Officer Precinct Structure Plan: Cardinia Creek

Conservation Management Plan

Project: 10-021

Prepared for:

Growth Areas Authority

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Executive Summary

Ecology Australia Pty Ltd and Streamline Research Pty Ltd were commissioned by the Growth Areas Authority (GAA) in March 2010 to prepare a Conservation Management Plan (CMP) for the eastern side of Cardinia Creek in the Officer Precinct Structure Plan (PSP) area, between Princes Highway and Princes Freeway. The key issues for management within this corridor of Cardinia Creek relate to four species listed as threatened under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- Growling Grass Frog *Litoria raniformis*;
- Southern Brown Bandicoot *Isoodon obesulus obesulus*;
- Dwarf Galaxias *Galaxiella pusilla*; and
- Australian Grayling *Prototroctes maraena*.

Dwarf Galaxias was recorded within Cardinia Creek in the study area during the assessment and previous assessments. This species is also known to utilise the floodplain habitat for breeding when inundated. Suitable habitat within the CMP study area (e.g. floodplain and artificial wetlands) has also been identified for Growling Grass Frog and this species is considered likely to use the creek corridor for dispersal (DSE Draft Sub Regional Strategy for Growling Grass Frog. Cardinia Creek throughout the length of the study area is considered suitable for the Australian Grayling, with known records of the species downstream within Cardinia Creek, in the Clyde North Precinct area. Southern Brown Bandicoot is not known from the study area, however suitable habitat exists and Cardinia Creek has been identified as a habitat corridor for this species (DSE Draft Southern Brown Bandicoot Sub-regional Strategy).

The four species are addressed within the CMP in regards to actions for habitat protection, enhancement, creation and management. The management actions and monitoring procedures are defined under two operational phases:

- Phase One of the CMP includes requirements from the date of CMP approval through pre-Construction, construction and on-going management and monitoring stages for the 10 year post-completion of works (i.e. certification of the wetland enhancement/ modifications works by DSE). The initiation of the 10 year post-construction period for each wetland will differ depending on the completion date and certification of each site; and
- Phase Two of the CMP includes the on-going management and monitoring actions to be undertaken in perpetuity, which will commence at the completion of Phase One (i.e. 10 years following the completion of wetland modifications and creek corridor construction).

An estimate of costs associated with the CMP works/actions has been provided by the GAA. As the land manager for the Conservation Zone, Parks Victoria will be responsible for the implementation of the CMP works. The works will be funded by land owners in the Officer precinct that remove suitable threatened species habitat as outlined in Appendix 8. Land owners

are to enter into an on-title agreement with DSE (or an alternative arrangement approved by DSE) to provide funding for the CMP works. Works undertaken in the study area are to be in accordance with the CMP.

1 Introduction

1.1 Project Information

Ecology Australia Pty Ltd and Streamline Research Pty Ltd were commissioned by the Growth Areas Authority (GAA) in March 2010 to undertake habitat assessments, targeted fauna surveys and to prepare a Conservation Management Plan (CMP) for the eastern side of Cardinia Creek between Princes Highway and Princes Freeway, Officer.

The key issues for management within this corridor of Cardinia Creek relate to four threatened fauna species:

- Growling Grass Frog *Litoria raniformis* [listed as Vulnerable under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); Listed as Nationally Vulnerable by Tyler (1997) – National Action Plan for Frogs; Listed as threatened under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act)*;* and Listed as Endangered in Victoria by DSE (2007)];
- Southern Brown Bandicoot *Isoodon obesulus obesulus* [listed as Endangered under the EPBC Act, threatened under the FFG Act and listed as Near Threatened in Victoria (DSE 2007)];
- Dwarf Galaxias *Galaxiella pusilla* [listed as Vulnerable under the EPBC Act, threatened under the FFG Act and classified as Vulnerable in Victoria (DSE 2007)]; and
- Australian Grayling *Prototroctes maraena* [listed as Vulnerable under the EPBC Act, threatened under the FFG Act and classified as Vulnerable in Victoria (DSE 2007)].

Ecology Australia was engaged to prepare the CMP for the Growling Grass Frog and the Southern Brown Bandicoot. Streamline Research was subcontracted to prepare actions for the CMP regarding the Dwarf Galaxias and the Australian Grayling. These four species are addressed within the CMP in regards to habitat protection, enhancement, creation and management.

The aim of this assessment was to:

- Undertake a habitat assessment for Growling Grass Frog, Southern Brown Bandicoot, Dwarf Galaxias and Australian Grayling within selected sites in the study area;
- Conduct targeted surveys for the four threatened species within selected sites;
- Map previous records for each threatened fauna species within 10 km of the study area;
- Outline the presence and/or availability of habitat in the study area; and
- Recommend mitigation actions for protection of habitat and outline on-going management and monitoring to enhance and maintain dedicated threatened fauna habitat.

Note: the actions for the protection/enhancement of vegetation/habitat is also designed to benefit other threatened fauna species including: Latham's Snipe *Gallinago hardwickii* [listed as Near Threatened in Victoria (DSE 2007) and listed under the Migratory Schedules of the EPBC Act]; Southern Toadlet *Pseudophryne semimarmorata* [listed as Vulnerable in Victoria (DSE 2007)]; and Glossy Grass Skink *Pseudemoia rawlinsoni* [listed as Near Threatened in Victoria (DSE 2007)].

1.2 Study area

The study area is located within the Officer Precinct Structure Plan area, approximately 9.8 km west of Pakenham, Victoria (see Figure 1 and Appendix 1). The study area is bounded by Cardinia Creek to the east, Princes Freeway (Pakenham Bypass) to the south, Princes Highway to the north, and private property to the west. The northern portion of the study area (i.e. north of Rix Road) is located on public land managed by Parks Victoria. Melbourne Water currently manages a small, irregularly shaped parcel of land within the south of the study area, adjacent to the northern side of the Princes Freeway (see Figure 1). The remaining area in the south is located on private property. Figure 1 outlines the study area and future land ownership arrangements (also see Appendix 1 for study area boundary).

The study area is located within the Cardinia Shire and Gippsland Plain Bioregion.

Under the Cardinia Planning scheme, south of Rix Road, the study area is zoned as Urban Growth Zone (UGZ) and Parks Conservation and Resource Zone (PCRZ). North of Rix Road, the study area is zoned as PCRZ, Low Density Residential Zone (LDRZ) and Urban Floodway Zone (UFZ). A Public Acquisitions Overlay (PAO) in favour of Parks Victoria, covers land adjacent to the creek to the south of Rix Road (see Figure 1).

Cardinia Creek is the main waterway within the Officer Precinct. The floodplain and creek provide known habitat for the Dwarf Galaxias. Australian Grayling are also known from Cardinia Creek. Dwarf Galaxias move onto the floodplain during flood periods, while, the Australian Grayling is not expected to leave the main channel of Cardinia Creek, even when the creek is in flood. Neither Growling Grass Frog nor Southern Brown Bandicoot are known from the study area, however, the creek and associated riparian vegetation provides potential habitat for both these species.

There are several anabranches on the floodplain that inundate in different seasons. . One of the anabranches passes across the floodplain immediately to the north of the Princes Freeway and includes an existing wetland (site eight) on the channel that contained a small amount of very shallow water during the assessment. Figure 6 shows the approximate location of the 1 in 100 year floodline and the extent of floodplain habitat in the study area.

There are four artificial wetlands in the study area (See Figures 3, 5, 6). There are two artificial wetlands within the northern half of the study area (sites one and two) and two located to the south of Rix Road, near the Princes Freeway (e.g. sites eight and 10). Three of these wetlands are

proposed as dedicated habitat for the Growling Grass Frog (e.g. Site one, two and eight – see Figure 2) and are located within the Conservation Zone. The largest artificial wetland (e.g. site 10, see Figure 2), will be managed for recreational purposes. These wetlands are only expected to be connected to Cardinia Creek, during the largest floods (>1:20 year). The artificial wetlands do not currently provide suitable habitat for either the Dwarf Galaxias or Australian Grayling but provide some habitat values for Growling Grass Frog.

Note: the waterbodies are numbered according to Dwarf Galaxias survey sites (see Ecology Australia and Streamline Research 2011).

1.3 Terminology

The following terminology is used throughout the CMP:

- **Pre-construction Period** - the period prior to any development occurring within the Cardinia Creek corridor. The objective of this phase is to protect current habitat values for threatened fauna species and maintain the long-term viability of populations currently occupying the study area.
- **Construction period** - the stage in which the development works (e.g. any earthworks and/or vegetation removal) are initiated.
- **On-going Management and Monitoring Period**- actions that occur in some instances immediately following approval of the CMP, whilst other management and monitoring actions occur post-construction (immediately following completion of construction works)
- **Waterbodies** – used as a collective term to describe any existing body of water including Cardinia Creek, artificial wetlands and ephemeral anabranches, etc.
    - Waterbodies in the study area will be either managed as dedicated frog habitat (e.g. sites one, two and eight within the Conservation Zone) or for recreational purposes (e.g. site 10 within the Recreation Zone).
- **Artificial wetlands** – refer to the four artificial wetlands in the study area (sites one, two, eight and 10).
- **Anabranches** – refer to the ephemeral drainage lines on the floodplain adjacent to Cardinia Creek. These waterbodies will inundate during periods of flooding.

Figure 2 outlines two zones in the study area that will be used for recreation purposes, which are:

- **Recreation Zone:** this area will be managed by Cardinia Shire Council and will provide both passive and active recreation activities such as walking, jogging, cycling, picnicking, sporting activities, open grass areas for informal ball games and dog off-lead exercise areas.

- **Conservation Zone:** this area will managed by Parks Victoria and will be managed for both conservation and recreation purposes. Recreational activities will be limited to passive recreation (as opposed to active recreation) and possible activities may include walking, jogging, cycling, nature study and small group picnics.

Throughout the document, references to actions that "will" or "must" happen are required by the Conservation Management Plan and the approval under the EPBC Act. Actions that are recommendations or "should" happen are not required to be undertaken under the approval of the Conservation Management Plan under the EPBC Act but are guidelines and/or recommended directions for future actions.

1.4 Background Information and Survey Methodology

Background information for threatened fauna species including their ecology, regional distribution, occurrence and/or availability of potential habitat in the study area, threatening processes and potential impacts of development are outlined in Ecology Australia and Streamline Research (2011). This report also provides survey methodologies and results of the field assessments including vegetation values.

2 Conservation Management Plan: Phase One

2.1 Objectives

The principal environmental objectives of the CMP are to:

- Preserve known populations of Dwarf Galaxias in Cardinia Creek and it's associated floodplain habitats;
- Preserve suitable habitat for Australian Grayling within Cardinia Creek;
- Preserve suitable dispersal habitat for Growling Grass Frogs along Cardinia Creek and anabranches;
- Enhance potential breeding habitat for Growling Grass Frogs within the artificial wetlands (sites one, two and eight, see Figure 6). These wetlands will also be enhanced to provide potential refuge habitat for Dwarf Galaxias;
- Preserve and enhance suitable remnant riparian woodland habitat for Southern Brown Bandicoots;
- Provide, protect and maintain favourable aquatic and terrestrial habitats;
- Preserve existing flooding characteristics and aquatic passage;
- Preserve and improve water quality conditions in Cardinia Creek;
- Protect and maintain vegetation in and adjacent to Cardinia Creek; and
- Mitigate impacts from adjacent recreational and urban development.

Management actions and protocols are divided into Pre-construction and Construction stages and on-going Management and Monitoring actions for both the Conservation Zone (see Sections 2.4 and 2.5) and the Recreation Zone (see Section 2.6), see Figure 2. These actions are required and/or recommended from the date of approval of the CMP, throughout construction and for the duration of the 10 year post-completion of the wetland modifications / corridor works (Phase One). Within the Conservation Zone, the initiation of the 10 year post-construction period for each wetland will vary depending on the completion of works and certification of each wetland. Sections 2.4.1, 2.4.2 and 2.5 provide a summary of mitigation and on-going monitoring/management actions during each phase of CMP implementation.

Note: Phase Two management will be implemented in perpetuity from the completion of Phase One. Management required within Phase Two will not be as intensive or as frequent as that in Phase One, assuming that suitable habitat is maintained for the threatened fauna species (see Section 2.8).

Although the field assessment and CMP are targeted toward the management of threatened fauna, the actions for the protection and enhancement of the vegetation and fauna habitat within the corridor are designed to benefit other fauna species. These include but are not restricted to:

- Southern Toadlet – Suitable habitat for this species is located within the floodplain and riparian vegetation where an accumulation of leaf litter in small damp depressions could potentially be used as breeding habitat. The protection of the existing habitat within the floodplain and riparian habitats, and the addition of scattered rocks/logs for the Growling Grass Frog around the existing artificial wetlands, may also benefit this species;
- Glossy Grass Skink - Suitable habitat for this species is present within the floodplain of the study area. Protection of the floodplain and enhancement works at existing wetlands may also provide habitat for this species. Reeds, tussock grasses, rushes and other low dense vegetation fringing wetlands would provide potential habitat for this species;
- Latham's Snipe - Maintenance of existing values within the floodplain including the anabranches and surrounding dense exotic grassy vegetation will provide protection of habitat for this species; and
- Other threatened water bird species also likely to benefit from the above actions are the FFG-listed Lewin's Rail (*Rallus pectoralis*), Baillon's Crake (*Porzana pusilla palustris*) and Great Egret (*Ardea alba*); and State-classified threatened species such as the Royal Spoonbill (*Platalea regia*) and the Nankeen Night-Heron (*Nycticorax caledonicus hilli*).

These management actions will also have positive effects for many other locally-common fauna species throughout the study area.

2.2 Compliance with Legislation

Victoria

The Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) aims to protect threatened flora and fauna and sets out a number of conservation and management objectives:

- To guarantee that all taxa of Victoria's flora and fauna can survive, flourish and retain their potential for evolutionary development in the wild;
- To conserve Victoria's communities of flora and fauna;
- To manage potentially threatening processes;
- To ensure that any use of flora or fauna by humans is sustainable;
- To ensure that the genetic diversity of flora and fauna is maintained; and
- To encourage the conserving of flora and fauna through co-operative community endeavours.

The following species that are listed for protection under the FFG Act that have been identified in the precinct or habitat for the species has been identified in the precinct:

- Growling Grass Frog;
- Dwarf Galaxias;
- Australian Grayling;
- Southern Brown Bandicoot;
- Swamp Skink;
- Matted Flax Lily; and
- Maroon Leak Orchid.

A number of species listed above including; Swamp Skink, Matted Flax Lily and Maroon Leek Orchid, have been recorded or habitat for the species has been recorded in the precinct but not within the Cardinia Creek Corridor. This CMP therefore does not address management for these species. Although the enhancement of the habitat values along Cardinia Creek as outlined in the CMP is likely to increase suitability of habitat for these species. This CMP does address mitigation and management for Growling Grass Frog, Dwarf Galaxias, Australian Grayling, and Southern Brown Bandicoot as habitat for these species has been identified to occur in the precinct and in the Cardinia Creek corridor.

Permits and or authorisations may be required for impacts approved under this CMP in relation to protected flora under this Act.

The *Wildlife Act 1975* aims to promote the protection and conservation of Victoria's wildlife with the purposes of:

- Establishing procedures in order to promote;
- Protection and conservation of wildlife;
- Prevention of taxa of wildlife from becoming extinct;
- Sustainable use of and access to wildlife; and
- Prohibiting and regulate the conduct of persons engaged in activities concerning or related to wildlife.

The Wildlife Regulations 2002 of the Act prescribe penalties for the purposes of the Wildlife Act. These include penalties for persons who wilfully damage, disturb or destroy any wildlife habitat without appropriate authorisation (Section 9 of the Wildlife Regulations 2002). Authorisation and/or permits may be required under the Act for impacts on wildlife referred to in this CMP.

Commonwealth

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) requires approval from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities for any proposal to undertake actions that could have a significant impact on Matters of National Environmental Significance (MNES). Matters of NES include listed threatened species and ecological communities.

The following species are listed for protection under the EPBC Act and have been identified within the precinct or suitable habitat for the species has been identified within the precinct:

- Growling Grass Frog;
- Dwarf Galaxias;
- Australian Grayling;
- Southern Brown Bandicoot;
- Matted Flax Lily; and
- Maroon Leak Orchid.

Under Part 9 (Approval of Actions) of the EPBC Act, individual land owners are required to refer any actions that are likely to have significant impacts on any of these species to the Commonwealth Minister. However, this precinct is included in the approvals available under Melbourne's Strategic Assessment which is effectively approval for all development in the precinct under Part 10 of the EPBC Act.

Melbourne Strategic Assessment under Section 146 of the EPBC Act

An agreement under the Strategic Assessment provision of the EPBC Act (Section 146(1) Agreement, Part 10 Strategic Assessment (EPBC Act)) was made between the Commonwealth of Australia and the State of Victoria on 16th June 2009. This agreement outlines that the State will undertake a Strategic Assessment to assess requirements under the EPBC Act.

As part of this agreement, the Victorian Government has sought approval from the Commonwealth Government for activities that will impact on MNES as a result of a defined Program. The Program is set out in Delivering Melbourne's Newest Sustainable Communities: Program Report (DPCD, December 2009) and applies to:

- Areas inside the existing Urban Growth Boundary (UGB) at 7/8/2010 that are to be subject to the Victorian Government's Precinct Structure Planning process and are exhibited after 26 May 2009 (28 precincts in total);
- The designation of areas for future urban development within an expanded UGB (as approved by Amendment VC68 to the Victorian Planning Provisions on 6/8/2010);
- The proposed Outer Metropolitan Ring / E6 Transport Corridor; and
- The Tarneit section of the proposed Regional Rail Link project (West Werribee to Deer Park).

Commonwealth approval of all actions associated with urban development in the 28 precincts inside the urban growth area boundary at 7 August 2010 was granted on 8 July 2010, this includes the Officer Precinct. The approval has effect for wetlands of international importance, listed threatened species and communities and listed migratory species.

The approval of actions requires urban development to be undertaken in accordance with the approved Program approved by the Commonwealth Minister. As part of the approved Program, prescriptions have been developed by Victoria for managing several matters of NES which are likely to be impacted as a result of the Program. These prescriptions have been approved by the Commonwealth and identify decision guidelines on what habitat must be retained and what can be cleared. They also identify how impacts are to be mitigated, including through the provision of appropriate offsets or strategic planning initiatives.

The approved Prescriptions for Growling Grass Frog and Southern Brown Bandicoot require:

- Protection and management for the species and their habitat in accordance with the Sub Regional Strategies; and
- A Conservation Management Plan to be prepared to the satisfaction of Department of Sustainability and Environment.

Commitments have been made in relation to Australian Grayling to:

- Protect 100 m either side of Cardinia Creek to be managed for the environment with appropriate statutory protection;
- Protect Cardinia Creek from point source water quality contamination; and
- Prepare a Conservation Management Plan.

To date, a prescription has not been developed for Dwarf Galaxias, however, DSE has directed that a Conservation Management Plan is to be prepared for the species to demonstrate that the populations along Cardinia Creek are managed appropriately and impacts mitigated.

The Cardinia Creek corridor, located within the Officer Precinct supports suitable habitat for Growling Grass Frog, Southern Brown Bandicoot, Australian Grayling and known populations of Dwarf Galaxias. These known populations of threatened species has triggered a CMP within this area to outline measures to protect and enhance habitat. This CMP ensures the protection and management of existing habitat for nationally threatened species along Cardinia Creek and its buffers.

Existing habitat for the Growling Grass Frog and Southern Brown Bandicoot within the larger Officer precinct area (see Figure 4) is proposed to be removed for development under the Officer Precinct Structure Plan (see Appendix 8 for habitat approved to be removed). As such, the Officer PSP CMP (excluding Cardinia Creek) (Ecology Partners in draft) and this Officer PSP Cardinia Creek CMP, allows for the removal of these habitats to be offset through the creation of consolidated habitat corridors and provision for augmenting habitat along waterways (e.g. the Cardinia Creek Officer CMP area).

Through the application of the Strategic Assessment process, this CMP outlines the obligations for landowners and/or developers within the Precinct. The application of the CMP will mean that referrals under the EPBC Act on a property-by-property basis will not be required.

When this CMP is approved by the Department of Sustainability and Environment, urban development may proceed provided the requirements of this CMP are adhered to, subject to obtaining any relevant approvals required under the Cardinia Planning Scheme and other relevant local and state laws.

