduce reliance on herbicides, which incorporates a combination of manual removal, the use of a brush-cutter and flame thrower and herbicide,
- Test for, and treat *Phytophthora* spp., including Cinamon Fungus *Phytophthora cinnamomi*, which is known to contribute to dieback. Investigate the safety and effectiveness of Phosphite to suppress Cinamon Fungus to counter dieback if Cinamon Fungus is known to be, or thought to be the cause. Phosphite works by enhancing the plant's natural defence mechanisms, making it more resistant to the pathogen. See Arthur Rylah Institute for more information: [ARI Seminar | Fighting Phytophthora | Associate Professor Barbara Wilson and Dr Mark Garkaklis](#),
- Minimise the use of broadleaf selective ester formulations that volatilise (eg Garlon®, Grazon®), particularly in hot weather.
- Avoid all residual herbicides that can impact mycorrhizal fungi colonisation such as picloram and aminopyralid (eg. Vigilant®).
- Avoid spraying herbicides with root uptake properties such as Metsulfuron, which can cause off-target impacts to trees (Di-Bak injectors away from remnant trees are ok). Grass selective herbicides can be used to control Kikuyu, Ehrharta beneath trees with no known impacts on tree health,
- Plant dense and species diverse islands of indigenous shrubs near affected Eucalypts in areas devoid of mid-storey to encourage small insect feeding birds (thereby changing the local invertebrate ecology and possibly reducing insect attack on trees),
- Burn small areas of the site in cooler months (if fire risks can be adequately managed). Protect trees from burning. Control regenerating Bracken and weeds to promote natural post-fire regeneration (refer to following section),
- Seek updates on the latest Phytophthora research and treatment options through organisations such as the Arthur Rylah Institute (ARI) and the Department of Energy, Environment and Climate Action (DEECA).

Keep detailed and accurate records of any trials that are undertaken, to evaluate the effectiveness of the actions. Detailed records will also allow the history of the trial to be passed on to successive site managers for continuity.

4.4 Revegetation

Indigenous species sourced from local provenance stock are recommended for supplementary planting in areas of bare ground following the removal of Blackberry and Willows. Revegetation to address dieback, in accordance with recommendations in Section 4.3 may also be appropriate.

Where possible, select plant species for revegetation that currently occur within the management area. If additional species are required, use VBA data and flora species that occur within Heathy Woodland, Swamp Scrub and Swampy Woodland in the Pearcedale area and correlate planting with EVC mapping shown Figure 6. Additional species could also be selected with reference to Oates & Taranto (2001) EVC descriptions.

Rabbits were observed in apparently high numbers, particularly on sandy soils (Heathy Woodland). Plant protection for revegetation, such as tree guards, or small fenced areas are therefore recommended.

4.5 Pest animals

4.5.1 Rabbits

Rabbit control presents significant challenges at the site due to:

- dense vegetation, which makes locating warrens difficult, and also allows rabbits to harbour in vegetation (rather than burrowing).
- The potential presence of small native mammals, which makes certain control methods such as Pindone unsuitable due to unintentional poisoning.
- Rabbit populations are likely to be well established on surrounding properties, which would lead to rapid re-infestation of the management area following control efforts.

Broad-scale rabbit-proof fencing of the entire management area is also considered inappropriate due to the disruptions this would cause to habitat connectivity for ground-dwelling fauna.

Unless sustained rabbit control program can be coordinated with neighbouring landholders, and substantial funds are available for long-term control, it is recommended to limit rabbit control to micro-site protection of revegetation and the rabbit-proof fencing of any small patches of high-value plants (such as orchids).

4.5.2 Foxes and cats

Fox and cat control present many of the same challenges as rabbit control due to dense vegetation, the potential difficulty in locating dens, the potential for rapid re-infestation of the management area following control efforts and the unsuitability of certain poisons due to proximity to residential properties.

Fox control would also be onerous and requires a long-term commitment. It is recommended to contact a licenced pest controller to quote on methods of highest efficacy and lowest impact on the ecology of the site.

Cat traps are routinely set within the Moonlit Sanctuary property. Cat traps have limited efficacy, particularly after a domestic cat has been trapped and returns to the site (the cat will not enter the trap if it has been previously trapped).

4.5.3 Habitat management for fauna

Aquatic fauna

Investigate options to increase habitat suitability for native fish by consulting an aquatic ecologist. For example, explore whether the cover of *Lemna* sp. Duckweed could be reduced through periodic manual removal to increase light availability for other native aquatic flora to encourage increased aquatic floristic diversity.

Threatened fauna species

The site has the potential to support threatened fauna species, including Latham's Snipe. Latham's Snipe is regularly observed by the authors in the south-east Melbourne region within dense, treeless, weed dominated understorey on the margins of wetlands and slow-flowing watercourses. Habitat adjacent to the Langwarrin Creek near Tyabb-Tooradin Road could therefore potentially support the species. Consideration of Latham's Snipe habitat requirements in City of Casey maintenance activities is therefore recommended, as part of broader actions to work with City of Casey to avoid and minimise impacts (as described in Recommendations Section 5.1).

An assessment of the likelihood of occurrence of threatened fauna species is recommended (as described in Recommendations Section 5.1).

Terrestrial fauna

Incorporate terrestrial fauna habitat considerations into the management of the site (both aquatic and terrestrial fauna), including the:

- gradual removal of woody weeds,
- gradual removal of understorey herbaceous and grassy weeds to facilitate the recruitment of indigenous plants for continuity of faunal habitat for small ground-dwelling fauna, such as Australian Swamp Rat *Rattus lutreolus*,
- retention of all trees and native vegetation,
- exploration of tree-dieback causes (as detailed above)
- retention of fallen trees, logs and litter,
- maintenance of a diversity of habitats, including structurally diverse understorey and canopy.

Incorporate aquatic fauna habitat considerations into the management of the site, including:

- Liaison with City of Casey to establish a works plan that aims to avoid and minimise impacts to the Langwarrin Creek during scheduled earth works for flood mitigation,
- revegetation of disturbed areas following City of Casey flood mitigation works using indigenous terrestrial, aquatic and semi-aquatic species that readily colonise artificial substrates to expediate habitat recovery following disturbance,

- Rubbish removal from the creek on a regular basis (as per Table 5),
- Prevention of herbicide entering the waterway, the selection of appropriate herbicides and the minimisation of herbicide use where possible in areas adjacent to the creek (as per Section 4.2.2),
- Address effluent containment issues at the fodder crop (as per Table 5).
- Investigate habitat management options to increase habitat suitability for native fish with an aquatic ecologist. For example, explore whether the cover of *Lemna* sp. Duckweed could be reduced through periodic manual removal to increase light availability for native aquatic flora to encourage increased aquatic floristic diversity.

4.6 Management actions

A five-year management plan is provided on the following pages (Table 5), with reference to Map Appendix 3.

Table 5. 5-year management plan

					Cover reduction targets					
Zone / polygon	Area (ha)	Management aims	Recommended methods	Priority	Current	Year 1	Year 2	Year 3	Year 4	Year 5
Blackberry thickets	0.267	Control Blackberry <1% cover within areas identified as Blackberry thicket (and throughout the remainder of the management area).	Tri-blade to remove biomass in mosaic pattern (5m x 5m) prior to spraying (particularly near the creek) Selective foliar application. Leave half un-treated in a mosaic in Year 1 and treat remainder in Year 2 to allow fauna to adapt.	High	80%	40%	10%	5%	1%	<1%
Willow infestation	0.122	Eliminate Willow	Di-Bak M stem injector with Metsulfuron-methyl active ingredient / constituent	High	90%	5%	<1%	0%	0%	0%
Kikuyu infestation	0.104	Control Kikuyu to <1% cover	Grass selective herbicide (Haloxypop, Fluazifop-p and/or Clethodim).	High	35%	5%	1%	<1%	<1%	<1%
Swamp Scrub High Threat Weeds	3.014	Control high-threat weeds (in addition to Blackberry thickets and Willows), including isolated blackberry, Hawthorn, Red Ink-weed and others.	Cut & paint Selective foliar application hand weed Di-Bak stem injector with Metsulfuron-methyl for mature tree-form woody weeds	High	20%	10%	5%	1%	<1%	<1%
Swamp Scrub Moderate Threat Weeds	3.014	Control moderate threat weeds, including perennial grasses, such as Sweet Vernal-grass and Cocksfoot as a second priority to high-threat weeds.	Cut & paint Selective foliar application hand weed	Moderate	60%	50%	40%	30%	20%	<20%
Heathy Woodland High Threat Weeds	0.443	Control high-threat weeds (in addition to Blackberry thickets), including isolated Blackberry, Briar Rose, Hawthorn and others.	Cut & paint Selective foliar application hand weed Di-Bak stem injector with Metsulfuron-methyl for mature tree-form woody weeds	High	10%	5%	1%	<1%	<1%	<1%
Heathy Woodland Moderate Threat Weeds	0.443	Control moderate threat weeds, including perennial grasses, such as Sweet Vernal-grass and Cocksfoot as a second priority to high-threat weeds.	Cut & paint Selective foliar application hand weed	Moderate	50%	40%	30%	20%	<20%	<20%
Swampy Woodland High Threat Weeds	0.322	Control high-threat weeds, primarily isolated Kikuyu (outside of Kikuyu polygon) along with occasional Hawthorn, Blackberry and other woody weeds	Cut & Paint Selective Foliar Application Di-Bak stem injector with Metsulfuron-methyl for mature tree-form woody weeds	High	5%	1%	<1%	<1%	<1%	<1%
Swampy Woodland Moderate Threat Weeds	0.322	Control moderate threat weeds, including perennial grasses, such as Cocksfoot as a second priority to high-threat weeds.	Cut & Paint Selective Foliar Application Hand Weed	High	50%	40%	30%	20%	<20%	<20%

Zone / polygon	Area (ha)	Management aims	Recommended methods	Priority
Swamp Scrub	3.014	Throw seed and divide uncommon sedges and rushes into similar habitat throughout the site	Seed dispersal species include <i>Juncus amabilis</i> and <i>Carex appressa</i> . Replanting after division species include <i>Machaerina juncea</i> , <i>Isolepis</i> sp., <i>Lobelia anceps</i> .	Moderate
Swamp Scrub	3.014	Search for autumn flowering orchids in moss beds so that colonies can be hand-weeded	Random meander search in suitable habitat. Record any locations and mark with a permanent stake. Hand weed the colony (no herbicide or disturbance)	Moderate
Fodder crop	0.272	Prevent effluent runoff from entering bushland zones and waterway.	Contain effluent by creating contour swales planted with indigenous semi-aquatic species to impede surface flows	High
Fodder crop	0.272	Monitor surrounding areas for fodder crop plants colonising and invading adjacent native vegetation.	3-6 monthly monitoring	Moderate
All Zones	4.536	Determine possible tree-dieback causes.	Determine if tree die-back is a local phenomenon or if site species hydrology is more likely the cause. If a local phenomenon, test for the presence of cinnamon fungus <i>Phytophthora cinnamomi</i> and consider Phosphite application if necessary. Try self-test kit (eg. www.treelogictools.com.au) or send sample to laboratory for confirmation prior to treatment.	High
All zones	4.536	Remove plastic rubbish and tree-guards from established revegetation	Bag rubbish, including rubbish within Langwarrin Creek for disposal in landfill or plastic recycling	Moderate
All zones	4.536	Revegetation to maintain habitat connectivity and increase plant diversity	Supplementary planting to re-introduce canopy trees and understorey diversity with prioritisation given to bare areas left after Blackberry, Willow and Kikuyu removal. Source seed from within the site.	High
All zones	4.536	Ensure any future site works do not result in the removal of native vegetation. Seek planning permission for any proposed native vegetation removal that cannot be avoided.	Engage a DEECA certified ecological consultant to advise on avoidance, minimisation of impacts, native vegetation removal permits and offset requirements,	High