2.3 Implementation, Timeframe and Review

Implementation, timing and review requirements for the CMP are discussed below.

2.3.1 Management Responsibilities and Funding

The plan shown in Figure 1 shows existing and proposed land ownership arrangements along the Cardinia Creek corridor under existing public acquisition overlays and the Officer PSP proposals. Parks Victoria currently manage a large parcel of land in the northern half of the corridor and two existing PAO areas in favour of Parks Victoria are located in the southern part of the corridor. There is one parcel of Crown Land adjacent to the creek which no public land manager has yet claimed responsibility for. Melbourne Water currently owns a parcel of land adjacent to the creek in the southern part of the corridor.

This CMP outlines a 'Conservation Zone' to protect and enhance habitat for fauna species and a 'Recreation Zone' for primary recreation use (see Figure 2). Parks Victoria will assume management responsibility for CMP actions relating to the Conservation Zone. Parks Victoria typically manages Crown Land. To enable Parks Victoria to maintain land in the Conservation Zone, the existing parcel of land owned by Melbourne Water would be converted to Crown Land.

The designation of Parks Victoria as the 'Responsible Agency' for implementing the CMP actions in the Conservation Zone, is on the basis that Parks Victoria are adequately funded to implement and establish the works that are beyond their standard obligations in managing their existing land parcel and the land covered by the PAO.

There are three areas of land shown in Figure 1 that are within the Conservation Zone that are not contained within existing Crown Land, PAO land or Melbourne Water land. These areas would either remain in private ownership with the land owner being responsible for implementing CMP actions or this land could be transferred to Crown Land and Parks Victoria would assume responsibility for implementing CMP actions. In Figure 1, these three parcels of land are nominated as 'Private Ownership (with Conservation Zone) unless transferred to crown land'.

A legal agreement will be established between DSE, Parks Victoria and Cardinia Shire Council committing to the implementation of actions in the Conservation and Recreation Zones as outlined in this CMP. This agreement will be established to the satisfaction of all parties.

Melbourne Water will continue to manage the bed and banks of the incised waterway channel of Cardinia Creek. Appropriate access to the creek to conduct these activities would be arranged between Parks Victoria and Melbourne Water.

The works outlined in the CMP are a response to the future development of the Officer PSP area through the Prescriptions approved under the *Environment Protection and Biodiversity Conservation Act 1999*. The CMP works are considered offset works that allow Growling Grass Frog and Southern Brown Bandicoot habitat to be removed elsewhere in the Officer Precinct Structure Plan area (see Appendix 8). The CMP works will be funded by land owners that remove suitable habitat shown in Appendix 8. Land owners are to enter into an on-title agreement with

DSE (or an alternative arrangement approved by DSE) to provide funding for the CMP works. Each land owner will be required to make a payment as contribution to the overall cost of the CMP works (as outlined in Appendix 7) which is equivalent to the proportion of suitable Growling Grass Frog and Southern Brown Bandicoot habitat in the Officer Precinct Structure Plan area (as defined in Appendix 8) that is removed from the owners property. Works that are considered standard obligations of public land managers are proposed to be funded by the relevant land manager.

The Contingency Actions section of the CMP outlines management responsibilities and funding arrangements for unforeseen events not covered by the management actions and costings outlined in this CMP (see Section 2.8).

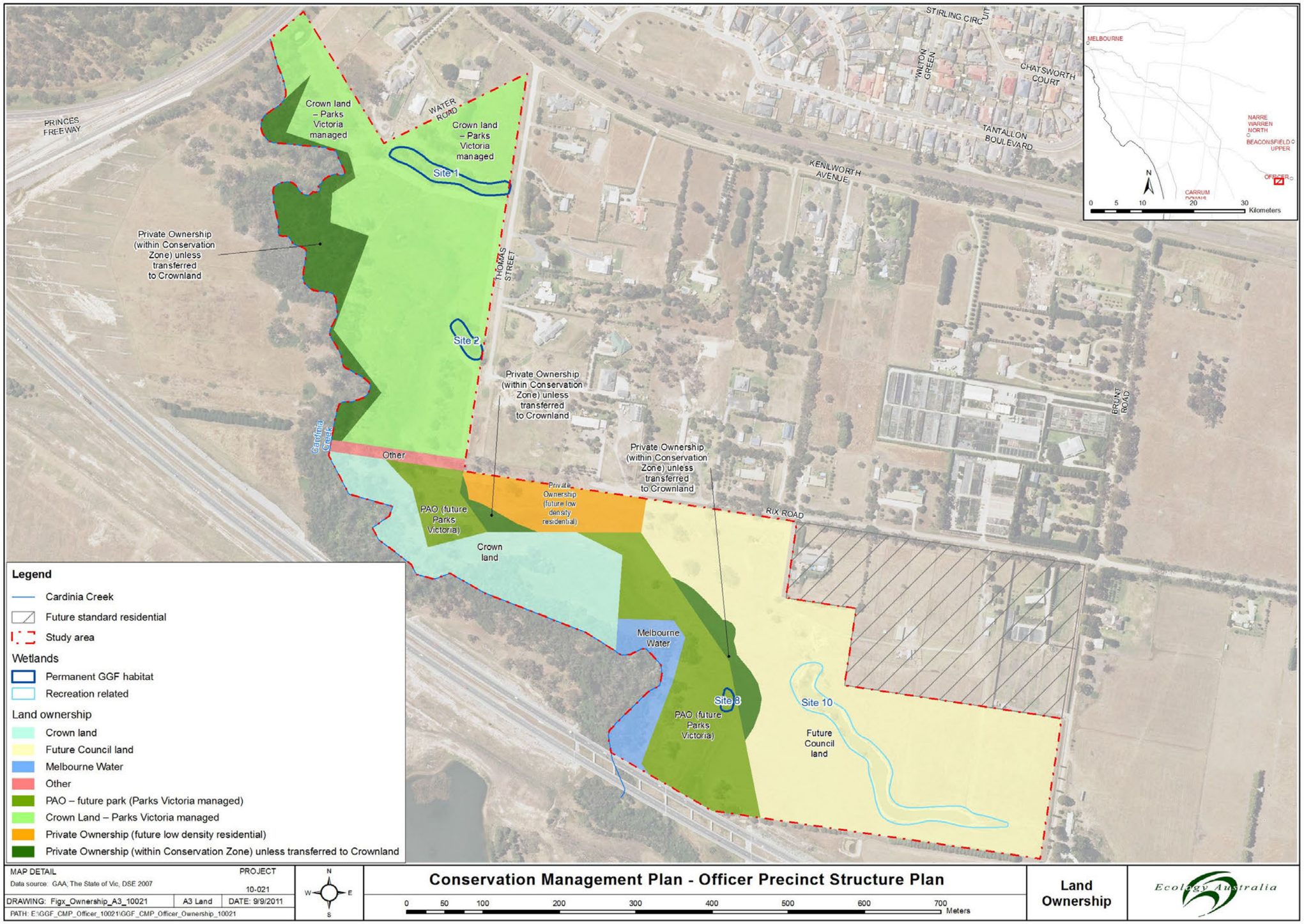

Figure 1 Officer PSP Cardinia Creek CMP: Land Ownership in the study area 2011

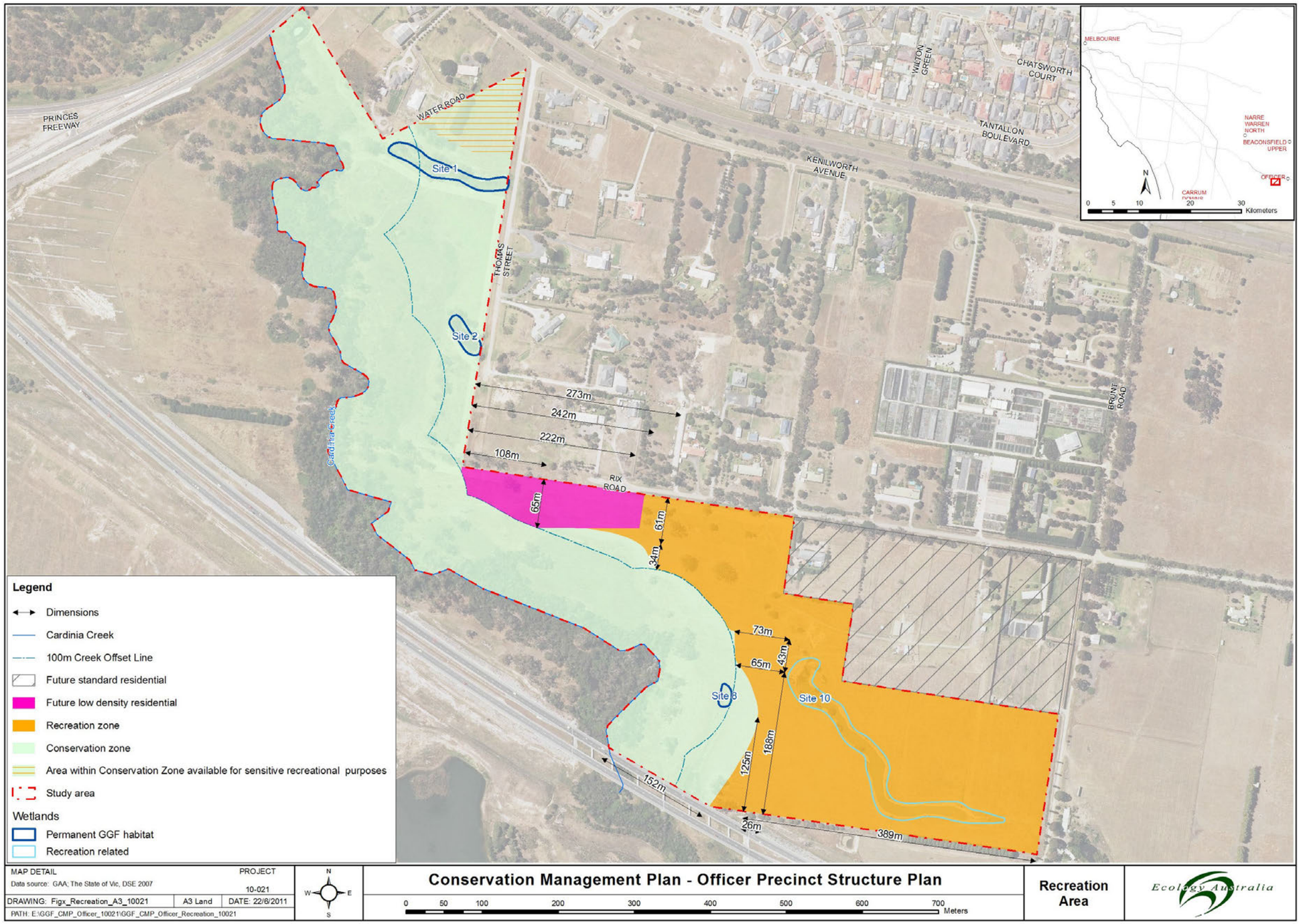

Figure 2 Officer PSP Cardinia Creek CMP: Recreation and Conservation Zones within the Cardinia Creek Corridor. The Conservation Zone will be managed as dedicated habitat for threatened fauna species. The Recreation Zone will be managed by Cardinia Council.

2.3.2 Timeframes

The management actions outlined in this plan will be implemented once the CMP has been approved by DSE as part of the planning scheme amendment process. The CMP will operate from this date of approval, throughout construction and will continue to apply for 10 years (Phase One) post completion of each works component (e.g. completion of modifications to existing artificial wetlands for enhancement of Growling Grass Frog habitat). Wetland modifications will be undertaken once funds are available. DSE will certify each wetland once enhancement measures have been undertaken and identify when the 10 year timeframe commences.

Monitoring for the Growling Grass Frog will commence at least one season prior (during breeding period) to the construction of the wetlands and continue annually once wetland modifications are complete for the 10 year post-construction period. Monitoring for Dwarf Galaxias and Australian Grayling will commence when funds are available following CMP approval (and at a minimum will commence prior to the construction of the wetlands), throughout construction and for the duration of the 10 year post-construction period.

At the completion of Phase One, Phase Two will be implemented where the Conservation Zone will be managed by Parks Victoria in perpetuity. Management required within Phase Two will not be as intensive or as frequent as that in Phase One, assuming that suitable habitat has been successfully established for the threatened fauna species during Phase One.

The actions required by the CMP will vary year to year and the timing of work will be important for establishing and managing threatened fauna habitat. Section 2.4.1, 2.4.2 and 2.5 outline mitigation, and on-going monitoring and management actions, their timing for implementation and the responsible party(s).

2.3.3 Reporting and Review

Regular reporting and CMP reviews will be required to inform DSE of any new issues, meeting milestones and results of the population and habitat monitoring.

An annual summary report will be submitted to DSE during Phase One by Parks Victoria outlining the results of the habitat enhancement works in the Conservation Zone (e.g. wetlands modifications, revegetation, etc.), monitoring/survey data and other maintenance activities.

The CMP will be reviewed every five years and at the completion of Phase Once. The review will be undertaken in consultation with DSE, Parks Victoria, Cardinia Shire Council and Melbourne Water and, if necessary, DSEWPC, to address and rectify any issues that may have arisen during the implementation of the CMP. Such issues may include a significant population decrease (e.g. Dwarf Galaxias) and/or major changes in habitats. A review of the CMP is an assessment of the effectiveness of the document and will not necessarily result in a re-write of the CMP.

In the event that through the above review process, it is proposed to extend the requirements outlined in this CMP (such as changes to the current scope of works, management actions and monitoring requirements), these must be determined by consultation and agreement between DSE, Parks Victoria, Cardinia Shire Council and Melbourne Water.

All changes to works requirements will be subject to the provision and commitment of an appropriate funding mechanism (see Contingency Actions – Section 2.8). If the contingency actions are required, land managers should contribute to identifying an appropriate funding source so that remedial actions may be implemented.

If DSE approves a revised CMP, that CMP must be implemented rather than the existing CMP (subject to consistency of land use with the Officer Precinct Structure Plan).

Should any changes to existing habitats and/or population of Dwarf Galaxias be determined from monitoring activities between the scheduled five year CMP reviews, a review of the CMP must also be undertaken. The colonisation of the study area by the Growling Grass Frog, Australian Grayling or Southern Brown Bandicoot (noting that monitoring for the bandicoot is not required by the CMP) would also trigger the requirement for CMP review.

A shortfall of CMP funding would also necessitate a review of the CMP.

CONSERVATION ZONE

2.4 Conservation Zone: mitigation measures for the pre-construction and construction periods

Proposed works in the Conservation Zone include:

- Installation of permanent fencing at select sites;
- Enhancement/modification of three existing artificial wetlands (sites one, two and eight, see Figures 3). The enhancement or modification of wetlands will benefit Growling Grass Frog and the Dwarf Galaxias by increasing the availability of potential breeding habitat, and increasing habitat diversity through the corridor;
- Pathway construction; and
- Creation of a Conservation / Passive Recreation Zone (see Figure 2).

No significant modification to the Cardinia Creek anabranches and floodplain environs will be made as part of the proposed development in the corridor to protect habitat for the Dwarf Galaxias that may move onto the floodplain during flood events. Where land is not already used for residential purposes, a minimum of 100 m from Cardinia Creek will be included in the Conservation Zone in response to the Australian Grayling commitment in the Melbourne Strategic Assessment report. The artificial wetlands (e.g. sites one, two and eight) will be modified to enhance habitat for both the Growling Grass Frog and Dwarf Galaxias. Sections 2.4.4, 2.5.1, 2.5.3 provide details on the planting of fringing/aquatic native vegetation and reshaping that will be undertaken to provide shallow margins. The wetlands will also have some areas with water depths of up to 1.0 m. The deeper water is advantageous, as it provides refuge (for Dwarf Galaxias and Growling Grass Frog) when shallower parts of the wetland dry up, providing permanent water habitat. The wetlands can have both shaded areas (which are favoured by the Dwarf Galaxias) and open areas (which are favoured by the Growling Grass Frog).

The following management actions are those that ‘must’ or ‘should’ be implemented from the approval of the CMP and throughout the 10 year post-construction phase (Phase One).

2.4.1 Mitigation Actions for the Pre-Construction Period

As a priority, known habitat for Dwarf Galaxias will be protected along the floodplain and Cardinia Creek.

Prior to construction works within the corridor a qualified zoologist and/or aquatic biologist (as appropriate) must be involved at the following points: Endorsement of plans for works within the Conservation Zone

Mitigation Actions for the Pre-Construction Period

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
Pre-construction period Protect and maintain the Conservation Zone during any construction works (including development of recreational facilities, works within the conservation zone, or residential areas adjacent to the conservation zone)				
No-Go Zones – Temporary Fencing				
No-Go Zones will be required and fenced with highly visible temporary fencing for • Any works occurring for recreation facilities or pathways in the conservation zone or roads, pathways, residential development adjacent to the conservation zone. . No-Go Zones will be established by Council along the perimeter of the Conservation Zone prior to and throughout the duration of works within the Recreation Zone or adjacent residential or road areas. Protect the Conservation Zone through the designation of No-Go Zones (see Sections 2.4.1, 2.6.1 and Figure 7). • Enhancement of existing artificial wetlands (Sites 1, 2 and 8, See Figure 2 and 6). No-Go Zones will be established by Parks Victoria prior to and	To be implemented pre-construction and be retained throughout the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No removal or degradation of terrestrial habitats or existing wetland area within the Conservation Zone for Growling Grass Frog (e.g. within 30 m of wetlands or between wetlands and Cardinia Creek).

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
throughout the duration of works associated with wetland enhancement. Protection of surrounding Conservation Zone.				
• No-Go Zone signage will be clearly displayed on temporary fencing and state that these areas are Conservation Zones with no access to contractors and machinery (see Sections 2.4.1 and 2.6.1). • No-Go Zones will protect connectivity of habitat along the creek and floodplain (i.e. north - south connectivity) and between the wetlands and the creek (e.g. east-west connectivity).	To be implemented pre-construction and be retained throughout the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No removal or degradation of terrestrial habitats or existing wetland area within the Conservation Zone for Growling Grass Frog (e.g. within 30 m of wetlands or between wetlands and Cardinia Creek).
Sediment Controls				
• Sediment control measures (No-Go Zone) will be implemented prior to construction works to protect the Conservation Zone during major habitat enhancement works and or recreational facilities (e.g. pathways) (see No-Go Zones Figure 7). • Best Practice procedures will be implemented to minimise construction impacts (sedimentation and pollution) on the creek, floodplain and existing wetlands. • Any sediment control fences should have intermittent gaps (one metre) approximately every 30 m to 50 m to allow for any movement of frogs. No Go Zones should be practical to allow suitable access points to construction area in consultation with DSE. • Designate construction, stockpile, refuelling and storage sites well away from Cardinia Creek	To be implemented pre-construction and be retained throughout the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No removal or degradation of terrestrial habitats or existing wetland area outside the construction footprint. • No machinery access into the Conservation Zone. • Pathways should not be located within the 30 m buffer zone allocated around the existing artificial wetlands and floodplain. • No increase in sediment loads which reduce water quality below acceptable State Environment Protection Policy Guidelines (SEPP guidelines) and/or reduces habitat suitability for frogs (e.g. high

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
and the floodplain.				turbidity).
Environmental Induction				
• Prior to construction, all employees from the contracting companies will take part in an environmental induction. This will involve an on-site meeting with the site manager to relay information regarding the Conservation Management Plan, specifically in relation to the threatened fauna species, their habitat requirements and importance of protecting these areas • In particular, contractors need to be familiar with the appearance and ecology of each species and adhere to actions proposed to either protect habitat or avoid direct impacts/loss of animals during the construction period. The contractors must also be aware to contact DSE and a qualified Zoologist immediately for fauna salvage, should any of the threatened fauna species be found during the construction activities.	To be undertaken pre-construction and as required during the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No removal or degradation of terrestrial habitats or existing wetland area within the Conservation Zone.
Salvage and translocate frogs				
• The Salvage and Translocation Plan will be prepared and implemented prior to any earth works or vegetation removal in close proximity to the existing artificial wetlands and floodplain. This will include works associated with installation of the permanent fence, wetland modifications, pathway construction, etc.	Salvage to occur one week prior to construction and throughout the entire period of construction.	Parks Victoria / land owner Engage qualified zoologist. In consultation with DSE.	To be confirmed – Refer to Contingency Actions Section 2.7.	• Permit acquisition.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
• Follow Salvage and Translocation Protocol as outlined in Appendix 5. • A permit to salvage and translocate animals will be required from the Department of Sustainability and Environment (DSE) under the Wildlife Act 1975. Only persons listed on the Victorian *Wildlife Act 1975* Management Authorisation will be permitted to handle native fauna. • A qualified Zoologist will be engaged to undertake pre-construction/ construction Growling Grass Frog salvage as outlined in Appendix 5. • A recipient site for translocated frogs has yet to be determined and must be selected in consultation with DSE. • Monitoring of translocated frogs will be undertaken in accordance with protocols outlined in Appendix 6.				
Permits				
• A permit to remove native vegetation will be required from Cardinia Shire Council.	To be obtained pre-construction.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• As per requirements of the regulating authority. Permit conditions adhered to.

2.4.2 Mitigation Actions for the Construction Period

During construction works, a qualified zoologist and/or aquatic biologist (as appropriate) will be required at the following points:

- A zoologist may be required (on-call) to attend if threatened fauna species are located on-site during construction works;
- Sign off on the excavation works for dedicated Growling Grass Frog wetlands; and
- Final sign-off on completed dedicated Growling Grass Frog wetlands.

During development works, clear protocols will be provided to construction personnel to identify the expected mitigation measures and importance to maintaining ecological values. Direct disturbance such as unplanned movement of construction equipment or indirect disturbances (e.g. spills from machinery) could have a detrimental effect on habitat that can be used by the Dwarf Galaxias. Compliance of mitigation practices during the construction period must be checked by the responsible agent. Non compliance issues need to be addressed.

To minimise and/or eliminate risks of construction activities associated with wetland modifications and pathway development within the Conservation Zone, the following mitigation measures and management actions will be implemented

Management Actions

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
Construction Period				
Wetland modification and design				
• Existing wetlands (e.g. site one, two and eight) will be modified at the outset of development activities to provide dedicated Growling Grass Frog habitat. Modification to follow guidelines for re-shaping and revegetation – Sections 2.4.4 and 2.5.1.	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Suitable habitat is maintained and enhanced prior to the removal of habitat elsewhere in the Officer Precinct.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
• Connectivity will be maintained for Growling Grass Frog between wetlands and along the creek (e.g. north – south connectivity) and between the wetlands and the creek through habitat manipulation including appropriate revegetation and management (e.g. intermittent slashing) may be necessary to maintain a mosaic of suitable open habitat).	To be retained throughout the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Increase connectivity of vegetation along Cardinia Creek corridor. • Maintenance of open structure.
• An experienced wetland rehabilitation and/or revegetation contractor will be engaged to undertake the enhancement works within the existing artificial wetlands and along Cardinia Creek (see Section 2.4.4).	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Wetlands will be modified according to the required elements as specified in CMP.
• Depth will be varied across each wetland, with permanent and ephemeral water areas. Water depth will be a maximum of 1 m.	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Wetlands will be modified according to the required elements as specified in CMP.
• Wetlands gradients slopes will grade from 1 in 8; 1 in 5; to 1 in 3.	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• All wetlands will be modified according to the required gradient.
• The existing artificial wetlands will be re-shaped to create flatten banks and create more suitable habitat for Growling Grass Frog. • Undertake enhancement plantings to increase the structural diversity of habitat and include	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in	• No alteration of aquatic vegetation such that it drops below 60% cover (where aquatic vegetation cover is calculated as the sum of the cover (%) of emergent, submergent and floating macrophytes divided by three,[=

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
three zones (e.g. shallow marsh, shallow inundation and permanent water). Planting regimes for artificial wetlands will incorporate at least three vegetation zones (e.g. shallow marsh, shallow inundation and permanent water). Plantings will aim to provide structural diversity of habitat and include emergent, submergent, floating and fringing aquatic vegetation.			Appendix 8).	Sum (%emergent + %submergent + %floating] /3, see Heard 2009). This figure of 60% cover was modelled on the Merri Creek catchment and may be applicable to other areas.
• Revegetation will be implemented as outlined in revegetation management plan.	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Maintain high habitat values in accordance with the CMP.
• Current exotic grassy vegetation will be maintained around wetlands to retain open areas. If possible, maintain open grassy areas with sedges, tussock-grasses, rocks and occasional low lying shrubs for shelter which allow frogs to forage adjoining the wetlands and allow east-west movement between the creek and wetlands.	To be undertaken during the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No alteration to buffer and corridor habitat that is not compatible with Growling Grass Frog habitat e.g. changes from more open grassy vegetation to closed dense or overgrown habitat.
• Scattered rock jumbles, large boulders, logs and fringing vegetation (e.g. rushes and sedges) will be provided for shelter and refuge sites around the enhanced wetlands.	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Rocks, logs and other cover are not removed or modified.
• Wetlands will be designed to exclude Eastern Gambusia through plantings (Draining of	To be undertaken	Parks Victoria	Land owners that remove	• Absence / low abundance of predatory fish.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
wetlands is unlikely to be successful in excluding the Eastern Gambusia in the long-term, given that the wetlands will be filled through flood events from Cardinia Creek)	during the construction period.		suitable habitat (as shown in Appendix 8).	
• Where possible maintain water levels in wetlands between 0.5 m and 1 m in vegetation zone 3 (see Wetland design)). Vegetation can be planted to minimise evaporation of water – Planting vegetation on the north side may provide some shading for the waterbody but also allow basking sites for Growling Grass Frog on the opposite side. • Note: The existing wetlands are be filled through flood events from Cardinia Creek and surface runoff. Pumping of water from Cardinia Creek into the wetlands will not be undertaken. Stormwater will be drained away from Cardinia Creek and will not be used to fill the wetlands or be directed into the creek. See Section 2.5.7 for water quality requirements and specifications.	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Wetland filling occurs. • Successful establishment of wetland plantings • No alteration to wetland hydrological regime which leads to wetlands drying-out completely.
• No lighting will be installed within 30 m of the existing wetlands. All lighting outside this area should be directed away from the waterbodies and the creek corridor.	To be undertaken during the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Absence of visual lighting disturbance to faun and light spillage to sensitive habitats.
• Wetlands must be certified by DSE – wetlands to be adequately designed in line with CMP. Once wetlands are certified the 10 year post construction management/monitoring will commence. The initiation of the 10 year post-	To be undertaken at the completion of the construction	Parks Victoria	Land owners that remove suitable habitat (as shown in	• Wetlands meet standards as outlined by the CMP.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
construction management and monitoring period for each wetland may be different depending on the date of wetland completion.	period.		Appendix 8).	
Construction of recreational facilities in Conservation Zone				
• Vegetation removal will be minimised and staged during the construction of recreational facilities (see Figure 2 and 5) and enhancement works to the artificial wetlands in the conservation zone. This does not apply to weed control works, except that weed control must be staged to retain potential habitat for fauna. • Removal of vegetation to be followed by site rehabilitation measures to stabilise the banks and reinstate fauna habitat. • Stage revegetation with weed removal as per Southern Brown Bandicoot and Growling Grass Frog habitat requirements.	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• No removal of vegetation outside construction footprint (excludes weed control works). • Minimal soil erosion and establishment of weeds at works sites. • Maintenance of high habitat values for Growling Grass Frog and Southern Brown Bandicoot habitat. • Potential movement of frogs through the creek systems is not compromised/habitat link is not severed.
• A north-south dispersal corridor will be maintained and enhanced by implementing revegetation within the remnant riparian woodland for the Southern Brown Bandicoot (see Sections 2.5.1, 2.5.3) and maintaining existing floodplain values. Slashing to create a mosaic of open and closed grassy vegetation in the floodplain (drainage channel within the anabranches) may be required. • See revegetation plan (Section 2.5.1).	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Connectivity of habitat for Southern Brown Bandicoot

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
• Ecological connectivity along Cardinia Creek and in east-west direction (see habitat corridors above) will be maintained.	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Potential movement of frogs between and along the creek system is not compromised/habitat link is severed.
• Pathways will be located within the Recreation Zone where possible. Sensitive design options (e.g. boardwalks) will be implemented where pathways are directed into or adjacent to the Conservation Zone (i.e. within the 30 m impact buffer). See Section 2.4.3. • A Memorandum of Understanding will need to be prepared between Council and Parks Victoria for the shared pathway. This will outline construction standards and maintenance obligations.	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Dedicated threatened fauna habitat is not fragmented. • Potential movement of frogs along the creek system is not compromised/habitat link is not severed. • Protection of sensitive vegetation communities from trampling by foot traffic.
General Protocols for any construction in Conservation Zone				
• Protect the Conservation Zone throughout the entire construction period through the maintenance of all No-Go Zones (e.g. temporary fencing and signage) (see Sections 2.4.1and Figure 7 for No-Go zone implementation) and immediate post-construction rehabilitation (see Sections 2.4.3, 2.5.1 and 2.5.3). The construction site manager will undertake regular inspections of the No-Go Zones to ensure that temporary fencing, sediment controls and signage are maintained. Replacement will be required as necessary (See Section 2.4.1).	To be undertaken during the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No impacts to No-Go zones

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
• Salvage and relocation protocols must be followed prior to disturbance of any waterbody (e.g. sites one, two, eight and 10, Figure 2 and 6) – see Appendix 5.	To be undertaken during the construction period.	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	-
• Soil stabilisation will be undertaken in disturbed areas. Sedimentation control measures must remain in place until the completion of works, and disturbed soils have been effectively stabilised. All areas of soils exposed by construction activity must be stabilised with sterilised grasses and, once these grasses have established be landscaped with native vegetation endemic to the local region (no fertilisers should be used).	To be undertaken during the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Minimisation of soil erosion in works areas.
• The need for weed control within the construction zone and at machinery wash down sites will be determined during the construction period and undertaken as required.	To be undertaken during the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Reduction in weed cover.
• Food waste will be removed from site to discourage pest animals	To be undertaken during the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No increase in pest animals (e.g. foxes) on-site.
• Chemical and fuel will not be stockpiled near the floodplain or artificial wetlands	To be undertaken during the	Parks Victoria / land owner	Land owners that remove suitable	• No change in habitat.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
	construction period.		habitat (as shown in Appendix 8).	
• Should contractors identify a Growling Grass Frog on-site, all works will temporary cease and immediate notification of DSE and a qualified Zoologist will be made. Salvage and translocation will be implemented by a qualified Zoologist as required.	To be undertaken during the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No death or injury to Growling Grass Frog during construction activities.
• All new staff will be inducted by the Site Manager (see Section 2.4.1).	To be undertaken during the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No degradation to environmental values within the Cardinia Creek Corridor.
• Heavy vehicles and machinery will not access the Conservation Zone, particularly the floodplain (i.e. No-Go Zone) where possible. Use handheld equipment where possible. An exception to this may be the construction works associated with wetland modification / enhancement of site eight. • Implement appropriate fencing and signage to illustrate access restrictions.	To be undertaken during the construction period.	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Exclusion of machinery from No-Go Zones.
Permanent Fencing of Conservation Zone				
• The Conservation Zone (Figure 2) will be protected by installing <u>permanent</u> fencing (e.g. farm fencing with ringlock along the bottom to exclude dogs) at select locations (e.g. sensitive environs such as the wetlands) along the	Ongoing	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in	• Fencing to be installed and maintained.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
interface of Recreation and Conservation Zones (Figure 7). This will minimise potential disturbance to these sites. • Permanent fencing will need to consider any future access requirements for contractors to construct / maintain the wetlands, floodplain and for Melbourne Water to access the waterway. • Note: Melbourne Water will require foot access for maintenance staff on the eastern side of the creek. Furthermore, vehicle access under the Princes Freeway should be maintained or an alternative vehicle access provided if removed.			Appendix 8).	

2.4.3 Guidelines for Pathways in the Conservation Zone

- Minimise the construction of pathways within the Conservation Zone (Figure 2); Maintaining existing connectivity to the south of the study area i.e. under the Pakenham Bypass (as above)
- Where pathways are located in close proximity to the 30 m 'impact buffer' zone around wetland, sensitive design options (e.g. a raised boardwalk or similar design) will be used to ensure contiguity of habitat and to reduce a barrier effect to the potential movement of frogs (see Sections 2.5.5 and 2.5.9). This will also minimise trampling and damage to vegetation;
- Other path treatments (e.g. gravel or sealed) may be used within the Conservation Zone where they are located beyond the 30 m 'impact buffer' around wetlands or other areas where habitat connectivity will not be compromised.
- Pathways located to the north of Rix Road may be located within or adjacent to the Conservation Zone (i.e. within the Thomas Street road reserve).
    - Note: A Memorandum of Understanding will need to be prepared between Council and Parks Victoria for the shared pathway. This will outline construction standards and maintenance obligations.
- A pathway connection under the Pakenham Bypass will be provided. Due to existing alignment restrictions, this path may be located entirely or within a part of the floodplain (Conservation Zone). The pathway alignment under the Bypass is not covered within this CMP. Minimisation of potential impacts will be addressed through design treatments such as a raised boardwalk where appropriate. The alignment and design of this shared pathway must be undertaken in consultation with and to the satisfaction of DSE. It is essential to maintain connectivity and protect habitat in this area for the Dwarf Galaxias and the Growling Grass Frog.
- Consideration should be given in the long-term to upgrading the open concrete culvert under the Princes Highway which is likely to currently present a barrier to dispersal for Growling Grass Frog, Southern Brown Bandicoot, Dwarf Galaxias and Australian Grayling.

2.4.4 Guidelines for wetland enhancement / modification

Three artificial wetlands will be modified to provide dedicated habitat for the Growling Grass Frog and Dwarf Galaxias (e.g. sites one, two and eight within the Conservation Zone, see Figure 2 and 6). All wetlands dedicated for Growling Grass Frog habitat will have a direct impacts buffer of at least 30 m provided around each of these waterbodies. This impact buffer aims to protect wetlands from recreational activities.

Wetland modifications principles for sites one, two and eight (see Figure 3) will include:

- Depth will vary across wetlands sites one, two and eight, with permanent and ephemeral water areas. If possible, water depth will be a maximum of 1 m.
- Modified wetland gradient slopes will vary from 1 in 8; 1 in 5; to 1 in 3 (according the vegetation zones below). Steep-sided wetlands are less favourable for the Growling Grass Frog.
- The artificial wetlands are filled through flooding events from Cardinia Creek. Ideally, these wetlands would not dry out completely, particularly over the spring and summer months (i.e. the breeding period). This is necessary to ensure habitat continues to be available for tadpoles over the summer months to permit metamorphosis. Changes to the hydrological regime also impacts Growling Grass Frog habitat through the alteration of aquatic vegetation communities, given the sensitivity of these plants to water depths and length of inundation (Heard and Scroggie 2009). Ideally, water levels in wetlands would be between 0.5 m and 1 m in vegetation zone 3. Plantings may be used to minimise evaporation. For example, taller plantings on the north and western sides of the waterbody while still maintaining open areas suitable habitat for basking on the southern and eastern sides.

Although the wetlands will not be used for stormwater treatment, useful guidelines for revegetation and creation of habitat are also outlined within (Melbourne Water 2005) Constructed Wetland Guidelines. See Section 2.5.1 for revegetation management plan.

Wetland planting

Vegetation floristics, composition and structural characteristics within and around the modified existing wetlands (sites one, two and eight, Figure 3) will replicate habitat used by the species elsewhere. Wetland plantings will be designed to allow a relatively 'open' vegetation structure with a diversity of indigenous macrophytic vegetation around and within the wetlands. Plantings will be indigenous to the local area and low growing with a maximum height of around 1.5 metres.

Three vegetation zones will be implemented. These zones are consistent with planting regimes at other constructed or proposed wetlands specifically designed for Growling Grass Frogs (e.g. Heard et al. 2004b; Organ 2005). Figure 3 below illustrates the various vegetation zones, which are also briefly summarised:

- Zone I – Permanently moist or seasonally wet margins; shallow seasonal inundation in lower part of zone. This zone will be densely planted with tussock-forming or rhizomatous perennials. The inter-tussock spaces will be vegetated with a sward of rhizomatous, stoloniferous or tufted perennials. Some species will also be dominants or co-dominants of the vegetation in Zone 2, thus are likely to form continuous swards straddling both zones. The primary objective in Zone 1 is to achieve a closed cover of vegetation as quickly as possible after planting to stabilise banks (thus preventing erosion, particularly by wave action) and to exclude weeds. Plantings will include amphibious tussock-forming grasses,

herbs, rushes and augmentation with suitable basking, shelter, perching and male calling sites, e.g. sparse rocks and logs;

- Zone II – Shallow inundation; upper minimum depth of inundation c. 10 cm; amphibious and emergent aquatic herbs, some straddling Zones 1 and 2. This zone may be vegetatively structurally diverse but the aim is to produce a dense cover to stabilise the substrate and prevent colonisation by weeds, particularly during periods of low water. All species selected are emergent aquatic plants or amphibious species able to cope with exposure during draw-down. Several species are winter-deciduous because of low temperatures (e.g. *Bolboschoenus caldwellii*), or may be summer-dormant (e.g. *Eleocharis acuta*) when receding water levels impose drought stress. In each case the aerial parts die back to storage organs (rhizomes, tubers etc). Dormant plants resume growth in spring and summer respectively. Plantings amphibious and emergent aquatic herbs, grasses and sedges (suitable for basking, shelter, perching and male calling sites);
- Zone III – Permanent water (open water, submerged marsh, deep marsh); submergent and emergent aquatic-herbs, some straddling Zones 2 and 3. This zone will be dominated by submerged aquatic species of permanent water. These are rhizomatous or stoloniferous perennials which are intended to densely cover the substrate. Submergent and emergent aquatic herbs (e.g. Water Ribbons and Pond Weed) are required for egg-laying sites, protection of tadpoles and prey ambush sites. A high cover of Pond Weed (*Potamageton* spp.) has been found to be correlated with the abundance of Growling Grass Frogs in the Pakenham area (Hamer and Organ 2006a);

A revegetation list of suitable plants is provided in Appendix 3;

Other Management Actions for Wetland Enhancement

- Fringing vegetation will be planted out to 15 m from the edge of the water, beyond which, existing grassy vegetation will be maintained to allow foraging and shelter habitat for the Growling Grass Frog (this may need to be adjusted as needed due to the location of Site one and two adjacent to Thomas Street).
- It is important to maintain open grassy areas which allow frogs to forage in areas adjoining the artificial wetlands and allow movement and dispersal between the waterbodies and creek. The floodplain intervening the wetlands and creek will be protected and act as a habitat corridor promoting east-west connectivity (between the creek and wetlands) and north-south connectivity (between wetlands and along the floodplain) for Growling Grass Frog. Grassy vegetation occurring within the study area (predominantly exotic) will be retained. Where possible, all new plantings will use indigenous flora species of local provenance. Plantings within habitat corridors will be maintained as open areas with sedges, tussock-grasses (e.g. *Poa* spp.), rocks and occasional low lying shrubs for shelter (Section 2.5.5 provides more detail on habitat corridors and connectivity); and
- In areas managed specifically for the Growling Grass Frog (e.g. existing artificial wetlands – sites one, two and eight, Figure 2 and 6), plantings of indigenous trees will be kept quite

sparse, particularly within the riparian zone of the wetlands, to avoid over-shading of the waterbodies. However, as the wetlands will also provide potential habitat for the Dwarf Galaxias, a mosaic of open and more closed plantings will be maintained. For example, plantings on the north and western side will allow cooler temperatures and shading (as required for Dwarf Galaxias), while also decreasing evaporation of water and allowing open areas for basking of frogs on the opposite bank.

Refuge and shelter sites

Sites which provide diurnal shelter/refuge and over-wintering habitat are critical components to Growling Grass Frog habitat. The Growling Grass Frog utilises thick vegetation cover at ground level, rocks and other solid ground cover for diurnal shelter and over-wintering refuge (Gillespie and Clemann 1999, Wilson 2003). Wetlands will be augmented with scattered rock jumbles, large boulders, logs and fringing vegetation (e.g. rushes and sedges) to provide shelter and refuge sites:

- Rocky areas (e.g. large boulders and rock jumbles) and logs will be provided for shelter/cover and over-wintering habitat around modified existing artificial wetlands. This also increases habitat diversity if vegetated:
    - Scattered rock jumbles, large boulders and logs will be placed along cleared areas of existing wetland banks and can extend 5 metres from the waters edge, and 1 metre below the maximum water depth. Rocks will vary in size from 300 mm to 1500 mm in diameter and cover 10 % of the bank area. The spaces between the refuge sites should vary to optimise habitat diversity and variability. No mortar will be used within the rock work to ensure crevices are available for frogs to shelter in; and
- Fringing vegetation will be provided around waterbodies such as indigenous rushes, sedges and tussock-grasses that provide shelter / over-wintering habitat.