5. Conclusion and recommendations

5.1 Recommendations

- Investigate opportunities for environmental grant opportunities such as the Melbourne Water *Liveable Communities, Liveable Waterways Program*, which can fund works to improve waterway vegetation management, stormwater management, rural land management to support improved water quality outcomes and other targeted program initiatives.
- Liaise with City of Casey to determine if any future works in the Langwarrin Creek can be undertaken in a manner that avoids or minimises potential impacts to the site. For example, the removal of spoil following the works, or containing the works to a pre-defined footprint that avoids or minimises impacts to native vegetation.
- Undertake master planning for the site to determine the siting and extent of any future construction works with the aim of avoiding impacts to native vegetation and habitat. Undertake additional native vegetation mapping in areas outside of the management area if necessary (to compliment mapping undertaken during this study).
- Engage a contractor with demonstrated specialist skills in bushland management to enact the recommended management actions outlined in this plan.
- Undertake revegetation in accordance with this plan and prepare a revegetation plan to guide species selections, planting density and site preparation.
- Incorporate terrestrial fauna habitat considerations into the management of the site (both aquatic and terrestrial fauna), as described in Section 4.5.3.
- Undertake a threatened species likelihood of occurrence assessment and modify the site management accordingly for any species considered to have a high likelihood of occurrence (if applicable).
- Investigate any opportunities to improve habitat connectivity for Koalas and other fauna between the Koala bio-corridor (on the opposite site of the Tyabb-Tooradin Road) and the Moonlit Sanctuary.
- Incorporate aquatic fauna habitat considerations into the management plan, as described in Section 4.5.3.

5.2 Conclusion

The management area represents a site of *very high* local conservation significance (Shepherd & Garden 2025), due to its potential to support threatened species, its ecological integrity and its location within a defined biolink area (Ecology Systems 2025). Management of the site therefore presents an important opportunity to improve a substantial area of habitat within an area of important landscape context in the south-east Melbourne region.

References

ANGFA (2022). *Langwarrin Creek Fish Survey; Moonlit Sanctuary Wildlife Park, 6 August 2022*. Unpublished report for Moonlit Sanctuary by Australian & New Guinea Fishes Association (ANGFA).

APVMA & Agriculture Victoria (2022) *Spray drift restraints and buffer zones*, Agriculture Victoria. Accessed online: <https://agriculture.vic.gov.au/farm-management/chemicals/spraying-agricultural-chemicals/managing-spray-drift/spray-drift-restraints-and-buffer-zones>

Atlas of Living Australia (2026). Atlas of Living Australia biological database. Accessed online: spatial.ala.org.au

DELWP (2017). *Guidelines for the removal, destruction or lopping of native vegetation*. Department of Environment, Land, Water and Planning, Victoria.

DEECA (2026a). *NatureKit*. Department of Environment, Land Water & Planning. Accessed online: <http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit>

DEECA (2026b). Victorian Biodiversity Atlas. Victorian Government Department of Environment, Land Water & Planning. Accessed online: <https://vba.dse.vic.gov.au/vba/index.jsp>

DEECA (2026c) Ecological Vegetation Class Benchmarks by bioregion. Victorian Government Department of Environment, Land Water & Planning. Accessed online: <http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/evc-benchmarks>

DSE (2004). *Vegetation Quality Assessment Manual – Guidelines for applying the habitat hectares scoring method Version 1.3* Department of Sustainability and Environment, Melbourne.

Ecology Systems (2025). *City of Casey Biolinks Plan 2025*. Unpublished report prepared for the City of Casey by Ecology Systems.

Jurskis, V. (2005). Eucalypt decline in Australia, and a general concept of tree decline and dieback. *Forest Ecology and Management Volume 215, Issues 1–3*, 25 August 2005, Pages 1–20.

Geoscience Australia (2026). Historical Aerial Photography: Accessed online: <https://www.ga.gov.au/scientific-topics/national-location-information/historical-aerial-photography>

Google Earth (2026). Microsoft Windows 11 Google Earth application. Accessed via desktop computer.

iNaturalist (2026). iNaturalist citizen science biological database. Accessed online: <https://www.inaturalist.org/>.

Oates, A. & Taranto, M (2001). *Vegetation mapping of the Port Phillip and Westernport region*. Arthur Rylah Institute for Environmental Research.

Shepherd & Garden (2025). *City of Casey Sites of Biodiversity Significance: Biodiversity Assessment Stage 2*. Unpublished report by Shepherd Ecological and Ecology Systems for the City of Casey.