Note:

Certification / approvals will be sought from DSE once wetland modifications to sites one, two and eight are complete.

Maintenance and enhancement works for other threatened fauna habitat including revegetation, weed and pest animal control, etc., are outlined within Section 2.5 (On-going Management and Monitoring).

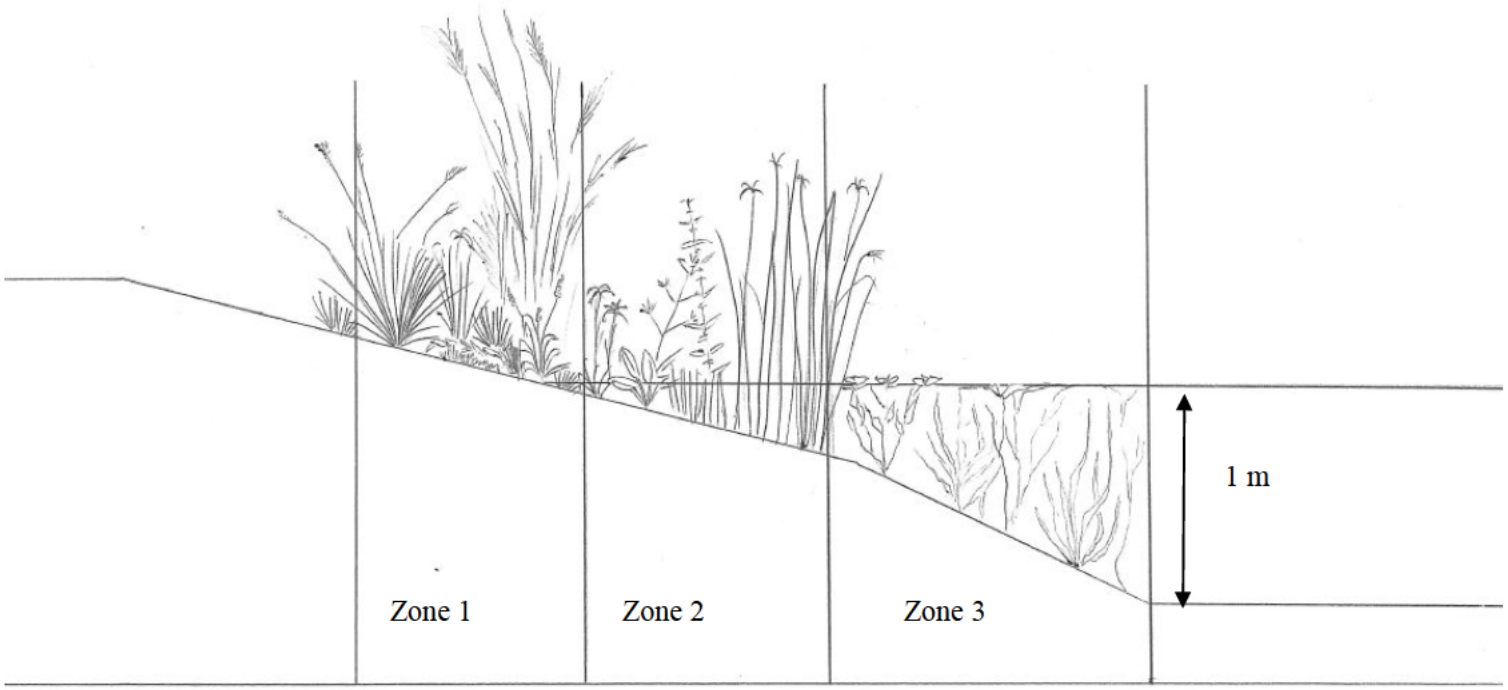

Figure 3 Officer PSP Cardinia Creek CMP: Conceptual cross section of vegetation zones 1, 2 and 3 for modifications to existing artificial wetlands (sites one, two and eight)

2.5 Conservation Zone: On-going Management and Monitoring Actions

The following management actions are those that 'must' or 'should' be implemented from the approval of the CMP and throughout the 10 year post-construction phase (Phase One).

Management Actions

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
Revegetation					
• The revegetation management plan will be implemented as outlined in Appendix 2 and 3 and with regard to threatened fauna habitat requirements outlined in Sections 2.4.4, 2.5.3, 2.5.4 and 2.5.5. Riparian zones in the artificial wetlands should be rehabilitated. Planting of fringing and emergent vegetation will create suitable habitat for the Growling Grass Frog as well as the Dwarf Galaxia	For the duration of the 10 year post-construction period of the CMP (Phase One).	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Successful establishment of revegetation in Management Zones 1 and 4 (see measures above).	• Undertake staged weed removal and revegetation replacement as required.
• Revegetation will be monitored and maintained.	Undertake every six months for the first year post-construction, and as required for the duration of the 10 year post-construction period of the CMP	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Revegetation in existing wetlands and along the creek corridor has established (see measures above). Survival rate of >80 % of plantings	• Undertake staged weed removal and revegetation replacement as required.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
	(Phase One).				
• A mosaic of open grassy areas in the floodplain will be maintained. Approximately 50% of exotic grassy / anabranches in the floodplain will be slashed every two years to maintain a mosaic of open and closed vegetation and retain floodplain hydrology.	For the duration of the 10 year post-construction period of the CMP (Phase One).	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• No alteration of Dwarf Galaxias habitat. • No alteration in the connectivity for the potential movement of frogs between and along the creek system. • Maintenance of open areas for foraging and closed areas for shelter for the Southern Brown Bandicoot.	• Habitat manipulation including appropriate mosaic slashing may be necessary to maintain open habitat.
Weed Control					
• Liaison and coordination of weed control works should be undertaken in conjunction with other land managers. Weed control would be best undertaken as a whole of catchment approach. Discuss target weed species and appropriate techniques for control.	For the duration of the 10 year post-construction period of the CMP (Phase One).	Parks Victoria / land owner	Parks Victoria / Cardinia Shire Council / Melbourne Water	• Implementation and coordination of weed removal works throughout the catchment.	• Monitor weed cover. Undertake staged weed removal and enhancement plantings as required.
• A weed management plan will be prepared for the Conservation Zone. • Suitably qualified personnel are to implement the weed management plan	For the duration of the 10 year post-construction period of the CMP (Phase One).	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Implementation of weed management plan. • An overall reduction in the area covered by invasive weeds.	• Undertake staged weed removal and enhancement plantings as required.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
• A staged removal of weeds will be undertaken to maintain fauna habitat at any one time. This is particularly important for maintenance of habitat for any one time for both Growling Grass Frog and Southern Brown Bandicoot. • Weeds will be removed in autumn with revegetation undertaken in early winter.	For the duration of the 10 year post-construction period of the CMP (Phase One).	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Reduction in weed cover. • If possible, thickets of Blackberry or other weeds which are retained as part of a staged removal and kept no more than 50 m apart. This is the maximum distance connectivity for Southern Brown Bandicoots could be maintained (DEWHA 2010). • Before entire removal of weeds - revegetation to grow to 50 cm in height and 50 % lateral cover, • Overall, maintain a vegetation structure between of 50-80% foliage density in the 0.2-1 m height range (DEWHA 2010).	• As soon as possible, rehabilitate after weed removal • Undertake monitoring and enhancement plantings with locally indigenous species, as required
• The use of herbicides in and adjacent to water-bodies will be avoided where practicable. Application methods resulting in low levels of off-target damage (e.g. cut/paint, and drill/fill) will be favoured over spray application.	Ongoing	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No significant off-target damage from herbicide usage. • No increase in chemicals which reduce water quality below acceptable State Environment Protection Policy Guidelines (SEPP	• Utilise mechanical control techniques near water-bodies where practical.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
				guidelines) and/or reduces habitat suitability for frogs.	
Direct Impact Buffers (see Section 2.5.4)					
• A minimum buffer width of 30 m will be implemented around each dedicated habitat wetland and floodplain edge as per DSE requirements. • Connectivity will be maintained through sensitive pathway design options within the 30 m buffer of a waterbody.	Ongoing	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Exclusion of human and dog access to buffer habitat. • No alteration to buffer habitat from degradation due to recreational usage.	• Exclude human and dog access through permanent fencing at select locations where necessary. • Further fencing / signage requirements as necessary.
• Within wetland direct impact buffer zones, all development will be excluded and manage vegetation to ensure compatibility with terrestrial frog habitat.	Ongoing	Parks Victoria / land owner in Conservation Zone and Cardinia Shire Council in Recreation Zone.	Land owners that remove suitable habitat (as shown in Appendix 8).	• No alteration to buffer habitat that is not compatible with Growling Grass Frog habitat e.g. no change from more open grassy vegetation to closed dense or overgrown habitat.	• Habitat manipulation including appropriate revegetation and management (e.g. slashing) may be necessary to maintain suitable open habitat.
Habitat corridors (see Section 2.5.5)					
• The creek will be buffered by a corridor width of between 60 m to > 500 m width. The area of the Conservation Zone ranges in width from 60 m to 200 m. This area will be managed primarily	Ongoing	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• No degradation within the corridor due to adjacent residential development.	• Fence off Conservation Zone.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
for conservation.					
• Connectivity along Cardinia Creek will be maintained by protecting the entire Conservation Zone including, the creek, remnant woodland, floodplain and artificial wetlands. Within these areas: minimise vegetation removal and plant appropriate vegetation along with staged weed removal.	Ongoing	Parks Victoria/ land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Potential movement of frogs through the creek systems is mot compromised/habitat link is not severed.	• Habitat manipulation including appropriate revegetation and management (e.g. slashing) may be necessary to maintain open habitat. Ensure matrix of open and closed grassy habitat for shelter and foraging areas.
• East-west connectivity will be maintained by creating a mosaic of open and closed grassy areas within the floodplain. The floodplain will be managed for existing values. Should any plantings/augmentation occur they will be comprised of sedges, tussock-grasses, rocks/logs and only occasional low-lying shrubs for shelter.	Ongoing	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Maintenance of potential movement of frogs between potential breeding habitat of the wetlands and the creek system (i.e. habitat link is not severed). • Maintenance of a mosaic of open and closed grassy vegetation in the floodplain that allows foraging and shelter habitat for Growling Grass Frog and Southern Brown Bandicoot but also	• Habitat manipulation including appropriate management (e.g. slashing) may be necessary to maintain open habitat.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
				maintains habitat values for Dwarf Galaxias.	
• Where paths are located within the Conservation Zone, sensitive design options (e.g. boardwalks or similar) will be retained and monitored to ensure suitable connectivity.	Ongoing	Parks Victoria in Conservation Zone / Cardinia Shire Council in Recreation Zone.	Land owners that remove suitable habitat (as shown in Appendix 8).	• Minimal vegetation removal. • No fragmentation of habitat in the Conservation Zone.	• No degradation to the Conservation Zone from recreational use.
Hydrology and Maintenance of Water Quality					
• Floodplain channels and wetlands may become in-filled and poorly defined. Minor excavation work may be required to maintain the hydrology of the floodplain.	Ongoing	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• No change in current flooding regime	• Implement further excavation work as required to maintain the hydrology of the floodplain.
• Excessive aquatic vegetation in the floodplain wetlands and anabranches may reduce the habitat quality for the Dwarf Galaxias. • 50% of the drainage channel within each anabranch will be slashed every two years to reduce the density of the aquatic vegetative growth. A mosaic pattern of slashing will be undertaken to provided habitat values for all threatened fauna species and in particular maintain water pathways on the floodplain and assist with	Ongoing	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• No alteration to the floodplain habitat suitability for the Dwarf Galaxias.	• Implement further monitoring and floodplain vegetation maintenance (e.g. slashing) as required.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
retention of water in the floodplain wetlands when they are inundated (e.g. Dwarf Galaxias habitat). • All other areas of exotic grassy vegetation within the floodplain will be slashed as required.					
Feral Animal Control					
• A feral predator control program will be prepared for the Conservation Zone.	Ongoing	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Absence / low abundance of exotic predators	• Monitor and undertake work as required.
• Monitor the wetlands to ensure the maintenance of reduced habitat suitability for exotic fish - dense submergent plantings and riparian plantings on the north and western side of the water body. If necessary: • Engage a fish control expert. • Prepare and implement fish control management plan in consultation with DSE, MW, Council, and a suitably qualified zoologist. • Monitor through yearly fish surveys	Ongoing	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Absence / low abundance of predatory fish.	• Monitor and respond as required. • Undertake further wetland plantings as required. • Wetlands will be modified to reduce habitat suitability for exotic fish - dense submergent plantings and riparian plantings on the north and western side of the water body.
• Fox control will be undertaken within the study area as	Ongoing	Parks Victoria / land owner	Land owners that remove	• Absence of foxes within the study area.	• Intensify control efforts as required.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
considered necessary by Parks Victoria from monitoring abundance. Destroy any fox dens immediately if found on-site. • A suitably qualified feral animal contractor will be engaged to undertake control measures.			suitable habitat (as shown in Appendix 8).		
• Coordination of fox control works should be undertaken as a community wide effort. Discuss control techniques with relevant authorities. • Liaison should be undertaken with relevant stakeholders to discuss need for control and the most cost effective and appropriate techniques.	Ongoing	Parks Victoria	Parks Victoria / Cardinia Shire Council / Melbourne Water / Surrounding private landowners	• Initiation of a catchment wide fox control program.	• Intensify control efforts as required.
• On-going removal of all food waste from site. A strict 'no dumping policy' for rubbish or litter (e.g. signs with litter fine amounts) will be enforced. Signage near public facilities would be helpful to explain that leaving food waste and rubbish may encourage pest animals such as foxes and rodents.	Ongoing	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Absence of food waste. • Contractor induction program prepared.	
• Signage will be used for education of detrimental effects of releasing introduced fish into	Ongoing	Parks Victoria in Conservation Zone.	Land owners that remove suitable habitat	• Appropriate signage is erected around wetlands prohibiting the	• Maintain and replace signage as required.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
waterways and impacts of foxes (see Section 2.5.9).			(as shown in Appendix 8).	introduction of fish. • Absence or low abundance of exotic fish.	
User related issues					
• The Conservation Zone (see Figure 2 and 6) will be maintained as a No-Go Zone for uncontrolled public use once the corridor is developed and will be protected through permanent fencing and/or landscape treatments such as revegetation that will form a visual cue. Select locations (e.g. sensitive environs such as wetlands) will be permanently fenced along the interface of the Conservation and Recreation Zones. Revegetation will form an additional barrier along the fenceline and will enable the fence to be removed at a later stage, if deemed appropriate.	Ongoing	Parks Victoria / land owner	Land Owners that remove suitable habitat (as shown in Appendix 8).	-	•
• Encourage path use and awareness of Conservation Zones through a clear delineation of trails.	Ongoing	Parks Victoria in Conservation Zone	Land owners that remove suitable habitat (as shown in Appendix 8).	• Pedestrian traffic in the Conservation Zone is limited to designated paths.	• Revegetate and/or fencing may help to designate areas.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
• Dogs will be prohibited within the Conservation Zone with the exception of any paths located on the periphery of this zone, where dogs must be on-leash. • Enforce strict dogs 'on-leash' within the Recreation Zone (Figure 2). • Off-leash areas for dogs will be permanently fenced and will not be located adjacent to the Conservation Zone. • Signage will be provided to educate visitors of the potential impacts of domestic pets and outline of dog restrictions.	Ongoing	Parks Victoria / land owner in Conservation Zone	Land owners that remove suitable habitat (as shown in Appendix 8).	• Exclusion of dogs in the Conservation Zone, except on peripheral paths where dogs must be on-leash. • Dog's on-leash only in designated Recreation Zone. • Dog's off-leash within permanently fenced enclosure in the Recreation Zone.	• Provision of further fencing and interpretive signage as required.
• The further introduction of exotic fish into the creeks or wetlands (see above) will be prohibited and enforced (fines).	Ongoing	Parks Victoria in Conservation Zone	Land owners that remove suitable habitat (as shown in Appendix 8).	• Absence / low abundance of exotic fish.	• Provision of further interpretive signage as required. • Increase monitoring and enforcement.
• Interpretive signage will be provided in areas of interest including prohibit riding of trail bikes and horses along the shared pathway. • A contractor will be engaged to maintain and replace signage as required. (see Table 1 for	Ongoing	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Provision of signage outlining environmental values, potential impacts from recreational use and appropriate behaviours.	• Provision of further signage and interpretive material as required.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
requirements).					
• Permanent fencing (e.g. farm fencing with ring lock along the bottom to exclude dogs) will be maintained where appropriate at the interface of recreation and Conservation Zones. The reserve will be fenced (if and where appropriate) from the future residential development to prevent access and disturbance by trail bikes and other vehicles.	Ongoing	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Protection of the Conservation Zone from degradation caused by human and dog disturbance. • Protective fencing installed.	• Maintain and replace fencing as required.
• Temporarily fence (with appropriate signage) will be installed around revegetation zones if required (e.g. wetland enhancement) and to prohibit access where appropriate until revegetation is established (see Figure 7).	Ongoing	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Protection of newly revegetated sites from human and dog access. • Protective fencing installed.	• Maintain and replace fencing as required.
• Prohibit the removal of fallen timber and other plant material.	Ongoing	Parks Victoria	Parks Victoria	-	•
• The introduction of exotic fish into Cardinia Creek or further stocking of the artificial wetlands will be prohibited. The public will be educated about the impacts of exotic fish on	Ongoing	Parks Victoria/ Council	Parks Victoria / Cardinia Shire Council.	-	•

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
native fauna and their habitat through existing communication methods. Information can be provided via interpretive signage, mail drops and the Council/Parks Victoria website.					
Population and Habitat Monitoring					
• Annual monitoring of Growling Grass Frog will be undertaken within all existing wetlands, the floodplain (if inundated) and Cardinia Creek, to determine the potential colonisation of the habitat areas (See Appendix 6). Monitoring must be undertaken for a minimum of one season (during the breeding period) prior to the wetland modifications / enhancements. Note: The CMP does not require monitoring for the Southern Brown Bandicoot or their habitat (DSE and Cardinia Shire Council, pers. comm.).	Monitoring will commence at least one season prior to wetland construction and continue annually once wetlands are certified by DSE (application to DSE) for the duration of the 10 year post-construction period of the CMP (Phase One).	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Colonisation by Growling Grass Frog.	• Modify management according to monitoring results (if required).
• Annual monitoring will be undertaken for the Dwarf Galaxias and Australian Grayling populations as per prescribed schedule.	For the duration of the 10 year post-construction period of the CMP (Phase One).	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Maintenance of Dwarf Galaxias populations. • Australian Grayling populations present within the section of Cardinia Creek covered by this CMP.	• Modify management according to monitoring results (if required).

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
• Annual water quality monitoring will be undertaken in wetlands and Cardinia Creek.	For the duration of the 10 year post-construction period of the CMP (Phase One). Annual monitoring will commence from approval of CMP for Cardinia Creek. Monitoring of wetlands will commence once certified by DSE (application to DSE). Monitor during yearly fish surveys	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• No increase in nutrients, toxins, chemicals, sediment loads or an algal bloom which reduces water quality below acceptable State Environment Protection Policy Guidelines (SEPP guidelines) and/or reduces habitat suitability for frogs (e.g. high turbidity). • Results of review and regular monitoring of water quality are available for analysis.	• Implement further sediment and pollutant controls, if required.
• Revegetation will be monitored and maintained as required. • Implement weed control and replacement plantings as required.	Every six months for the first year after planting. Yearly ongoing, for the duration of the 10 year post-construction period of the CMP (Phase One).	Parks Victoria	Land owners that remove suitable habitat (as shown in Appendix 8).	• Establishment and maintenance of successful revegetation.	• Intensify / adapt weed control techniques as required.
• An annual weed-monitoring program will be implemented. • Ongoing informal monitoring should be undertaken in combination with weed control works.	Annual weed monitoring for the duration of the 10 year post-construction period of the CMP (Phase One).	Parks Victoria / land owner	Land owners that remove suitable habitat (as shown in Appendix 8).	• Elimination and/or control of target species as outlined in Appendix 4.	• Intensify / adapt weed control techniques as required.

2.5.1 Guidelines for Revegetation Works

Revegetation within the study area must be undertaken:

- As a follow-up measure associated with particular weed-control activities in potential Growling Grass Frog, Southern Brown Bandicoot, Dwarf Galaxias and Australian Grayling habitat;
- To enhance potential habitat for Growling Grass Frog, Southern Brown Bandicoot, Dwarf Galaxias and Australian Grayling;

Revegetation will also have additional benefits:

- Enhance habitat for a suite of other indigenous fauna species;
- Enhance existing stands of remnant vegetation; and
- Enhance natural landscape amenity.

The planting of trees, shrubs and robust perennial grasses and graminoids will provide competition for exotic species where weed control (removal) has created opportunities for invasion/reinvasion of the same or other undesirable exotic species. Such competition will assist in reducing germination and establishment of some weed species (particularly in higher quality vegetation). In lower quality vegetation characterised by high-threat, ubiquitous herbaceous species, revegetation of the large shrub and tree strata will enhance landscape amenity values, habitat continuity, and habitat values for a suite of common indigenous fauna throughout the study area. Additionally, revegetation utilising a range of indigenous shrub species suffering from local population decline (e.g. Hemp Bush *Gynatrix pulchella*), will bolster population numbers within the study area, as natural recruitment of these species is being hampered by varying processes (e.g. weed competition, altered hydrological regimes, indigenous and exotic mammal browsing).

Indigenous plant species suitable for use in revegetation of the study area are given below in Appendix 2 and 3. Appendix 2 provides species suitable for use in revegetation of terrestrial environments, and also includes a number of robust perennial graminoids recommended for use in the ephemeral wetlands of the floodplain (see Figure 5, Management Zone 2). Appendix 3 provides species suitable for use in revegetation of existing and future (constructed) wetlands (including Cardinia Creek).

Note: All revegetation works within the study area will need to consider and support appropriate maintenance access. Melbourne Water will provide more information to facilitate development of a detailed planting regime at the appropriate time.

Revegetation zones

Two broad revegetation zones according with Ecological Vegetation Classes ('Swampy Riparian Woodland' and 'Swampy Woodland') are identified for the study area (Figure 5). Appendix 2 outlines plant species suitable for each of these EVCs.

For wetland revegetation (Appendix 3), three planting zones are identified based on level of inundation.

Wetland planting zones for the study area are conceptually illustrated in Figure 3 and outlined in Section 2.4.4.

Revegetation methods

Three methods are generally used in revegetation exercises:

1. Direct seeding;
2. Planting of 'tubestock' or 'cells' propagated from seeds, cuttings, or divisions; and
3. Facilitation of natural recruitment from naturally dispersed *in situ* or off-site sources of propagules (mostly seeds) onto a suitable seed-bed.

The planting of tubestock is considered the only viable option within the study area because of massive competition from weeds in direct seeding or natural recruitment.

Revegetation strategy

The process of successful revegetation requires planning, documentation, implementation, monitoring and maintenance;

1. **Site selection:** must include consideration of the following issues:

- Existing indigenous flora – ensure revegetation activities do not negatively impact existing indigenous vegetation; and
- Weed flora – ensure sufficient weed control has been undertaken pre-planting.

2. **Site preparation:** will be variously required throughout the study area and will include:

- Weed control;
- Tree-guarding and fencing (only recommended if grazing pressures are found to significantly increase mortality of plants). This may include 'netting' of wetland plantings; and
- Jute matting.

3. **Species selection:** plantings must make ecological sense, i.e. species 'belong' in particular environments and plant species associations. Also, consideration must be given to the

capacity for a species to prosper in a given situation (e.g. deep shade, high weed cover, shallow soils, etc.).

4. **Sources of propagating material:** all revegetation will utilise indigenous species propagated from material (seeds, cuttings, divisions) which must be obtained from the nearest natural populations, with the appropriate DSE permits and protocols to avoid harm to the source populations by overexploitation. All sources of material will be recorded by the contractor(s) or other parties involved in revegetation. Planted populations are unfortunately often unreliable as sources of material because much non-indigenous material is used in some sectors of the revegetation industry. All plants and propagation material must be correctly identified and named before being utilised in revegetation.
5. **Propagation of production plants:** must be undertaken with sufficient lead time to achieve good growth by the time of planting. This will require that the contractor has been allocated sufficient time to undertake collection and growing-on of the tubestock before the projected planting time. Conversely, over-grown or root-bound tubestock (depending upon the species involved) should be rejected.
6. **Documentation:** by documenting the various components of a revegetation program (e.g. locations and dates of seed collection, provenance of revegetated plants used at a particular site, weed control, monitoring, etc.) the success rates of future revegetation can be increased as a greater understanding of 'what works' is achieved and communicated to future practitioners.
7. **Planting:** autumn to spring planting (of terrestrial species) and spring planting (of wetland species) is recommended for the study area, allowing for optimal growing conditions (moisture availability and increasing soil temperature).
8. **Monitoring:** it is of utmost importance that all revegetation be monitored. Effectively timed monitoring will allow various degradation processes (weeds, grazing) to be managed before they adversely affect the plantings.
9. **Maintenance:** timing will coincide with ecological timelines (e.g. undertake weed control before seed-set) and always seek to optimise the health of the plants used in the revegetation. All plant losses will be replaced unless mortality has been the result of unmanageable site conditions (e.g. prolonged drought).

2.5.2 Weed Management

Management Actions

- Implement weed control as outlined above. Personnel must be suitably qualified and/or trained to undertake weed management works as outlined in this document.

- Implement a monitoring program to ensure weed control works are successful, and to identify ongoing works.
- Weeds contractors will liaise with the Cardinia Shire and Parks Victoria. Weed control must be consistent with the Shire of Cardinia Weed Management Strategy (Cardinia Shire 2007). The plan outlines the importance for staged weed control to ensure that weed control works do not adversely impact upon Southern Brown Bandicoot habitat.

The weed flora of the study area comprises five noxious weed species (as listed under the Catchment and Land Protection Act 1994 [CaLP Act] for the Port Phillip and Westernport CMA region), and numerous other environmental weed species (see Appendix 4). The weed flora is dominated by ubiquitous annual and perennial herbaceous species, with woody weeds (most notably Japanese Honeysuckle **Lonicera japonica* and Blackberry **Rubus anglocandicans*) scattered throughout.

Appendix 4 lists 14 weed species identified for elimination or control within the study area. These are a small proportion of the weed flora, but have been identified as species/populations that must be managed throughout the study area because of their seriousness as invaders, and/or are required to be managed under the CaLP Act. Other species will require management in certain circumstances (e.g. to allow for revegetation), but full-scale management would be untenable (e.g. Phalaris **Phalaris aquatica*).

It must be stated that the weed flora is not static, and new weed species are likely to appear within the study area over the duration of this management plan, introduced by a wide range of natural agents (e.g. wind and animals). The weeds listed for control in Appendix 4 should not be seen as exhaustive. Annual monitoring will allow for the identification of new weed species and their incorporation into the management program as appropriate.

Weed management operators must be suitably qualified and appropriately certified and possess the requisite weed and indigenous plant identification skills. Additionally, all aspects of the control program need to be appropriately documented (to an agreed standard) to enable the tracking and evaluation of control methods/activities, and to allow for refinement of procedures, as well as to inform future weed management activities. Finally, damage to indigenous vegetation (by herbicide or machinery and to soils) must be avoided at all times, and all health and safety, and environmental regulations, must be observed.

Herbicide use

All herbicide usage within the study area will be in accordance with the following:

- If herbicides are to be used adjacent to the creek and other waterbodies, a legally certified herbicide for use in such situations (as specified on the product label) will be used. Application methods resulting in low levels of off-target damage (e.g. cut/paint, and drill/fill) will be favoured over spray application;

- All use of herbicides (and associated additives) will be in accordance with the product label. Off-label use of herbicides may be permitted where approval has been granted from a state government department (e.g. Department of Sustainability and Environment or Department of Primary Industries);
- Site-specific herbicide planning (application methods, chemicals used, weather conditions, plant phenology, etc.) will be employed to reduce off-target herbicide damage. Off-target herbicide damage is the detrimental application of herbicide to plant species that have not been targeted for control. While this generally applies to plants in and around the point of herbicide application, it may also refer to organisms (flora and fauna) some distance away; and
- Seasonal restriction: If Growling Grass Frogs are found to be present in the study area, herbicide spraying must not be undertaken within the study area during the Growling Grass Frog breeding season (October – March); however 'wick-wiping' (the direct application of herbicide to foliage via a wick/sponge) and other non-spray techniques (e.g. cut/paint and drill/fill) may be undertaken during this period.

2.5.3 On-going habitat enhancement

The on-going management and monitoring actions relating to habitat enhancement and augmentation of the Conservation Zone are described below.

Specifically, the management actions for the Southern Brown Bandicoot outlined below are taken from the Strategic Management Plan for the Southern Brown Bandicoot in the former Koo Wee Rup Swamp area (developed by Ecology Australia 2008a for Cardinia Shire Council, City of Casey and Melbourne Water) and the recent Draft Significant Impact Guidelines for the Southern Brown Bandicoot under the EPBC Act 1999 (DEWHA 2010).

Management Actions

The following measures will be implemented throughout 'Phase One' and as required during 'Phase Two' of the CMP:

- Maintain enhancement plantings in artificial wetlands dedicated for Growling Grass Frog habitat (sites one, two and eight within the Conservation Zone, see Figure 2 and 6) as per wetland enhancement guidelines (see Section 2.4.4).
- Maintain and increase the structural diversity of habitat through plantings [e.g. emergent (e.g. rushes and reeds), submergent (e.g. Pond Weed and Water Ribbon), floating and fringing aquatic vegetation]. Species selected will be compatible with Growling Grass Frog and Dwarf Galaxias habitat requirements (see Sections 2.4.4 and 2.5.3).
- Maintain a sparse over-storey vegetation around wetlands to avoid over-shading the (also see Section 2.4.4). Manage wetlands for both the Growling Grass Frog but also the Dwarf Galaxias by maintaining plantings on the north and western side that will allow cooler

temperatures and shading (as required for Dwarf Galaxias), while also decreasing evaporation of water and allowing open areas for basking of frogs on the opposite bank.

- Management of the exotic grasslands within the floodplain and anabranches will be compatible with the Dwarf Galaxias (i.e. maintenance of the existing open vegetation). This would also provide suitable ephemeral habitat for the Growling Grass Frog and some foraging habitat at the interface of remnant woodland and open grassland for the Southern Brown Bandicoot.
    - Intermittent slashing of exotic grasses may be required to keep open grassy areas in the floodplain for Dwarf Galaxias (and Growling Grass Frog). A matrix of open and dense grassy vegetation in the floodplain will be maintained. For Dwarf Galaxias, 50% of the drainage channels (i.e. within the anabranches) will be slashed every two years to reduce the density of the aquatic vegetative growth.
    - Slashing should maintain water pathways on the floodplain and assist with retention of water in the floodplain wetlands when they are inundated.
    - The entire exotic grassy area will not be slashed at once as this may increase exposure of Southern Brown Bandicoots to predators. Slashing of exotic grassy vegetation will occur to create a matrix of open and closed vegetation as required.
        - The more open areas are likely to be utilised for foraging by Southern Brown Bandicoots, while dense long grass may provide shelter for this species. The Strategic Management Plan noted that large scale slashing was not recommended but narrow, cleared strips may provide good foraging space close to dense vegetation, minimising exposure when foraging (Ecology Australia 2008a). The presence of foxes often exaggerates a species requirement for cover and the need for food to be nearby (May and Norton 1996);
- Current exotic grassy vegetation can be retained within the study area to maintain open areas. This will also provide suitable floodplain habitat for Growling Grass Frog and Dwarf Galaxias during inundation.
- All new and replacement plantings will use indigenous flora species of local provenance as per Section 2.5.1
- The riparian woodland currently supports suitable habitat for the Southern Brown Bandicoot (see Figure 5). Enhance existing habitat for the Southern Brown Bandicoot through strategic weed removal together and targeted revegetation and restoration (Sections 2.5.1 and 2.5.2). These actions are intended to improve the overall habitat quality of these areas through improving the habitat structure and increasing the density of understorey vegetation to provide protection and shelter for the Southern Brown Bandicoot. The most essential habitat requirement for the Southern Brown Bandicoot is a low dense layer of understorey vegetation, which provides shelter and protection from

predators. Thus, it is also important that the plants used are of the appropriate growth form and structure, to replace the level of cover provided by the weeds.

  - As per Draft Significant Impact Assessment Guidelines for the Southern Brown Bandicoot (DEWHA 2010), the revegetation should aim for an understorey vegetation structure between an average of 50-80% foliage density in the 0.2-1 m height range.
  - Revegetation efforts will promote the development of a continuous and dense understorey. Supplementary plantings will improve the continuity, quality and density of the understorey vegetation, to improve vegetation functionality as a habitat and as a dispersal link. Revegetation efforts should be focussed where there are gaps in vegetation and the understorey is sparse. To achieve this, plants will be planted at the appropriate densities, to provide 'rapid closure' of the understorey vegetation. For example, canopy (tree) species must be planted at sufficient distances apart, so that their growth does not impede development of the understorey.

- Undertake a staged weed removal and replacement with indigenous dense understorey species as required. This is particularly important as Bandicoots are known to utilise dense weedy vegetation such as blackberries for shelter:
  - Weed removal will be followed immediately by rehabilitation of the area through appropriate revegetation (see Section 2.5.1).
  - If possible, thickets of Blackberry or other weeds which are retained as part of a staged removal of potential bandicoot habitat should be kept no more than 50 m apart. This was considered to be the maximum distance under which a reasonable level of habitat connectivity could be maintained, according to a recent workshop used to develop the Draft Significant Impact Guidelines for the Southern Brown Bandicoot, under the EPBC Act 1999 (DEWHA 2010).
  - Revegetation following staged removal of weeds should be allowed to grow to at least 50 cm in height, and the vegetation density should provide at least 50 % lateral cover, before the remaining areas of weeds are removed. This may take approximately 18 months, depending on the plant species chosen (Geoff Carr, Ecology Australia, pers. comm.).
  - Overall, the surrounding vegetation should maintain a vegetation structure between an average of 50-80% foliage density in the 0.2-1 m height range (DEWHA 2010).
  - Drift of herbicides onto native vegetation should be avoided, through carefully applied and targeted spot-spraying or 'wiping'

- On-going herbicide use near water will be environmentally sensitive and appropriate for use in these areas. Hand removal or 'wick-wiping' of weed species is preferred (also refer to Section 2.5.2).
- On-going measures to reduce habitat quality to exclude Eastern Gambusia will be undertaken. For example, dense submergent aquatic plantings and riparian plantings on the north and western side of the artificial wetlands will reduce the water temperature and provide partial shading of the waterbody, while still allowing basking sites for Growling Grass Frog on the opposite side (see also Section 2.5.8,).
- Fox control will be undertaken within the study area (see Section 2.5.8).
- Stocking of the artificial wetlands with the Dwarf Galaxias from another nearby population would require approval from DSE.
- The link to the north is severed by the Princes Highway and a deep concrete culvert that was inundated with water at the time of assessment. It is suggested that this culvert be upgraded in the long-term to provide suitable passage for Bandicoots and other fauna species (e.g. Growling Grass Frog). This is not however a requirement of this CMP.
- Informal tracks adjacent to the riparian vegetation in the north of the study area will be revegetated. These informal tracks fragment the habitat, encourage use by people and promote weed invasion. The rehabilitation of these tracks with plantings of native vegetation would increase the quality of habitat and decrease further weed invasion.
- Enforce dog exclusion within the Conservation Zone, with the exception of pathways located along the periphery of the Conservation Zone, where dogs must be on-leash (see Section 2.5.9). It is also recommended that Council consider cat curfews.

Shelter/refuge habitat is critical to reduce predation pressure on Southern Brown Bandicoots. The Southern Brown Bandicoot utilises dense native or exotic vegetation within the understorey for shelter from predators. Recommendations for provision of logs and dense understorey vegetation are made to provide shelter and refuge sites:

- Retain and/or provide if necessary suitable logs that provide shelter/cover for bandicoots in cleared areas along Cardinia Creek. This also increases habitat diversity if vegetated; and
- Provision of dense understorey indigenous vegetation along the creek will provide shelter habitat.

If required, fire management will be undertaken according to Parks Victoria's current practices in consultation with DSE, the Country Fire Authority (CFA) and appropriate Councils. The use of fire to manage vegetation will also follow Southern Brown Bandicoot guidelines (as per DEWHA 2010)

- If fire management is necessary, at any given time, no more than 20% of the habitat must have a reduced understorey vegetation structure below an average of 50% foliage density in the 0.2-1 m height range. This will maintain bandicoot habitat.

2.5.4 'Impact' Buffer zones

A 'buffer' is an environmental management tool used to protect the environmental values of a waterbody (Steedman and France 2000; Biosis Research 2003a; DSE 2004). It is important to maintain a suitable buffer width around Cardinia Creek Floodplain and the existing artificial wetlands (dedicated Growling Grass Frog habitat) to protect these from use by residents, edge effects and deterioration of habitat.

To maintain the long-term viability of Growling Grass Frog habitat, the DEWHA Growling Grass Frog Workshop (March 2008) suggested a width of 200 m around waterways where populations are present (DEWHA 2009). The value is based on movement data (radio tracking) between water bodies and foraging sites (Nick Clemann, Arthur Rylah Institute, pers. comm.; Peter Robertson Wildlife Profiles, pers. comm.). A minimum buffer width of 200 m was also recommended for protecting habitat within the Merri Creek environs, north of Melbourne's CBD (Sub-regional Conservation Strategy for Growling Grass Frog - Ecology Australia 2006c).

A width of 200 m around the existing artificial wetlands is not practical and in this case, DSE have suggested a minimum 'impact buffer' width of 30 m around each wetland to buffer the wetland from direct impacts of the adjacent recreational zone, noting that the wetlands are within a larger terrestrial system that provides for additional terrestrial habitat (i.e. the total width of the Conservation Zone between the creek and Recreation Zone ranges from c. 60 m to 200 m. Land between these existing water bodies and the creek will be managed primarily for conservation, and will exclude all recreational activities.

The existing water bodies are located on the eastern edge of the Conservation Zone and thus the 30 m 'impact buffer' would be implemented between the waterbody and the adjacent Recreation Zone (see Figure 2). Sensitive design options will be implemented for the pathway if it encroaches on the 30 m impact buffer. This buffer zone must be designated prior to pathway construction activities occurring.

Cardinia Creek will be 'buffered' from the proposed residential development within the Officer PSP area by both the Conservation and Recreational Zones in the corridor, ranging from c. 60 m width in the north to c. 570 m width in the south.

2.5.5 Habitat Corridors and Connectivity

Habitat connectivity within will be retained through the protection of the creek, riparian vegetation and floodplain - Conservation Zone - Management Zones 1, 2, 3, and 4, see Figure 2 and 5). Protection of these habitats will maintain connectivity and a suitable passage for movement/dispersal of frogs, bandicoots and fish along the Cardinia Creek corridor (north-south connectivity within the study area and beyond). Existing connectivity to the south of the study area (e.g. under the Princes Freeway/Pakenham Bypass) is considered to be high. The deep concrete culvert under the Princes Highway in the north is considered to pose a major barrier to movement/dispersal for all threatened fauna species. Consideration should be given in the long-term to upgrading this culvert with regard to the movement of frogs, bandicoots and fish.

The width of the entire Cardinia Creek corridor (i.e. area between the creek and proposed residential development) varies between 60 m in the north and > 500 m in the south. The width of the Conservation Zone varies in width between 60 m and 200 m from the creek in the north and south of the study area respectively. This area includes the creek, remnant riparian vegetation floodplain and artificial wetlands. This entire area will be managed for conservation values and exclude all recreational activities.