APPENDIX 1. Fauna species recorded at the Moonlit property and surrounds

Group	Common name	Scientific name	Source
Amphibian	Eastern common froglet	<i>Crinia signifera</i>	Michael Johnson
	Growling grass frog	<i>Litoria raniformis</i>	Michael Johnson
	Pobblebonk	<i>Limnodynastes dumerilii</i>	Michael Johnson
	Southern brown tree frog	<i>Litoria ewingii</i>	Michael Johnson
	Peron's Tree Frog	<i>Litoria peroni</i>	Gerry Marantelli
	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	Gerry Marantelli
	Southern Toadlet	<i>Pseudophryne semimarmorata</i>	Gerry Marantelli
	Striped marsh frog	<i>Limnodynastes peronii</i>	Michael Johnson
	Whistling tree frog	<i>Litoria verreauxii</i>	Michael Johnson
Bird	Australasian grebe	<i>Tachybaptus novaehollandiae</i>	Michael Johnson
	Australasian shoveler	<i>Spatula rhynchotis</i>	Michael Johnson
	Australasian swampphen	<i>Porphyrio melanotos</i>	Michael Johnson
	Australian boobook	<i>Ninox boobook</i>	Michael Johnson
	Australian darter	<i>Anhinga novaehollandiae</i>	Michael Johnson
	Australian golden whistler	<i>Pachycephala pectoralis</i>	Michael Johnson
	Australian king parrot	<i>Alisterus scapularis</i>	Michael Johnson
	Australian magpie	<i>Gymnorhina tibicen</i>	Michael Johnson
	Australian pelican	<i>Pelecanus conspicillatus</i>	Michael Johnson
	Australian shelduck	<i>Tadorna tadornoides</i>	Michael Johnson
	Australian white ibis	<i>Threskiornis molucca</i>	Michael Johnson
	Australian wood (maned) duck	<i>Chenonetta jubata</i>	Michael Johnson
	Barking owl	<i>Ninox connivens</i>	Michael Johnson
	Bell miner	<i>Manorina melanophrys</i>	Michael Johnson
	Black swan	<i>Cygnus atratus</i>	Michael Johnson
	Black-faced cuckooshrike	<i>Coracina novaehollandiae</i>	Michael Johnson
	Black-fronted dotterel	<i>Thinornis melanops</i>	Michael Johnson
	Black-shouldered kite	<i>Elanus axillaris</i>	Michael Johnson
	Black-shouldered lapwing	<i>ss novaehollandiae</i>	Michael Johnson
	Black-tailed native-hen	<i>Tribonyx ventralis</i>	Michael Johnson
	Brown goshawk	<i>Tachyspizar fasciatus</i>	Michael Johnson
	Brown thornbill	<i>Acanthiza pusilla</i>	Michael Johnson
	Cape Barren goose	<i>Cereopsis novaehollandiae</i>	Michael Johnson
	Collared sparrowhawk	<i>Astur cirrocephalus</i>	Michael Johnson
	Common (Indian) mynah	<i>Acridotheres tristis</i>	Michael Johnson
	Common bronzewing	<i>Phaps chalcoptera</i>	Michael Johnson
	Crested pigeon	<i>Ocyphaps lophotes</i>	Michael Johnson
	Dusky moorhen	<i>Gallinula tenebrosa</i>	Michael Johnson
	Dusky woodswallow	<i>Artamus cyanopterus</i>	Michael Johnson
	Eastern barn owl	<i>Tyto javanica</i>	Michael Johnson
	Eastern crested shrike-tit	<i>Falcunculus frontatus</i>	Michael Johnson
	Eastern great egret	<i>Ardea modesta</i>	Michael Johnson
	Eastern rosella	<i>Platycercus eximius</i>	Michael Johnson

Group	Common name	Scientific name	Source
	Eastern spinebill	<i>Acanthorhynchus tenuirostris</i>	Michael Johnson
	Eastern yellow robin	<i>Eopsaltria australis</i>	Michael Johnson
	Eurasian coot	<i>Fulica atra</i>	Michael Johnson
	European blackbird	<i>Turdus merula</i>	Michael Johnson
	European goldfinch	<i>Carduelis carduelis</i>	Michael Johnson
	European starling	<i>Sturnus vulgaris</i>	Michael Johnson
	Fairy martin	<i>Petrochelidon ariel</i>	Michael Johnson
	Fan-tailed cuckoo	<i>Cacomantis flabelliformis</i>	Michael Johnson
	Flame robin	<i>Petroica phoenicea</i>	Michael Johnson
	Galah	<i>Eolophus roseicapilla</i>	Michael Johnson
	Golden-headed cisticola	<i>Cisticola exilis</i>	Michael Johnson
	Great cormorant	<i>Phalacrocorax carbo</i>	Michael Johnson
	Grey butcherbird	<i>Cracticus torquatus</i>	Michael Johnson
	Grey currawong	<i>Strepera versicolor</i>	Michael Johnson
	Grey fantail	<i>Rhipidura albiscapa</i>	Michael Johnson
	Grey goshawk	<i>Tachyspiza novaehollandiae</i>	Michael Johnson
	Grey shrikethrush	<i>Colluricincla harmonica</i>	Michael Johnson
	Grey teal	<i>Anas gracilis</i>	Michael Johnson
	Hardhead	<i>Aythya australis</i>	Michael Johnson
	Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>	Michael Johnson
	Horsfield's bronze-cuckoo	<i>Chrysococcyx basalis</i>	Michael Johnson
	House sparrow	<i>Passer domesticus</i>	Michael Johnson
	Jacky winter	<i>Microeca fascians</i>	Michael Johnson
	Latham's snipe	<i>Gallinago hardwickii</i>	Michael Johnson
	Laughing kookaburra	<i>Dacelo novaeguineae</i>	Michael Johnson
	Little black cormorant	<i>Phalacrocorax sulcirostris</i>	Michael Johnson
	Little corella	<i>Cacatua sanguinea</i>	Michael Johnson
	Little eagle	<i>Hieraaetus morphnoides</i>	Michael Johnson
	Little lorikeet	<i>Parvipsitta pusilla</i>	Michael Johnson
	Little pied cormorant	<i>Microcarbo melanoleucos</i>	Michael Johnson
	Little raven	<i>Corvus mellori</i>	Michael Johnson
	Little wattlebird	<i>Anthochaera chrysoptera</i>	Michael Johnson
	Masked lapwing	<i>Vanellus miles</i>	Michael Johnson
	Mudlark (magpie-lark)	<i>Grallina cyanoleuca</i>	Michael Johnson
	Musk lorikeet	<i>Glossopsitta concinna</i>	Michael Johnson
	Nankeen kestrel	<i>Falco cenchroides</i>	Michael Johnson
	Nankeen night heron	<i>Nycticorax caledonicus</i>	Michael Johnson
	New Holland honeyeater	<i>Phylidonyris novaehollandiae</i>	Michael Johnson
	Noisy miner	<i>Manorina melanocephala</i>	Michael Johnson
	Orange-bellied parrot	<i>Neophema chrysogaster</i>	Michael Johnson
	Pacific black duck	<i>Anas superciliosa</i>	Michael Johnson
	Pacific gull	<i>Larus pacificus</i>	Michael Johnson
	Pacific koel	<i>Eudynamis orientalis</i>	Michael Johnson
	Pacific swift	<i>Apus pacificus</i>	Michael Johnson
	Pallid cuckoo	<i>Heteroscenes pallidus</i>	Michael Johnson
	Pied currawong	<i>Strepera graculina</i>	Michael Johnson
	Plumed egret	<i>Ardea plumifera</i>	Michael Johnson