To maintain suitable habitat connectivity throughout the corridor for all threatened fauna species, the following elements will be provided:

Management Actions

- The Conservation Zone (Figure 2) will be managed primarily for conservation (e.g. the creek, riparian woodland, floodplain and three artificial wetlands - sites one, two and eight Figure 5). This will maintain north-south connectivity for fauna.
- Pathways to the north of Rix Road will be located within or adjacent (e.g. in the road reserve) to the Conservation Zone. Where necessary, sensitive design options (e.g. raised boardwalk or similar) will be implemented (e.g. where pathways are located within the 30 m 'impact buffer' area). This will minimise trampling by foot traffic, while still allowing movement along the creek (Sections 2.4.3 and 2.6). Other path treatments (e.g. gravel or sealed) may be used beyond the 30 m buffer around wetlands (see Section 2.4.3).
- Any pathway connection under the Pakenham Bypass is to maintain and protect connectivity of Dwarf Galaxias and Growling Grass Frog habitat (see Section 2.6.2).
- Revegetation and management of the floodplain and associated water bodies will aim to facilitate movement of the Growling Grass Frog while maintaining current habitat values for the Dwarf Galaxias (see Section 2.5.6).
- Implement appropriate revegetation within the remnant riparian woodland that aims to create suitable habitat for the Southern Brown Bandicoot through promotion of a continuous and dense understorey species (e.g. sedges, tussock-grasses, rocks/logs and low/dense shrubs for shelter) (see Sections 2.5.1 and 2.5.3). This will also enhance in-stream habitat along Cardinia Creek for Dwarf Galaxias and Australian Grayling.
    - The current width of the remnant riparian woodland along the creek varies, with some areas cleared to the banks and others covered by between 5 m to 30 m of riparian woodland vegetation. Where possible, and without interfering with the floodplain hydrology, the width of the remnant riparian woodland should be extended to 50 m as per DEWHA (2010). It is unlikely that a width of more than 50 m can be attained through revegetation of the remnant woodland. Plantings within this area will not extend into the exotic grassy vegetation of the floodplain that supports known habitat values for the Dwarf Galaxias and potential foraging/movement habitat for Growling Grass Frog.

- The Draft Significant Impact Guidelines for the Southern Brown Bandicoot under the EPBC Act 1999 (DEWHA 2010) suggests suitable corridors widths for dispersal and potential habitat to maintain the long-term viability of Bandicoot habitat. These include: A corridor of greater than 50 m width, for distances up to 1.1 km, which consists of native vegetation with an understorey structure of 50-80% foliage density in the 0.2-1 m height range; and wider corridors will be required for longer corridors (DEWHA 2010).

It is suggested that the concrete culvert under the Princes Highway be upgraded in the long-term to eliminate any major barriers to dispersal that currently exist for terrestrial and aquatic fauna species. Should the culvert be upgraded, the design must be in consultation with DSE and must give consideration to the movement of frogs, bandicoots and fish. If constructed, a drift fence will be used to funnel movement of fauna through the culvert and exclude animals crossing the Princes Highway. Upgrade of the Princes Highway Culvert is not however a requirement of this CMP. Robertson (2002) and Organ (2005) discuss culvert design for frogs.

2.5.6 Floodplain Hydrology

Floodplain Hydrology[1]

Floodplain hydrology, including the frequency and duration of flooding must remain unchanged by the proposed works within the study area and within the Officer Precinct. The maintenance of pathways of water passage on the Cardinia Creek floodplain is particularly critical to the protection of Dwarf Galaxias habitat.

The Development Services Scheme (DSS) covers a substantial portion of the Officer Precinct but does not include Cardinia Creek or the properties immediately adjacent to it. The Officer DSS will drain all stormwater away from Cardinia Creek. Furthermore, returning treated stormwater to the creek and/or artificial wetlands is not likely to be feasible (Melbourne Water letter to GAA - dated 16 August 2010). As such, the use of stormwater run-off to fill the existing wetlands is not covered within the CMP. This minimises and/or eliminates the potential impacts from the use of stormwater such as: sudden rises and falls in water levels; changes to the existing seasonal streamflows; and decreases in water quality from sedimentation and pollution. Changes to the hydrological regime may result in inappropriate floodplain inundation with too much water or too little will not allow the necessary connectivity of the floodplain anabranches and Cardinia Creek (as outlined in McGuckin, 2010).

The Background Information report associated within this CMP (e.g. Ecology Australia and Streamline Research 2011) shows that floodplain inundation occurred in most years between 1974 - 1996, but has infrequently occurred since that time. With the exception of 2004, when there was

[1] Written by John McGuckin of Streamline Research Pty. Ltd.

13 days of inundation, flooding since 1997 has only occurred on a handful of occasions. Furthermore, there has been seven years in which flooding has not occurred (1997, 1998, 2002, 2006, 2008, 2009 and 2010). A flooding event on the 5 and 6 February 2011 resulted in widespread inundation of the floodplain and anabranches within the study area (John McGuckin, pers. obs). Interestingly, the increased frequency of floodplain inundation in 2004 was attributed to a widespread distribution of Dwarf Galaxias in the floodplain wetlands between the Princes Highway and the Princes Freeway (McGuckin 2005). It is known that streamflows of 251 ML/day at Chasemore Road, Officer, coincide with the overtopping of Cardinia Creek onto the floodplain between the Princes Highway and the Princes Freeway (McGuckin 2001a).

2.5.7 Maintenance of Water Quality

It is essential to maintain suitable water quality within Cardinia Creek, the anabranches and the artificial wetlands dedicated as fauna habitat (e.g. sites one, two and eight). Water quality tolerances and preferences for Growling Grass Frogs are poorly known, however, recent studies have revealed that, whilst frogs are likely to tolerate a range of water conditions (Ashworth 1998, Hamer et al. 2002, Pyke 2002), frogs generally prefer water bodies possessing low levels of nutrients and salinity for successful breeding and recruitment to occur (Ashworth 1998, Organ 2002, 2003, 2005; Hamer and Organ 2006b). As such, the water quality of the creek and wetlands will need to be maintained within the ranges known at sites occupied by the Growling Grass Frog. This will also benefit Dwarf Galaxias.

Management Actions

Management actions and protocols for ensuring the maintenance of floodplain hydrology and water quality parameters are provided below.

- Slashing of the exotic grasses within the drainage channel of the anabranches will be undertaken for 50% of area every two years to reduce the density of the aquatic vegetative growth. A mosaic pattern of slashing is suggested for the anabranches. Slashing should maintain water pathways on the floodplain and assist with retention of water in the floodplain wetlands when they are inundated. Slashing exotic grasses outside the drainage channel will be undertaken as required.
- Best management practices for erosion and sediment control will be implemented in the pre-construction period and maintained throughout the construction period (see Sections 2.4.1 and 2.4.3).
- Floodplain channels and wetlands may become in-filled and poorly defined. Minor excavation work may be required to maintain the hydrology of the floodplain.
- If required, herbicides that are environmentally sensitive and approved for use around aquatic environments will be used in areas adjacent to existing wetlands and Cardinia Creek to reduce the potential for non-target impacts and reduce the source of nutrient enrichment and decrease the likelihood of algal blooms (see Section 2.5.2).

- A water quality monitoring program will be undertaken within Cardinia Creek at a location upstream of the works area and immediately downstream at yearly intervals, and after flooding events. The monitoring program must start prior to the commencement of construction activities and continue until construction activities are completed. A water quality program will be conducted in conjunction with annual monitoring for the Dwarf Galaxias using an *in-situ* probe test and a visual assessment of the water quality to identify issues such as turbidity or surface residue. Parameters recorded during the *in-situ* probe test will include:
    - Turbidity;
    - Temperature;
    - pH;
    - Dissolved oxygen;
    - Salinity; and
    - Electrical conductivity.
- Water Quality monitoring within wetlands will be undertaken annually once the modifications / enhancements are completed.
- Acceptable ranges for those water quality parameters outlined above will follow the Australian and New Zealand Guidelines for Freshwater and Marine Water Quality (ANZECC 2000) and the Environment Protection Agency (EPA) guidelines. If monitoring detects harmful levels of particular water quality attributes, remedial action will be undertaken in consultation with EPA, DSE and Council.

2.5.8 Pest Animal Management

Introduced animals pose a threat to the biodiversity values of habitat in the study area through predation (e.g. European Fox *Vulpes vulpes* and feral cats *Felis catus*) and/or degradation of native vegetation (e.g. European Rabbits *Oryctolagus cuniculus*). Eastern Gambusia and Common Carp pose a major threat to aquatic habitats of the study area and are known to predate on eggs and tadpoles of the Growling Grass Frog.

Pest animal control is essential to protect and enhance threatened fauna habitat in the study area, particularly in relation to potential threats of predation to Growling Grass Frog and Southern Brown Bandicoot. Management actions / protocols for mitigating impacts of this threatening process are outlined below.

Foxes

Fox predation is outlined as a Threatening Process in the Action Statement produced under the FFG Act (Mansergh and Markes 1993), and is also a threatening process under the EPBC Act (DEWHA 2008a). The Fox is declared vermin under the CaLP Act and all land owners and land managers have a legal obligation to control foxes on their property.

Fox predation rates on Bandicoots in the Koo Wee Rup region are potentially high, with hair analysis of fox scats collected during a survey in February 2008, revealing that 50% of scats collected contained the hair of Southern Brown Bandicoots (Ecology Australia 2008a). The Strategic Management Plan for Southern Brown Bandicoot (Ecology Australia 2008a) identified that the small and isolated populations of bandicoots in fragmented remnants within the former Koo Wee Rup Swamp area, are at increased risk of local extinction due to secondary pressures of Fox predation (Menkhorst and Seebeck 1990, Menkhorst 1995, Coates and Wright 2003).

Foxes are also likely to predate on Growling Grass Frogs and would threaten any population found with the area.

As the fox is a highly mobile animal, and would occur in surrounding areas, any control action on foxes would be potentially futile unless surrounding land managers and owners also took similar action in a co-coordinated community-based scheme over a large area (Saunders et al. 1995, Morton et al. 1999). An intensive, co-ordinated, regional approach is essential for fox control to succeed. This will require collaboration between a number of agencies, stakeholders and cooperation from private landholders, as well as an integrated approach. Recommendations are provided below to minimise fox abundance in the study area.

Management Actions

Parks Victoria will undertake a Feral Animal Control Program which may include fox control. See below suggested guidelines for fox control**:**

- The abundance and density of the fox within the study area should be monitored to determine the effort and intensity of control required (i.e. the number of baits required and frequency of baiting). This information will provide data on fox abundances to make baseline comparisons when monitoring the effectiveness of fox control programs. Estimates of fox abundance should be undertaken by spotlight counts in the very early hours of the morning. Locating den sites during the breeding season can also give an indication of their presence.
- Weeds will be removed that may harbour foxes. A staged removal and revegetation will be necessary, as weeds may also provide habitat for threatened fauna species (e.g. blackberry may provide habitat for Southern Brown Bandicoot), (see Sections 2.5.2 and 2.5.3).
- A feral animal contractor will be engaged to development and implement a fox control plan for the study area.
- While poison baiting is often the most effective means of control, no single technique can provide effective long-term control (Bloomfield 2001). Therefore, an integrated program that includes more than one technique is recommended.
- Control methods may include:
    - Poison baiting - Poison baiting is undertaken with meat based baits laced with 1080. Users must comply with the *Directions for the Use of 1080 Pest Animal Bait Products in Victoria* (Victorian Government 2007). When administered in

accordance with specified guidelines, non-target impacts to bandicoots in particular are considered to be low. Domestic cats and dogs however, are susceptible to 1080. Therefore, it is imperative that local pet owners are made well aware of the timing, duration and areas of baiting through print media and letter drops, and baited areas must be clearly signed and designated as 'No Pet Zones'. The risk to domestic animals is minimal when this is carried out correctly. Nonetheless, the minimal risk associated with non-target animal uptake of poison is greatly outweighed by the benefits. Fox control programs throughout Australia have been shown to be highly effective in increasing numbers of critical weight range (CWR) mammals [2](Dexter et al. 2007), including Southern Brown Bandicoots (Rees and Paull 2000, Coates 2008). Even when foxes are not completely eliminated, the abundance of mammals, including the Southern Brown Bandicoot has been shown to increase dramatically (Rees and Paull 2000, Dexter et al. 2007, Coates 2008). It is thought that species such as bandicoots, with a high reproductive rate may be able to recover and co-exist if predation pressures are kept sufficiently low (May and Norton 1996, Smith and Quin 1996). A control program should include an appropriate baiting regime based on the abundance of foxes estimated previously, and the density of baits should always be higher than the density of foxes (McPhee and Bloomfield 2004).

  - Den fumigation - is an effective technique in conjunction with baiting. Where possible, dens should be destroyed following fumigation, by ripping with machinery. Dens should be revisited each year in May to June and August to September to measure and monitor fox activity (Bloomfield 2001). Mapping dens will greatly assist in monitoring the effectiveness of this activity.

  - Soft-jaw Trapping - Soft-jaw trapping has been effective when used in conjunction with baiting programs. This method employs the use of rubber jaw leg-hold traps, which allows non-target species to be released. It is particularly useful in areas were methods such as baiting pose too much of a risk or to remove animals that will not take baits. Set traps must be monitored daily.

- Fox control programs should ideally commence in March to early April, and continue throughout autumn to control young foxes dispersing and settling into new territories (Ecology Australia 2008a). Additional rounds of fox control should be carried out in spring (November), during the fox breeding season to reduce rapid re-colonisation by foxes (McPhee and Bloomfield 2004). Baiting will take place twice per season (i.e. four times per year) for the first two years. If bait uptake reduces significantly after this, baiting

[2] CWR native mammals in the weight range 30 – 5500 g have been most prone to severe declines and extinctions across Australia since European settlement.

frequency can be reduced (McPhee and Bloomfield 2004). The program will continue for the duration of this plan.

- Discuss current control techniques with the DSE, Department of Primary Industries (DPI), Parks Victoria, local council, Melbourne Water, control contractors and local residents.
- Food waste will be removed and interpretive signage will be used to notify visitors that leaving food waste and rubbish in open space areas may encourage foxes and other pest animals, such as rodents.
- Rabbit and feral cat control will also be integrated into the fox control program (see below).
    - Coordination with surrounding stakeholders should be undertaken to develop a broad-scale integrated Fox control program. The larger the area of fox control, the longer it takes for foxes to re-colonise target areas. Thus, control should be executed on a broad regional scale with co-operation from land holders and land managers.

Cats

Predation of native wildlife by cats is listed as a Threatening Process on the *Flora and Fauna Guarantee Act 1988*. Action Statement No. 80 (Seebeck and Clunie 2004) has been produced to ameliorate the adverse effects of this process. Feral cat predation is also a threatening process under the EPBC Act (DEWHA 2008b). Although the impacts of predation by feral cats on native mammals is thought by many to be less than that of Foxes (May and Norton 1996, Smith and Quin 1996, Lechner 2006), it has been demonstrated that they can contribute significantly to local extinctions of native fauna (Bezuijen and McMahon 1999; Barratt 1995, 1997, 1998, Smith and Quin 1996). Feral cats are most likely to prey upon juvenile bandicoots, and this has been cited as one of the factors responsible for the decline of the Eastern Barred Bandicoot (*Parameles gunnii*). Recommendations are provided below to minimise feral cat abundance in the study area.

Management Actions

- Cardinia Council to require Local Laws to require cat curfews and to ensure implementation and compliance with the Local Law.
- If feral cats are considered to constitute a threat in the study area (i.e. through spotlight monitoring for foxes), methods for their control in the study area will be integrated into the predator control program. Cage trapping is a commonly used method of feral cat control and has recently been undertaken at Point Nepean in 2006 (MPWBRF 2008). Pre-feed baiting without traps maximises trapping success. Tagged cats that are trapped can be returned to their owners, and untagged cats impounded. If they are determined to be feral, they will be humanely destroyed.

- Discuss control techniques with the DSE, Department of Primary Industries (DPI), Parks Victoria, local council, Melbourne Water, control contractors and local residents.
- Surrounding residents will be notified when cat control activities are planned. This information should include control techniques, contacts and impacts of feral cats on native fauna (see Section 2.5.8).

Rabbits

Rabbits could potentially pose a threat to flora and fauna values within the study area through land degradation and over-grazing, particularly to revegetation efforts (DEWHA 2008c). Rabbit control should be undertaken in coordination with Fox control methods to prevent eruptions in rabbit numbers following fox control, and consequent increases in fox numbers, characteristic of predator - prey relationships.

Rabbit impacts may include:

- Overgrazing and inhibiting the regeneration of native vegetation (Cooke 1987). Rabbits selectively graze the seedlings of many native tree and shrub species. For example Cooke (1987) found that as few as 2-3 rabbits per hectare are sufficient to prevent regeneration of some important native plant species in the Coorong region of South Australia;
- Erosion of soil (Norman 1988); and
- High numbers of rabbits could potentially support elevated densities of Red Fox, to the detriment of native fauna species (Smith and Quin 1996) such as Bandicoots, with lower reproductive rates than rabbits.

Actions to minimise rabbit abundance in the study area are provide below.

Management Actions

Parks Victoria will undertake a Feral Animal Control Program which may include rabbit control. See below suggested guidelines for rabbit control:

- Monitoring of rabbit density will be undertaken during the nocturnal spotlight monitoring for exotic animals (e.g. foxes). This will indicate whether a control program is required and the areas in which rabbits are feeding (i.e. important for determining the placement of baits). Daytime estimates can also be made from scat counts, using the Gibb Index for estimating rabbit abundance. Searches should also be carried out to locate warrens.
- Destroy rabbit warrens through fumigation and/or ripping of warrens. Other methods of rabbit control such as baiting may also be necessary. Before undertaking fumigation or destruction of any rabbit warrens, contractors will ensure that burrows are not occupied by bandicoots or other native fauna.
- Fumigation is typically carried out in autumn and winter. Monitoring should be conducted to detect new warrens, and re-opened warrens should be fumigated.

- Weeds that may harbour rabbits and foxes will be removed. A staged removal and revegetation will be necessary (see Sections 2.5.1 and 2.5.2), as weeds also provide habitat for native fauna. For example, blackberry provides potential shelter from predators for the Southern Brown Bandicoot.

Eastern Gambusia

The noxious Eastern Gambusia can out-compete the Dwarf Galaxias for food and habitat and can stress and kill Dwarf Galaxias when the two species occupy the same environment.

Eastern Gambusia is also a potential predator of Growling Grass Frog eggs and tadpoles (Anstis 2002) and has been implicated in the decline of this species (Robertson et al. 2002). At present, the Eastern Gambusia is found in Cardinia Creek, and three of the existing artificial wetlands (sites one, eight and ten, see Figure 6). The species could potentially establish in all of the watercourses on the floodplain when flooding from Cardinia Creek occurs. The current absence of the species in many of these habitats is due to the drying of the anabranches since the last inundation of the floodplain.

As the Eastern Gambusia has a widespread distribution throughout the Cardinia Creek catchment it can not be effectively controlled on a local scale. Colonisation by the species in floodplain waterways is expected whenever flooding of Cardinia Creek occurs.

No eradication program has yet been devised that could be used to stop the Eastern Gambusia establishing in the Officer Precinct. Modifications to the existing wetlands could be made to reduce habitat features that are suitable to Eastern Gambusia. For example, dense submergent aquatic plantings and riparian plantings on the north and western sides of the waterbody will reduce the water temperature and maintain some shaded areas (both compatible for Dwarf Galaxias), while still allowing open areas of suitable habitat for basking Growling Grass Frog on the opposite side.

Management Actions

- All stocking of exotic fish or non-indigenous fish within the creek, floodplain, anabranches and all wetlands (both recreation and conservation wetlands) is prohibited (see Sections 2.5.8, 2.5.9 and 2.6.3).
- Interpretive signage will be installed to educate visitors about the impacts and enforcements (e.g. fines) associated with exotic fish introductions (see Sections 2.5.9 and 2.6.3).
- Undertake measures to reduce habitat quality for Eastern Gambusia in existing wetlands dedicated for Growling Grass Frog habitat. For example, dense submergent aquatic plantings and riparian plantings on the north and western side of the water body (see also Sections 2.4.4, 2.5.1, 2.5.3 and 2.5.8).
- Monitoring of exotic fish will be undertaken during the annual monitoring surveys for Dwarf Galaxias and Australian Grayling.