Group	Common name	Scientific name	Source
	Rainbow lorikeet	<i>Trichoglossus moluccanus</i>	Michael Johnson
	Red wattlebird	<i>Anthochaera carunculata</i>	Michael Johnson
	Red-browed finch	<i>Neochmia temporalis</i>	Michael Johnson
	Red-capped robin	<i>Petroica goodenovii</i>	Michael Johnson
	Royal spoonbill	<i>Platalea regia</i>	Michael Johnson
	Rufous fantail	<i>Rhipidura rufifrons</i>	Michael Johnson
	Sacred kingfisher	<i>Todiramphus sanctus</i>	Michael Johnson
	Sahul brush cuckoo	<i>Cacomantis variolosus</i>	Michael Johnson
	Silveryeye	<i>Zosterops lateralis</i>	Michael Johnson
	Spotted pardalote	<i>Pardalotus punctatus</i>	Michael Johnson
	Spotted turtle-dove	<i>Spilopelia chinensis</i>	Michael Johnson
	Straw-necked ibis	<i>Threskiornis spinicollis</i>	Michael Johnson
	Striated fieldwren	<i>Calamanthus fuliginosus</i>	Michael Johnson
	Striated pardalote	<i>Pardalotus striatus</i>	Michael Johnson
	Striated thornbill	<i>Acanthiza lineata</i>	Michael Johnson
	Sulphur-crested cockatoo	<i>Cacatua galerita</i>	Michael Johnson
	Superb fairywren	<i>Malurus cyaneus</i>	Michael Johnson
	Swamp harrier	<i>Circus approximans</i>	Michael Johnson
	Tawny frogmouth	<i>Podargus strigoides</i>	Michael Johnson
	Tree martin	<i>Petrochelidon nigricans</i>	Michael Johnson
	Varied sittella	<i>Daphoenositta chrysoptera</i>	Michael Johnson
	Wedge-tailed eagle	<i>Aquila audax</i>	Michael Johnson
	Weebill	<i>Smicromis brevirostris</i>	Michael Johnson
	Welcome swallow	<i>Hirundo neoxena</i>	Michael Johnson
	Whistling kite	<i>Haliastur sphenurus</i>	Michael Johnson
	White-browed scrubwren	<i>Sericornis frontalis</i>	Michael Johnson
	White-browed woodswallow	<i>Artamus superciliosus</i>	Michael Johnson
	White-eared honeyeater	<i>Nesoptilotis leucotis</i>	Michael Johnson
	White-faced heron	<i>Egretta novaehollandiae</i>	Michael Johnson
	White-fronted chat	<i>Epthianura albifrons</i>	Michael Johnson
	White-necked heron	<i>Ardea pacifica</i>	Michael Johnson
	White-plumed honeyeater	<i>Ptilotula penicillata</i>	Michael Johnson
	Willy wagtail	<i>Rhipidura leucophrys</i>	Michael Johnson
	Yeliow-faced honeyeater	<i>Caligavis chrysops</i>	Michael Johnson
	Yellow thornbill	<i>Acanthiza nana</i>	Michael Johnson
	Yellow-billed spoonbill	<i>Platalea flavipes</i>	Michael Johnson
	Yellow-rumped thornbill	<i>Acanthiza chrysorrhoa</i>	Michael Johnson
	Yellow-tailed black cockatoo	<i>Zanda funereus</i>	Michael Johnson
Fish	Cobbler	<i>Gymnapistes marmoratus</i>	ANGFA
	Common Galaxias	<i>Galaxias maculatus</i>	ANGFA
	Congolli or Tupong	<i>Pseudephritis urvillii</i>	ANGFA
	Eastern Gambusia	<i>Gambusia holbrooki</i>	ANGFA
	European Carp	<i>Cyprinus carpio</i>	ANGFA
	Firetail Gudgeon	<i>Hypseleotris galii</i>	ANGFA
	Glassgoby	<i>Gobiopterus semivestitus</i>	ANGFA
	Goldfish	<i>Carassius auratus</i>	ANGFA
	Mullet	<i>Mugil spp.</i>	ANGFA

Group	Common name	Scientific name	Source
	Short-finned eel	<i>Anguilla australis</i>	Michael Johnson & ANGFA
	Spotted Galaxias	<i>Galaxias truttaceus</i>	ANGFA
	Tamar Goby	<i>Afurcagobius tamarensis</i>	ANGFA
	Western mosquitofish	<i>Gambusia affinis</i>	Michael Johnson
Invertebrate	African black beetle	<i>Heteronychus arator</i>	Michael Johnson
	Aregentine ant	<i>Linepithema humile</i>	Michael Johnson
	Au common garden katydid	<i>Caedicia simplex</i>	Michael Johnson
	Au yellow-winged grasshopper	<i>Gastrimargus musicus</i>	Michael Johnson
	Australian bush fly	<i>Musca vetustissima</i>	Michael Johnson
	Australian emerald dragonfly	<i>Hemicordulia australiae</i>	Michael Johnson
	Australian garden orbweaver	<i>Hortophora transmarina</i>	Michael Johnson
	Australian painted lady	<i>Vanessa kershawi</i>	Michael Johnson
	Australian paralysis tick	<i>Ixodes holocyclus</i>	Michael Johnson
	Australian plague locust	<i>Chortoicetes terminifer</i>	Michael Johnson
	Autumn gum moth	<i>Mnesampela privata</i>	Michael Johnson
	Badge huntsman	<i>Neosparassus diana</i>	Michael Johnson
	Banded garden-spider	<i>Argiope trifasciata</i>	Michael Johnson
	Banded sugar ant	<i>Camponotus consobrinus</i>	Michael Johnson
	Black house spider	<i>Badumna insignis</i>	Michael Johnson
	Black spot moth	<i>Epicoma melanospila</i>	Michael Johnson
	Blue ant	<i>Diamma bicolor</i>	Michael Johnson
	Blue ringtail	<i>Austrolestes annulosus</i>	Michael Johnson
	Blue skimmer	<i>Orthetrum caledonicum</i>	Michael Johnson
	Blue-banded bee	<i>Amegilla cingulata</i>	Michael Johnson
	Bluetail damselfly	<i>Ischnura heterosticta</i>	Michael Johnson
	Bottlebrush sawfly	<i>Pterygophorus cinctus</i>	Michael Johnson
	Brown shield bug	<i>Poecilometis strigatus</i>	Michael Johnson
	Bush cockroach	<i>Ellipsidion humerale</i>	Michael Johnson
	Caper white	<i>Belenois java</i>	Michael Johnson
	Chestnut-veined crest moth	<i>Paralaea porphyrinaria</i>	Michael Johnson
	Common brown	<i>Heteronympha merope</i>	Michael Johnson
	Common brown crane fly	<i>Leptotarsus costalis</i>	Michael Johnson
	Common grass-blue	<i>Zizina labradus</i>	Michael Johnson
	Common hover fly (halfband)	<i>Melangyna viridiceps</i>	Michael Johnson
	Common pill woodlice	<i>Armadillidium vulgare</i>	Michael Johnson
	Couchgrass webworm	<i>Faveria tritalis</i>	Michael Johnson
	Daddy-long-legs	<i>Pholcus phalangioides</i>	Michael Johnson
	European earwig	<i>Forficula auricularia</i>	Michael Johnson
	European wasp	<i>Vespula germanica</i>	Michael Johnson
	False meadow katydid	<i>Conocephalomima barameda</i>	Michael Johnson
	Feather-horned beetle	<i>Rhipicera femorata</i>	Michael Johnson
	Garden snail	<i>Cornu aspersum</i>	Michael Johnson
	Garden wolf spider	<i>Tasmanicosa godeffroyi</i>	Michael Johnson
	German cockroach	<i>Blattella germanica</i>	Michael Johnson
	Gisborne cockroach	<i>Drymaplaneta semivitta</i>	Michael Johnson
	Green potato bug	<i>Cuspicona simplex</i>	Michael Johnson
	Harlequin red bug	<i>Dindymus versicolor</i>	Michael Johnson