Carp

The noxious Carp was found in one artificial wetland (site 10, designated as a recreational wetland). Carp are not present in Cardinia Creek upstream of Thompsons Road, Clyde North. It is unknown what deleterious effect could occur to nationally threatened species like the Dwarf Galaxias and Australian Grayling if carp were to invade the creek.

Site 10 is located within the Recreation Zone and will be designated as a recreational wetland.

Carp are likely to predate upon eggs, tadpoles and metamorphs of the Growling Grass Frog. It is unknown what impact this species would have on adult Growling Grass Frog.

Carp could potentially move between site 10 and Cardinia Creek when these waters are connected (during flood periods). Movement of carp to Cardinia Creek could also easily be made by an illegal introduction, once public access becomes available (deliberate movement of carp from Site 10 to Cardinia Creek).

Management Actions

- An eradication program will be implemented by Council to destroy the carp that are currently found in the artificial wetland site 10. It is possible this could be done by:
    - Pumping the waterbody dry (which may be difficult if it intercepts the underlying groundwater); and
    - Liming of the watercourse when it is dry should also destroy the noxious Eastern Gambusia which is also present in this wetland.
- An eradication program for carp will be completed prior to the development of the Recreation Zone.
- Interpretive signage will be installed to educate visitors about the impacts and enforcements (e.g. fines) associated with exotic fish introductions (see Section 2.5.9).
- A salvage program will be developed and implemented to ensure that Short-finned eels *Anguilla australis*, Common long necked tortoise *Chelodina longicollis* (and other native fauna) are salvaged and relocated during the carp eradication program (i.e. as the wetland is being drained). A salvage and relocation program for aquatic fauna will be undertaken by a qualified aquatic ecologist.

2.5.9 Mitigation measures for user related issues (post-construction)

Mitigation measures and management actions are provided below to minimise the potential impacts from recreational usage in the Cardinia Creek corridor.

Table 1 Officer PSP Cardinia Creek CMP: Interpretive signage required

Sites/areas	Interpretative signs for values	Other signs
Post Construction of creek corridor / residential development		
Cardinia Creek corridor	• Information on the Cardinia Creek corridor providing known or potential habitat for threatened fauna species (e.g. Dwarf Galaxias, Australian Grayling, Growling Grass Frog and Southern Brown Bandicoot. These signs will not give the detailed location of individual populations. This would aim to highlight the importance of protecting and maintaining habitat values (e.g. wetlands) and activities that could have a potentially degrading impact. • Feral predator (foxes and feral cat) control programs (e.g. types of control and duration of operation). • The impacts of dumped garden waste and the importance of controlling the invasion of environmental weeds or other exotics. • Waterway health including: the impacts of exotic fish such as Carp and Eastern Gambusia and the prohibition of stocking waterbodies with these invasive species. • Prohibition of rubbish dumping. • Prohibition for cats/dogs in the Conservation Zone (as per exception below) and outline their potential impacts on fauna values. A map showing the location of on-leash (e.g. dogs must be on-leash along paths located along the periphery of the Conservation Zone and designated open space areas) and off-leash (e.g. fenced enclosure) areas for dogs within the recreation zone	Exclusion Zones: Access for public restricted to viewing points only - exclude pedestrian access to the Conservation Zone.

2.5.10 Population and Habitat Monitoring

The following monitoring protocols are required to be implemented from the date of approval of the CMP and/or completion of modifications of the artificial wetlands dedicated as threatened fauna habitat and their certification by DSE. Monitoring protocols for threatened fauna populations and their habitat within the Conservation Zone is outlined below.

Population and habitat monitoring for the Growling Grass Frog

Management Actions

- Population monitoring along the floodplain and creek will be undertaken at least one season prior to the construction of the wetlands within the Conservation Zone and will continue annually throughout construction, and then for ten years post-construction (i.e. completion of the wetland modifications) (Phase One). Population and habitat monitoring will also be required in Phase Two.
- Engaging an appropriately qualified zoologist to monitor the potential colonisation and/or successful translocation of Growling Grass Frogs.
- Monitoring would be undertaken within all existing wetlands within the Conservation Zone including, sites one, two and eight, the floodplain (when inundated) and along Cardinia Creek during the breeding season (e.g. October – March). During the monitoring surveys, each waterbody (e.g. existing wetlands, floodplain and creekline) will be surveyed annually over two nights during this period. Appendix 6 outlines the methodology for population monitoring.
- Habitat monitoring within artificial wetlands including water depth, vegetation coverage, presence of exotic fish, water quality (to be undertaken annually in conjunction with fish monitoring) will be undertaken annually from the date of approval of the CMP, throughout construction, and then for ten years post-construction.
- Once wetland modifications have been completed, wetland vegetation (e.g. habitat) monitoring will be undertaken annually by a qualified zoologist. A proforma sheet for monitoring habitat elements and potential threats within Growling Grass Frog habitat is provided in Appendix 6.
- An annual report will be prepared by Parks Victoria and submitted to DSE, detailing the outcomes of the Growling Grass Frog population and habitat monitoring surveys.

Note: monitoring will also be required where changes to management practices can lead to degradation of habitats and consequently the ability of the frog to disperse through or colonise the area.

Population and habitat monitoring for the Southern Brown Bandicoot

As agreed between the Department of Sustainability and Environment and Cardinia Shire Council, monitoring of the Southern Brown Bandicoot and/or their habitat is not required along Cardinia Creek as part of this CMP.

Population and habitat monitoring for the Dwarf Galaxias and the Australian Grayling

Dwarf Galaxias and Australian Grayling populations in Cardinia Creek will be monitored. Regular monitoring of floodplain environments is also needed for the Dwarf Galaxias to continue using habitat after the proposed development adjacent to and within the floodplain (i.e. construction works associated with the modifications to Site 8). Fish surveys / monitoring are necessary to provide baseline data for comparison with future surveys during construction and post floodplain development. Fish surveys should show that through the implementation of appropriate mitigation measures that the Dwarf Galaxias, Australian Grayling and other fish fauna of Cardinia Creek have not been affected by the Officer Precinct development.

Contractors need to have contingency for reporting accidents (disturbance to aquatic habitat) that may impact on waterways (see Section 2.7). A chain of command between construction personnel, the land owner or the responsible agent and a qualified biologist is needed to report problems and to provide appropriate on-ground responses.

Monitoring should be performed by a suitably qualified aquatic biologist. Results of the Dwarf Galaxias and Australian Grayling monitoring will be prepared by Parks Victoria and submitted as an annual report to DSE. Melbourne Water to contribute to annual reporting by Parks Victoria, including comment on wider waterway issues that might affect Grayling Populations. It is recommended that on-going liaison between Parks Victoria and Melbourne Water be undertaken in regard to monitoring episodes or regimes to increase the survey efficiency and information quality.

The sites which should be the basis of future monitoring locations in the Officer Precinct includes all of the locations surveyed on the floodplain in the baseline investigation (see Ecology Australia and Streamline Research 2011) plus more intensive surveying of Cardinia Creek at a minimum of two locations. Data from the Dwarf Galaxias surveys associated with the Pakenham Bypass may also provide some baseline data for comparison. Indicative requirements for the annual monitoring for the Dwarf Galaxias are:

- *Field component*
    - *2 persons x 3 days*
    - *Travel 3 days x 140 km*
- *Reporting*
    - *1 person x 4 days*

Additional monitoring will be necessary for a minimum of two floods over the 10 year Phase One period (preferably with one event equal or greater than 1:10 year inundation).

Water quality monitoring can be conducted at the same time as the field study for the Dwarf Galaxias and Australian Grayling, without additional field or reporting costs.

Management Actions

- Representative sampling in Cardinia Creek and in floodplain watercourses before, during and post development should be made.
- A survey should be made for Australian Grayling and for other native fish between the Princes Highway and the Princes Freeway.
- Monitoring for the Dwarf Galaxias and Australian Grayling in waterways of the Officer Precinct should be conducted annually (August to November) and after significant flood events (equivalent of 1:10 year flood or higher).
- Monitoring should continue for 10 years post-construction and should include at least two periods of floodplain inundation (with at least one flood equivalent to a 1:10 year event or greater).
- The monitoring will have two components, monitoring of habitat and monitoring of any population/s found in the Officer Precinct.
- Water quality monitoring will be undertaken in conjunction with the annual monitoring for the Dwarf Galaxias and Australian Grayling. Management actions for water quality monitoring are outlined in Section 2.5.7.

In summary, the priority waters for the preservation of Dwarf Galaxias and Australian Grayling populations and Dwarf Galaxias habitat can be divided into two types of waters:

- Waters which currently support Dwarf Galaxias and Australian Grayling populations (Cardinia Creek).
- Waters which have habitat that could potentially support Dwarf Galaxias (Cardinia Creek floodplain anabranches and artificial wetlands).

RECREATION ZONE

2.6 Recreation Zone: Pre- Construction and Construction Mitigation Measures

The study area is part of the future Cardinia Creek Parklands that forms a series of linked but distinct parks that aims to protect the natural values of the region and also provide recreational facilities for a growing population within the area (Parks Victoria 2002)

2.6.1 Mitigation measures for the Pre-construction Period

Protect and maintain the Conservation Zone during any construction works within the Recreation Zone through the following measures:

Management Actions

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
Pre-construction period Protect and maintain the Conservation Zone during any construction works (including development of recreational facilities, works within the conservation zone, or residential areas adjacent to the conservation zone)				
No-Go Zones – Fencing				
No-Go Zones will be required for: • Fencing of No Go Zones will be required for any works in the Recreation Zone including construction of pathways, recreation facilities, modifications to wetlands or drainage etc.. No-Go Zones will be established by Council along the perimeter of the Conservation Zone prior to and throughout the duration of works within the Recreation Zone. Protect the Conservation Zone through the designation of No-Go Zones (see	To be implemented pre-construction and be retained throughout the construction period.	Cardinia Shire Council in Recreation Zone	Officer Development Contributions Plan	• No removal or degradation of terrestrial habitats or existing wetland area within the Conservation Zone for Growling Grass Frog (e.g. within 30 m of wetlands or between wetlands and Cardinia Creek).

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
Sections 2.4.1, 2.6.1 and Figure 7). • Enhancement of existing artificial wetlands (Sites 1, 2 and 8, See Figure 6). No-Go Zones will be established by Parks Victoria prior to and throughout the duration of works associated with wetland enhancement. Protection of surrounding Conservation Zone.				
• No-Go Zone signage will be clearly displayed on temporary fencing and state that these areas are Conservation Zones with no access to contractors and machinery (see Sections 2.4.1 and 2.6.1). • No-Go Zones will protect connectivity of habitat along the creek and floodplain (i.e. north - south connectivity) and between the wetlands and the creek (e.g. east-west connectivity).	To be implemented pre-construction and be retained throughout the construction period.	Cardinia Shire Council in Recreation Zone	Officer Development Contributions Plan	• No removal or degradation of terrestrial habitats or existing wetland area within the Conservation Zone for Growling Grass Frog (e.g. within 30 m of wetlands or between wetlands and Cardinia Creek).
Sediment Controls				
• Sediment control measures (No-Go Zone) will be implemented prior to construction works to protect the Conservation Zone during major habitat enhancement works and or recreational facilities (e.g. pathways) (see No-Go Zones Figure 7). • Best Practice procedures will be implemented to minimise construction impacts (sedimentation and pollution) on the creek, floodplain and existing wetlands. • Any sediment control fences should have intermittent gaps (one metre) approximately every 30 m to 50 m to allow for any movement of frogs. No Go Zones should be practical to allow suitable	To be implemented pre-construction and be retained throughout the construction period.	Cardinia Shire Council in Recreation Zone	Officer Development Contributions Plan	• No removal or degradation of terrestrial habitats or existing wetland area outside the construction footprint. • No machinery access into the Conservation Zone. • Pathways should not be located within the 30 m buffer zone allocated around the existing artificial wetlands and floodplain. • No increase in sediment loads which reduce water quality below acceptable State

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
access points to construction area in consultation with DSE. • Designate construction, stockpile, refuelling and storage sites well away from the Conservation Zone, Cardinia Creek and the floodplain.				Environment Protection Policy Guidelines (SEPP guidelines) and/or reduces habitat suitability for frogs (e.g. high turbidity).
Environmental Induction				
• Prior to construction, all employees from the contracting companies will take part in an environmental induction. This will involve an on-site meeting with the site manager to relay information regarding the Conservation Management Plan, specifically in relation to the threatened fauna species, their habitat requirements and importance of protecting these areas • In particular, contractors need to be familiar with the appearance and ecology of each species and adhere to actions proposed to either protect habitat or avoid direct impacts/loss of animals during the construction period. The contractors must also be aware to contact DSE and a qualified Zoologist immediately for fauna salvage, should any of the threatened fauna species be found during the construction activities.	To be undertaken pre-construction and as required during the construction period.	Cardinia Shire Council in Recreation Zone	Officer Development Contributions Plan	• No removal or degradation of terrestrial habitats or existing wetland area within the Conservation Zone.
Exotic fish control				
• Carp will be eradicated in artificial wetland (site 10) prior to any development within the creek corridor (e.g. drain and lime the wetland). • A suitably qualified contractor will be engaged to	To be implemented pre-construction.	Cardinia Shire Council	Officer Development Contributions Plan	• Absence / low abundance of carp • Fish control management plan prepared.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
undertake carp eradication. • A salvage and translocation program will be undertaken for other aquatic fauna (e.g. eels, turtles) during the carp eradication program.				
Salvage and translocate frogs				
• A permit to salvage and translocate animals will be required from the Department of Sustainability and Environment (DSE) under the Wildlife Act 1975. Only persons listed on the Victorian *Wildlife Act 1975* Management Authorisation will be permitted to handle native fauna. • A qualified Zoologist will be engaged to undertake pre-construction/ construction Growling Grass Frog salvage as outlined in Appendix 5. • The salvage and translocation plan will be implemented prior to any earth works or vegetation removal in close proximity to the existing artificial wetlands and floodplain. This will include works associated with installation of the permanent fence, wetland modifications, pathway construction, etc. • A recipient site for translocated frogs has yet to be determined and must be selected in consultation with DSE. • Monitoring of translocated frogs will be undertaken in accordance with protocols outlined in Appendix 6.	Salvage to occur one week prior to construction and throughout the entire period of construction.	Cardinia Shire Council in Recreation Zone. Engage qualified zoologist. In consultation with DSE.	To be confirmed – Refer to Contingency Actions Section 2.7.	• Permit acquisition.
Permits				

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
• A permit to remove native vegetation will be required from Cardinia Shire Council.	To be obtained pre-construction.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• As per requirements of the regulating authority. Permit conditions adhered to.

2.6.2 Mitigation Actions for the Construction Period

The construction period refers to the stage in which the development works (e.g. any earthworks and/or vegetation removal) are initiated. Proposed works in the Recreation and Conservation/Recreation Zones include:

- Development of passive open space e.g. the shared pathway / trail.
- Development of active open space e.g. potential sports ovals in the south-east corner of the study area.
- Possible modifications to the existing artificial wetland in the south of the study area (e.g. site 10, see Figure 2) for recreational purposes.

Residential development is proposed adjacent to the Cardinia Creek corridor (south of Rix Road).

During construction works, a qualified zoologist and/or aquatic biologist (as appropriate) may be required to be present during construction works if threatened fauna are found on-site during construction activities (see salvage and relocation protocols).

To minimise and/or eliminate risks of construction activities associated with recreational facilities and future residential development adjacent to the Conservation Zone, the following mitigation measures and management actions will be implemented.

Management Actions

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
Construction of recreational facilities				
• Maintain No-Go Zones to protect fauna habitat. The construction site manager will undertake regular inspections of the No-Go Zones to ensure that temporary fencing, sediment controls and signage are maintained. Replacement will be required as necessary (see Sections 2.4.1, 2.4.3, 2.6.1 and 2.6.2). Permanent fencing will need to consider access requirements for contractors to	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• No removal or degradation of terrestrial habitats or existing wetland area outside the construction footprint. • No machinery access into the Conservation Zone. • No increase in sediment loads which reduce water quality below

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
maintain the wetlands, floodplain and for Melbourne Water to access the waterway. • The construction site manager will undertake regular inspections of the No-Go Zones to ensure that temporary fencing, sediment controls and signage are maintained. Replacement will be required as necessary (See Section 2.6.1).				acceptable State Environment Protection Policy Guidelines (SEPP guidelines) and/or reduces habitat suitability for frogs (e.g. high turbidity).
• Connectivity along Cardinia Creek and in east-west direction (see habitat corridors above) will be maintained.	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• Potential movement of frogs between and along the creek system is not compromised/habitat link is severed.
• Heavy vehicles and machinery will not access the Conservation Zone, particularly the floodplain (i.e. No-Go Zone) where possible. Use handheld equipment where possible. An exception to this may be the construction works associated with wetland modification / enhancement of site eight. • Implement appropriate fencing and signage to illustrate access restrictions.	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• Exclusion of machinery from No-Go Zones.
• Pathways will be located within the Recreation Zone where possible. Sensitive design options (e.g. boardwalks) will be implemented where pathways are directed into or adjacent to the Conservation Zone (i.e. within the 30 m impact buffer). • Other path treatments (e.g. gravel or sealed) may be used within the Conservation Zone where they are located beyond the 30 m buffer around wetlands. • A pathway connection under the Pakenham Bypass will be provided that links to the main shared trail	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• Dedicated threatened fauna habitat is not fragmented. • Potential movement of frogs along the creek system is not compromised/habitat link is not severed. • Protection of sensitive vegetation communities from trampling by foot traffic.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
along the Cardinia Creek corridor. Due to existing access restrictions, the location of this path under the Bypass may be situated entirely or within a part of the floodplain. Minimisation of potential impacts will be addressed through design treatments such as a raised boardwalk where appropriate. The alignment and design of this shared pathway must be undertaken in consultation with and to the satisfaction of DSE. It is essential to maintain and protect connectivity of Dwarf Galaxias and Growling Grass Frog habitat under the Bypass. • A Memorandum of Understanding will need to be prepared between Council and Parks Victoria for the shared pathway. This will outline construction standards and maintenance obligations.				
• Existing remnant trees to be retained will be protected during any works.	Ongoing	Cardinia Shire Council in Recreation Zone	-	• Existing remnant trees retained.
• Soil stabilisation will be undertaken in disturbed areas.	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• Minimisation of soil erosion in works areas.
• The need for weed control within the construction zone and at machinery wash down sites will be determined during the construction period and undertaken as required.	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• Reduction in weed cover.
• Food waste will be removed from site to discourage pest animals	To be undertaken	Cardinia Shire Council in	Officer Development	• No increase in pest animals (e.g. foxes) on-site.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
	during the construction period.	Recreation Zone.	Contributions Plan	
• Chemical and fuel will not be stockpiled near the floodplain or artificial wetlands	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• No change in habitat.
• No lighting will be installed within 30 m of the existing wetlands. All lighting outside this area should be directed away from the waterbodies and the creek corridor.	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• Absence of visual lighting disturbance to faun and light spillage to sensitive habitats.
• Should contractors identify a Growling Grass Frog on-site, all works will temporary cease and immediate notification of DSE and a qualified Zoologist will be made. Salvage and translocation will be implemented by a qualified Zoologist as required.	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• No death or injury to Growling Grass Frog during construction activities.
• All new staff will be inducted by the Site Manager.	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• No degradation to environmental values within the Cardinia Creek Corridor.
• During development works, clear protocols will be provided to construction personnel to identify the expected mitigation measures and importance to maintaining ecological values in the adjoining Conservation Zone. Direct disturbance such as vegetation removal or indirect disturbances (e.g.	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• No degradation to environmental values within the Cardinia Creek Corridor.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
spills from machinery) could have a detrimental effect on threatened fauna habitat. Compliance of mitigation practices during the construction period must be checked by the land owner or the responsible agent. Non compliance issues need to be addressed.				
• Sedimentation control measures must remain in place until the completion of works, and disturbed soils have been effectively stabilised.	To be undertaken during the construction period.	Cardinia Shire Council in Recreation Zone.	Officer Development Contributions Plan	• No sediment pollution / degradation to environmental values within the Cardinia Creek Corridor.

2.6.3 On-going Management and Monitoring Actions

On-going management of the Recreation Zones should aim to have minimal impacts on the adjacent habitat values of the Conservation Zone.