Group	Common name	Scientific name	Source
	Honeybrown beetle	<i>Ecnolagria grandis</i>	Michael Johnson
	Inchman ant	<i>Muymecia forficata</i>	Michael Johnson
	Klug's xenica	<i>Geitoneura klugii</i>	Michael Johnson
	Knobbed orbweaver	<i>Eriophora pustulosa</i>	Michael Johnson
	Leaf-curling spider	<i>Phonognatha graeffei</i>	Michael Johnson
	Margin-winged stick insect	<i>Ctenomorphodes chronus</i>	Michael Johnson
	Meadow argus	<i>Junonia villida</i>	Michael Johnson
	Milky slug	<i>Deroceras reticulatum</i>	Michael Johnson
	Mountain huntsman	<i>Isopeda montana</i>	Michael Johnson
	orbweaver sp.	<i>Hortophora biapicata</i>	Michael Johnson
	Orchard swallowtail	<i>Papilio aegaeus</i>	Michael Johnson
	Passionvine hopper	<i>Scolypopa australis</i>	Michael Johnson
	Pink-bellied moth	<i>Oenochroma vinaria</i>	Michael Johnson
	Red-lined looper	<i>Crypsiphona oclutaria</i>	Michael Johnson
	Ringed xenica	<i>Geitoneura acantha</i>	Michael Johnson
	Robber fly sp.	<i>Cerdistus rusticanoides</i>	Michael Johnson
	Small pointed snail	<i>Cochlicella barbara</i>	Michael Johnson
	Small white (cabbage white)	<i>Pieris rapae</i>	Michael Johnson
	Social huntsman spider	<i>Delena cancerides</i>	Michael Johnson
	Southern moon moth	<i>Dasypodia selenophora</i>	Michael Johnson
	Southern reptile tick	<i>Bothriocroton hydrosauri</i>	Michael Johnson
	sp rove beetle	<i>Thyreocephalus sp</i>	Michael Johnson
	sp three-banded slug	<i>Ambigolimax sp</i>	Michael Johnson
	sp. chalcopertus beetle	<i>Chalcopertoides columbinus</i>	Michael Johnson
	sp. click beetle	<i>Monocrepidius erubescens</i>	Michael Johnson
	sp. cockroach	<i>Balta bicolor</i>	Michael Johnson
	sp. longhorn beetle	<i>Ancita marginicollis</i>	Michael Johnson
	sp. longhorn beetle	<i>Epithora dorsalis</i>	Michael Johnson
	sp. roundneck longhorn beetle	<i>Phacodes personatus</i>	Michael Johnson
	sp. roundneck longhorn beetle	<i>Xystrocera virescens</i>	Michael Johnson
	sp. St Andrews cross spider	<i>Argiope keyserlingi</i>	Michael Johnson
	sp. swift moth	<i>Elhamma australasiae</i>	Michael Johnson
	Spiny (Christmas jewel) spider	<i>Austracantha minax</i>	Michael Johnson
	Spitfire sawfly	<i>Perga affinis</i>	Michael Johnson
	Straight-lined carpet moth	<i>Chrysolaentia subrectaria</i>	Michael Johnson
	Swordgrass brown	<i>Tisiphone abeona</i>	Michael Johnson
	Tau emerald	<i>Hemicordulia tau</i>	Michael Johnson
	Variable antherid	<i>Anthela varia</i>	Michael Johnson
	Varied eggfly	<i>Hypolimnas bolina</i>	Michael Johnson
	Wandering ringtail	<i>Austrolestes leda</i>	Michael Johnson
	Water scorpion	<i>Laccotrephes tristis</i>	Michael Johnson
	Western honey bee	<i>Apis mellifera</i>	Michael Johnson
	Willow-herb day-moth	<i>Phalaenoides tristifica</i>	Michael Johnson
	Yellow admiral	<i>Vanessa itea</i>	Michael Johnson
	Yellow-banded dart	<i>Ocybadistes walkeri</i>	Michael Johnson
Mammal	Australian swamp rat	<i>Rattus lutreolus</i>	Michael Johnson
	Black rat	<i>Rattus rattus</i>	Michael Johnson

Group	Common name	Scientific name	Source
	Common brushtail	<i>Trichosurus vulpecula</i>	Michael Johnson
	Eastern grey kangaroo	<i>Macropus giganteus</i>	Michael Johnson
	Eastern ringtail possum	<i>Pseudocheirus peregrinus</i>	Michael Johnson
	European rabbit	<i>Oryctolagus cuniculus</i>	Michael Johnson
	Grey-headed flying fox	<i>Pteropus poliocephalus</i>	Michael Johnson
	House mouse	<i>Mus musculus</i>	Michael Johnson
	Koala	<i>Phascolarctos cinereus</i>	Michael Johnson
	Kreff's glider	<i>Petaurus notatus</i>	Michael Johnson
	Lesser long-eared bat	<i>Nyctophilus geoffroyi</i>	Michael Johnson
	Red fox	<i>Vulpes vulpes</i>	Michael Johnson
	Short-beaked echidna	<i>Tachyglossus aculeatus</i>	Michael Johnson
Reptile	Bloched blue-tounge skink	<i>Tiliqua nigrolutea</i>	Michael Johnson
	Common blue-tounge skink	<i>Tiliqua scincoides</i>	Michael Johnson
	Eastern long-necked turtle	<i>Chelodina longicollis</i>	Michael Johnson
	Lowland copperhead	<i>Austrelaps superbis</i>	Michael Johnson
	Pale-flecked (garden) sunskink	<i>Lampropholis guichenoti</i>	Michael Johnson
	Southern marbled gecko	<i>Christinus marmoratus</i>	Michael Johnson
	Tiger snake	<i>Notechis scutatus</i>	Michael Johnson

APPENDIX 2. Flora species recorded at the management area

Taxon Origin	Scientific Name	Common Name	
Indigenous (native) species			
	<i>Acacia melanoxylon</i>	Blackwood	
	<i>Adiantum aethiopicum</i>	Common Maidenhair	
	<i>Alisma plantago-aquatica</i>	Water Plantain	
	<i>Allocasuarina littoralis</i>	Black Sheoak	
	<i>Alternanthera denticulata</i>	Lesser Joyweed	
#	<i>Angophora</i> sp. (planted)	Apple	
	<i>Billardiera mutabilis</i>	Common Apple-berry	
	<i>Bursaria spinosa</i>	Sweet Bursaria	
	<i>Carex appressa</i>	Tall Sedge	
	<i>Clematis microphylla</i>	Small-leaved Clematis	
	<i>Crassula helmsii</i>	Swamp Crassula	
	<i>Dianella brevicaulis</i>	Small-flower Flax-lily	
	<i>Dianella longifolia</i> var. <i>longifolia</i>	Pale Flax-lily	
	<i>Dichondra repens</i>	Kidney-weed	
	<i>Dipodium roseum</i>	Rosy Hyacinth-orchid	
	<i>Eucalyptus ovata</i>	Swamp Gum	
	<i>Eucalyptus viminalis</i> subsp. <i>pyroriana</i>	Coast Manna-gum (planted)	
	<i>Eucalyptus viminalis</i> subsp. <i>viminalis</i>	Manna Gum	
	<i>Exocarpos cupressiformis</i>	Cherry Ballart	
	<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge	
	<i>Goodenia ovata</i>	Hop Goodenia	
	<i>Isolepis inundata</i>	Swamp Club-sedge	
	<i>Juncus amabilis</i>	Hollow Rush	
	<i>Juncus kraussii</i> subsp. <i>australiensis</i>	Sea Rush	
	<i>Kunzea leptospermoides</i>	Yarra Burgan	
	<i>Lemna</i> spp.	Duckweed	
	<i>Lepidosperma elatius</i>	Tall Sword-sedge	
	<i>Lepidosperma gunnii</i>	Slender Sword-sedge	
	<i>Lobelia anceps</i>	Angled Lobelia	
	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Mat-rush	
	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	
	<i>Lythrum hyssopifolia</i>	Small Loosestrife	
	<i>Machaerina juncea</i>	Bare Twig-sedge	
	<i>Melaleuca ericifolia</i>	Swamp Paperbark	
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass	
	<i>Myoporum insulare</i>	Common Boobialla	
	<i>Persicaria decipiens</i>	Slender Knotweed	
	<i>Persicaria lapathifolia</i>	Pale Knotweed	
	<i>Phragmites australis</i>	Common Reed	
	<i>Pteridium esculentum</i> subsp. <i>esculentum</i>	Austral Bracken	
	<i>Rytidosperma setaceum</i> var. <i>setaceum</i>	Bristly Wallaby-grass	

Taxon Origin	Scientific Name	Common Name	
	<i>Rytidosperma</i> spp.	Wallaby Grass	
	<i>Senecio minimus</i>	Shrubby Fireweed	
	<i>Solanum aviculare</i>	Kangaroo Apple	
	<i>Tetragonia tetragonioides</i>	New Zealand Spinach	
	<i>Themeda triandra</i>	Kangaroo Grass	
	<i>Typha orientalis</i>	Broad-leaf Cumbungi	
Non-native species			Threat status
#	<i>Acacia floribunda</i>	White Sallow-wattle	High
*	<i>Araujia sericifera</i>	White Bladder-flower	
*	<i>Asparagus asparagoides</i>	Bridal Creeper	
*	<i>Cenchrus clandestinus</i>	Kikuyu	
*	<i>Coprosma repens</i>	Mirror Bush	
*	<i>Cotoneaster glaucophyllus</i>	Large-leaf Cotoneaster	
*	<i>Crataegus monogyna</i>	Hawthorn	
*	<i>Lonicera japonica</i>	Japanese Honeysuckle	
*	<i>Malus</i> spp.	Pear	
*	<i>Phytolacca octandra</i>	Red-ink Weed	
#	<i>Pittosporum undulatum</i>	Sweet Pittosporum	
*	<i>Rosa rubiginosa</i>	Sweet Briar	
*	<i>Rubus anglocandicans</i>	Common Blackberry	
*	<i>Salix</i> spp.	Willow	
*	<i>Tradescantia fluminensis</i>	Wandering Jew	
*	<i>Zantedeschia aethiopica</i>	White Arum-lily	Moderate
*	<i>Agrostis capillaris</i>	Brown-top Bent	
*	<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	
*	<i>Atriplex prostrata</i>	Hastate Orache	
*	<i>Cirsium vulgare</i>	Spear Thistle	
*	<i>Cynodon dactylon</i> var. <i>dactylon</i>	Couch	
*	<i>Cyperus eragrostis</i>	Drain Flat-sedge	
*	<i>Dactylis glomerata</i>	Cocksfoot	
*	<i>Ehrharta erecta</i>	Panic Veldt-grass	
*	<i>Helminthotheca echioides</i>	Ox-tongue	
*	<i>Holcus lanatus</i>	Yorkshire Fog	
*	<i>Parietaria judaica</i>	Wall Pellitory	
*	<i>Paspalum dilatatum</i>	Paspalum	
*	<i>Phalaris aquatica</i>	Toowoomba Canary-grass	
*	<i>Rumex conglomeratus</i>	Clustered Dock	
*	<i>Rumex crispus</i>	Curled Dock	
*	<i>Solanum pseudocapsicum</i>	Madeira Winter-cherry	

Non-native species

Threat status

*	<i>Chenopodium murale</i>	Sowbane	Low
*	<i>Cotula coronopifolia</i>	Water Buttons	
*	<i>Cynosurus echinatus</i>	Rough Dog's-tail	
*	<i>Ehrharta longiflora</i>	Annual Veldt-grass	
*	<i>Erigeron bonariensis</i>	Flaxleaf Fleabane	
*	<i>Euphorbia peplus</i>	Petty Spurge	
*	<i>Lactuca serriola</i>	Prickly Lettuce	
*	<i>Lotus subbiflorus</i>	Hairy Bird's-foot Trefoil	
*	<i>Modiola caroliniana</i>	Red-flower Mallow	
*	<i>Plantago lanceolata</i>	Ribwort	
*	<i>Prunella vulgaris</i>	Self-heal	
*	<i>Rorippa palustris</i>	Marsh Yellow-cress	
*	<i>Solanum nigrum</i>	Black Nightshade	
*	<i>Symphyotrichum subulatum</i>	Aster-weed	
*	<i>Taraxacum officinale</i> spp. agg.	Garden Dandelion	
*	Exotic origin		
#	Native species occurring outside of its natural range		

APPENDIX 3. Conservation Management Plan

A Conservation Management Plan in A1 format is provided as an attachment to this report.