Management Actions

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
Weed Control					
• Liaison and coordination of weed control works should be undertaken in conjunction with other land managers. Weed control would be best undertaken as a whole of catchment approach. Discuss target weed species and appropriate techniques for control.	Ongoing.	Cardinia Shire Council / Melbourne Water Note: Cardina Shire Council has weed	Parks Victoria / Cardinia Shire Council / Melbourne Water Note: Cardinia Shire Council is	• Implementation and coordination of weed removal works throughout the catchment.	• Monitor weed cover. Undertake staged weed removal and enhancement plantings as required.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
		control responsibility for Recreation Zone.	the funding source for weed control in the Recreation Zone.		
• The use of herbicides in and adjacent to water-bodies (Sites 1, 2 and 8) will be avoided where practicable. Application methods resulting in low levels of off-target damage (e.g. cut/paint, and drill/fill) will be favoured over spray application.	Ongoing	Cardinia Shire Council	Cardinia Shire Council.	• No significant off-target damage from herbicide usage. • No increase in chemicals which reduce water quality below acceptable State Environment Protection Policy Guidelines (SEPP guidelines) and/or reduces habitat suitability for frogs.	• Utilise mechanical control techniques near water-bodies where practical.
Direct Impact Buffers					
• A minimum buffer width of 30 m will be implemented around each dedicated habitat wetland (Sites 1, 2 and 8) and floodplain edge as per DSE requirements. • Connectivity will be maintained through sensitive pathway design options within the 30 m buffer of a waterbody.	Ongoing	Cardinia Shire Council in Recreation Zone.	Cardinia Shire Council.	• Exclusion of human and dog access to buffer habitat. • No alteration to buffer habitat from degradation due to recreational usage.	• Exclude human and dog access through permanent fencing at select locations where necessary. • Further fencing / signage requirements as necessary.
• Within wetland direct impact buffer zones, all development will be excluded and manage	Ongoing	Cardinia Shire Council in	Cardinia Shire Council.	• No alteration to buffer habitat that is	• Habitat manipulation

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
vegetation to ensure compatibility with terrestrial frog habitat.		Recreation Zone.		not compatible with Growling Grass Frog habitat e.g. no change from more open grassy vegetation to closed dense or overgrown habitat.	including appropriate revegetation and management (e.g. slashing) may be necessary to maintain suitable open habitat.
• Where paths are located within the Conservation Zone, sensitive design options (e.g. boardwalks or similar) will be retained and monitored to ensure suitable connectivity.	Ongoing	Cardinia Shire Council in Recreation Zone.	Cardinia Shire Council.	• Minimal vegetation removal. • No fragmentation of habitat in the Conservation Zone.	• No degradation to the Conservation Zone from recreational use.
Fox Control					
• Coordination of fox control works should be undertaken as a community wide effort. Discuss control techniques with relevant authorities. • Liaison should be undertaken with relevant stakeholders to discuss need for control and the most cost effective and appropriate techniques.	Ongoing	Parks Victoria / Cardinia Shire Council / Melbourne Water / Surrounding private landowners	Parks Victoria / Cardinia Shire Council / Melbourne Water / Surrounding private landowners	• Initiation of a catchment wide fox control program.	• Intensify control efforts as required.
User related issues					
• On-going removal of all food waste from site.	Ongoing	Cardinia Shire Council in Recreation Zone.	Cardinia Shire Council.	• Absence of food waste. • Contractor induction program prepared.	
• Encourage path use and awareness of Conservation Zones through a clear	Ongoing	Cardinia Shire Council in	Cardinia Shire Council.	• Pedestrian traffic in the Conservation Zone is	• Revegetate and/or fencing

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
delineation of trails.		Recreation Zone.		limited to designated paths.	may help to designate areas.
• Enforce strict dogs 'on-leash' within the Recreation Zone (Figure 2) and along pathways located along the periphery of the Conservation Zone. • Off-leash areas for dogs will be permanently fenced and will not be located adjacent to the Conservation Zone. This is consistent with Cardinia Shire Council Local Law 4, Section 27 that states that all dog owners are required to walk their dog on a leash once off their property. • Signage will be provided to educate visitors of the potential impacts of domestic pets and outline of dog restrictions.	Ongoing	Cardinia Shire Council in Recreation Zone.	Cardinia Shire Council.	• Exclusion of dogs in the Conservation Zone, expect along pathways located on the periphery of the Conservation Zone, where dogs must be on-leash. • Dog's on-leash only in designated Recreation Zone. • Dog's off-leash within permanently fenced enclosure in the Recreation Zone.	• Provision of further fencing and interpretive signage as required.
• The further introduction of exotic fish into the creeks or wetlands (see above) will be prohibited and enforced (fines).	Ongoing	Cardinia Shire Council in Recreation Zone.	Cardinia Shire Council.	• Absence / low abundance of exotic fish.	• Provision of further interpretive signage as required. • Increase monitoring and enforcement.
• Raise awareness of responsible cat and dog ownership through a range of existing communication methods (e.g. the Council website or other local print media). This will specifically outline the threats of domestic pets	On Going	Cardinia Shire Council	Cardinia Shire Council	-	-

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
to threatened fauna species (e.g. Bandicoots and Growling Grass Frog). Promotion of responsible pet ownership and the ways in which this can assist the conservation of threatened fauna is essential to change attitudes towards the management of cats and dogs. • The Draft Significant Impact Guidelines for Bandicoots (DEWHA 2010), recommends that cat movements in residential areas adjacent to known or potential habitat be restricted by enforcing cat exclusion zones of up to 800 m (from the Cardinia Creek corridor). As suitable habitat for the Southern Brown Bandicoot exists along the riparian zone of Cardinia Creek, it is recommended that Council consider implementing curfews for cats between dawn and dusk. • This is consistent with Councils Local Laws and Section 25 of the *Domestic Animals Act 1994* that requires all cats throughout the municipal district to be kept secured to the premises of the owner.					
• Light spillage and impacts to fauna will be minimised through the design of lighting by: • Street lighting should be located as far away as possible from the creek corridor and be directed away from the Creek; • All street lighting adjacent to the corridor should use shielding or cut lighting to ensure that light reaches only areas needing	Ongoing	Cardinia Shire Council	Cardinia Shire Council	• Limited light impact to fauna habitat.	• If light impacts are identified then change lighting regime.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
illumination; • Eliminating bare bulbs and lighting pointing upwards (where practicable) that can interfere with normal fauna behaviour; • Using narrow spectrum bulbs as often as possible to lower the range of species affected by lighting; • Using 'down lights' that do not directly spill outside the area where light is required, with motion sensor lighting where appropriate to reduce light spill, duration of lighting and the unnecessary impacts on nocturnal fauna utilizing the adjoining vegetation; • Use embedded lights if possible to illuminate pathways; and • Lighting will not be located within the 30 m wetland impact buffer zones. All lighting adjacent to the artificial wetlands will be directed away from the waterbody edge.					

LOW-DENSITY RESIDENTIAL AREA

2.7 Low-density residential area: Pre- Construction and Construction Mitigation Measures

A low-density residential area will be developed on the south side of Rix Road adjacent to the Conservation Zone as shown in Figures 1 and 2.

2.7.1 Mitigation measures for the Pre-construction Period

Protect and maintain the Conservation Zone during any construction works within the Low-density Residential Area through the following measures:

Management Actions

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
Pre-construction period Protect and maintain the Conservation Zone during any construction works				
No-Go Zones – Fencing				
No-Go Zones will be required for: • Fencing of No Go Zones will be required for any works in the Low-density Residential Area. No-Go Zones will be established by the land owner along the perimeter of the Conservation Zone prior to and throughout the duration of works within the Low-density Residential Area. Protect the Conservation Zone through the designation of No-Go Zones (see Sections 2.4.1, 2.6.1 and Figure 7).	To be implemented pre-construction and be retained throughout the construction period.	Land Owner	Land Owner	• No removal or degradation of terrestrial habitats within the Conservation Zone for.
• No-Go Zone signage will be clearly displayed on temporary fencing and state that these areas are Conservation Zones with no access to contractors and machinery (see Sections 2.4.1 and 2.6.1). • No-Go Zones will protect connectivity of habitat along the creek and floodplain (i.e. north - south connectivity) and between the wetlands and the creek (e.g. east-west connectivity).	To be implemented pre-construction and be retained throughout the construction period.	Land Owner	Land Owner	• No removal or degradation of terrestrial habitats within the Conservation Zone.
Sediment Controls				
• Sediment control measures (No-Go Zone) will be implemented prior to construction works to protect the Conservation Zone (see No-Go Zones Figure	To be implemented pre-construction and be retained throughout the construction	Land Owner	Land Owner	• No removal or degradation of terrestrial habitats or existing wetland area outside the

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
7). • Best Practice procedures will be implemented to minimise construction impacts (sedimentation and pollution) on the creek, floodplain and existing wetlands. • Any sediment control fences should have intermittent gaps (one metre) approximately every 30 m to 50 m to allow for any movement of frogs. No Go Zones should be practical to allow suitable access points to construction area in consultation with DSE. • Designate construction, stockpile, refuelling and storage sites well away from the Conservation Zone, Cardinia Creek, and the floodplain.	period.			construction footprint. • No machinery access into the Conservation Zone. • No increase in sediment loads which reduce water quality below acceptable State Environment Protection Policy Guidelines (SEPP guidelines) and/or reduces habitat suitability for frogs (e.g. high turbidity).
Environmental Induction				
• Prior to construction, all employees from the contracting companies will take part in an environmental induction. This will involve an on-site meeting with the site manager to relay information regarding the Conservation Management Plan, specifically in relation to the threatened fauna species, their habitat requirements and importance of protecting these areas • In particular, contractors need to be familiar with the appearance and ecology of each species and adhere to actions proposed to either protect habitat or avoid direct impacts/loss of animals during the construction period. The contractors must also be aware to contact DSE and a qualified Zoologist immediately for fauna salvage, should any of the	To be undertaken pre-construction and as required during the construction period.	Land Owner	Land Owner	• No removal or degradation of terrestrial habitats or existing wetland area within the Conservation Zone.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
threatened fauna species be found during the construction activities.				
Salvage and translocate frogs				
• A permit to salvage and translocate animals will be required from the Department of Sustainability and Environment (DSE) under the Wildlife Act 1975. Only persons listed on the Victorian *Wildlife Act 1975* Management Authorisation will be permitted to handle native fauna. • A qualified Zoologist will be engaged to undertake pre-construction/ construction Growling Grass Frog salvage as outlined in Appendix 5. • The salvage and translocation plan will be implemented prior to any earth works or vegetation removal in close proximity to the existing artificial wetlands and floodplain. • A recipient site for translocated frogs has yet to be determined and must be selected in consultation with DSE. • Monitoring of translocated frogs will be undertaken in accordance with protocols outlined in Appendix 6.	Salvage to occur one week prior to construction and throughout the entire period of construction. .	Land Owner	To be confirmed – Refer to Contingency Actions Section 2.7.	• Permit acquisition.
Permits				
• A permit to remove native vegetation will be required from Cardinia Shire Council.	To be obtained pre-construction.	Land Owner	Land Owner	• As per requirements of the regulating authority. Permit conditions adhered to.

2.7.2 Mitigation Actions for the Construction Period

The construction period refers to the stage in which the development works (e.g. any earthworks and/or vegetation removal) are initiated.

Residential development is proposed adjacent to the Cardinia Creek corridor (south of Rix Road).

During construction works, a qualified zoologist and/or aquatic biologist (as appropriate) may be required to be present during construction works if threatened fauna are found on-site during construction activities (see salvage and relocation protocols).

To minimise and/or eliminate risks of construction activities associated with future residential development adjacent to the Conservation Zone, the following mitigation measures and management actions will be implemented.

Management Actions

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
Construction of residential development				
• Maintain No-Go Zones to protect fauna habitat. The construction site manager will undertake regular inspections of the No-Go Zones to ensure that temporary fencing, sediment controls and signage are maintained. Replacement will be required as necessary (see Sections 2.4.1, 2.4.3, 2.6.1 and 2.6.2). • The construction site manager will undertake regular inspections of the No-Go Zones to ensure that temporary fencing, sediment controls and signage are maintained. Replacement will be required as necessary (See Section 2.6.1).	To be undertaken during the construction period.	Land Owner	Land Owner	• No removal or degradation of terrestrial habitats or existing wetland area outside the construction footprint. • No machinery access into the Conservation Zone. • No increase in sediment loads which reduce water quality below acceptable State Environment Protection Policy Guidelines (SEPP guidelines) and/or reduces habitat suitability for frogs (e.g. high turbidity).
• Heavy vehicles and machinery will not access the Conservation Zone, particularly the floodplain (i.e. No-Go Zone) where possible. Use handheld equipment where	To be undertaken during the construction	Land Owner	Land Owner	• Exclusion of machinery from No-Go Zones.

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
possible. • Implement appropriate fencing and signage to illustrate access restrictions.	period.			
• Soil stabilisation will be undertaken in disturbed areas.	To be undertaken during the construction period.	Land Owner	Land Owner	• Minimisation of soil erosion in works areas.
• The need for weed control within the construction zone and at machinery wash down sites will be determined during the construction period and undertaken as required.	To be undertaken during the construction period.	Land Owner	Land Owner	• Reduction in weed cover.
• A road frontage of the Low-density Residential Area to the Conservation Zone is preferred.	To be undertaken during the construction period.	Land Owner	Land Owner	• No access to Conservation Zone by dogs and cats through the fence.
• A fence is to be located on the boundary between the Low-density Residential Area and the Conservation Zone, and designed to prevent passage of dogs and cats through the fence.	To be undertaken during the construction period.	Land Owner	Land Owner	• No access to Conservation Zone by dogs and cats through the fence
• Chemical and fuel will not be stockpiled near the floodplain or artificial wetlands	To be undertaken during the construction period.	Land Owner	Land Owner	• No change in habitat.
• Any lighting installed in the Low-density Residential Area	To be	Land Owner	Land	• Absence of visual lighting disturbance

Action	Timing	Responsible Agent	Funding Source	Measurable Outcomes
is to be baffled to minimise light spill into the Conservation Zone.	undertaken during the construction period.		Owner	to faun and light spillage to sensitive habitats.
• Should contractors identify a Growling Grass Frog on-site, all works will temporary cease and immediate notification of DSE and a qualified Zoologist will be made. Salvage and translocation will be implemented by a qualified Zoologist as required.	To be undertaken during the construction period.	Land Owner	Land Owner	• No death or injury to Growling Grass Frog during construction activities.
• All new staff will be inducted by the Site Manager.	To be undertaken during the construction period.	Land Owner	Land Owner	• No degradation to environmental values within the Cardinia Creek Corridor.
• During development works, clear protocols will be provided to construction personnel to identify the expected mitigation measures and importance to maintaining ecological values in the adjoining Conservation Zone. Direct disturbance such as vegetation removal or indirect disturbances (e.g. spills from machinery) could have a detrimental effect on threatened fauna habitat. Compliance of mitigation practices during the construction period must be checked by the land owner or the responsible agent. Non compliance issues need to be addressed.	To be undertaken during the construction period.	Land Owner	Land Owner	• No degradation to environmental values within the Cardinia Creek Corridor.
• Sedimentation control measures must remain in place until the completion of works, and disturbed soils have been effectively stabilised.	To be undertaken during the construction period.	Land Owner	Land Owner	• No increase in sedimentation and minimisation of soil erosion.

2.7.3 On-going Management and Monitoring Actions

On-going management of the Low Density Residential Zone should aim to have minimal impacts on the adjacent habitat values of the Conservation Zone.

Management Actions

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
• Maintain fence between the Low Density Residential area and the Conservation Zone	Ongoing	Cardinia Shire Council / land owner	Cardinia Shire Council / land owner	Fence is maintained	Any holes or degradation of the fence is fixed.
Light spillage and impacts to fauna will be minimised through the design of lighting by: • Street lighting should be located as far away as possible from the creek corridor and be directed away from the Creek; • All street lighting adjacent to the corridor should use shielding or cut lighting to ensure that light reaches only areas needing illumination; • Eliminating bare bulbs and lighting pointing upwards (where practicable) that can interfere with normal fauna behaviour;	Ongoing	Cardinia Shire Council	Cardinia Shire Council / land owner	• Limited light impact to fauna habitat.	• If light impacts are identified then change lighting regime.

Actions	Timing	Responsible Agent	Funding Source	Measurable Outcome	Adaptive Management
• Using narrow spectrum bulbs as often as possible to lower the range of species affected by lighting; • Using 'down lights' that do not directly spill outside the area where light is required, with motion sensor lighting where appropriate to reduce light spill, duration of lighting and the unnecessary impacts on nocturnal fauna utilizing the adjoining vegetation; • Use embedded lights if possible to illuminate pathways; and • Lighting will not be located within the 30 m wetland impact buffer zones. All lighting adjacent to the artificial wetlands will be directed away from the waterbody edge.					

2.8 Contingency Actions

A range of management issues may arise during the implementation of the CMP that can not be predicted. The scale, frequency and impact on threatened species and/or their habitat from these unforseen events therefore can not be quantified.

The section aims to outline some of the potential management issues that may arise and the responses to ensure that the Cardinia Creek corridor provides sustainable habitat for the threatened fauna species. The contingency actions outlined are not required as obligations of the CMP. Public land managers that manage the habitat areas along the Cardinia Creek corridor outlined by this CMP will not be responsible for funding contingency actions unless action required as direct result of damage caused by the Public Land Manager (i.e. Chemical spill). . If contingency funding is required then public land managers will participate in identifying an appropriate funding source to enable these actions to be undertaken.

We do not provide an exhaustive list of possible events and their management responses but aim to select a few key issues that may arise.

Degradation of habitat quality

The quality of habitat present is likely to influence the colonisation (e.g. Growling Grass Frog in modified wetlands) and continued presence of threatened fauna species within the corridor (e.g. Dwarf Galaxias in Cardinia Creek and use of the floodplain during flooding events). The condition of habitat will be annually monitored (exceptions for Southern Brown Bandicoot) and on-going management undertaken as part of the obligations of the CMP. Parks Victoria, Cardinia Shire Council and DSE will be notified immediately once degradation of habitat has been recorded. Habitat degradation is likely to be an ongoing issue within the corridor, especially during the construction period and post-construction period with recreational usage of the corridor.

Outside of the standard management actions required under the CMP, additional management responses may be required that will depend on the type and intensity of the degrading process. Potential causes of habitat degradation and management responses are outlined below:

Potential Degrading factor:

- Inadequate maintenance in the Conservation Zone (e.g. overly dense grassy vegetation in the floodplain may reduce the habitat quality for the Dwarf Galaxias).

Management Response:

- Increase the frequency and intensity of the maintenance operations.

Potential Degrading factor:

- Flooding events that result in high levels of sediment or contaminants from upstream or from stormwater runoff from paved surfaces in the corridor and precinct.

Management Responses

- After a large scale flood events, wetlands may require cleaning to remove sediment and build up of organic material. Clean out will only be undertaken once wetlands have been assessed by a suitably qualified and experienced consultant / personnel in water quality analysis and it is determined that the build up of organic matter has accumulated to the point that it is necessary to require clean-out.
- Prior to the wetland clean-out a qualified zoologist should be engaged to provide advice on the appropriateness of such actions in terms of the potential impacts the operations may have on tadpoles in the wetlands or frog populations. Any frogs encountered during these operations will be salvaged and translocated by a qualified zoologist into another suitable wetland near-by following the procedures outlined in Appendix 5.
- Increase water quality testing and implement mitigation measures as required if the water chemistry measurements do not fall within the accepted ranges for these parameters, e.g. draining or flushing out of the wetlands as required.

Potential Degrading factor:

- Poor water quality from flooding events (e.g. pollution such as chemical, hard rubbish, sedimentation etc.).
- Dumping of hard rubbish could potentially occur into waterways, as it currently occurs at many locations throughout the Cardinia Shire.
- Oil and other contaminants may be dumped directly into waterways, particularly where there is road access.

Management Responses

- Monitoring following an incident will comprise a survey and appropriate sampling to confirm the extent of the disturbance to aquatic habitat. For spillages, post incident monitoring will be repeated at weekly intervals until the contaminant is no longer considered to be a threat.
- Implement further restrictions on public access to decrease likelihood of rubbish dumping (e.g. fencing, signage).
- Remove hard litter (if required between normal maintenance schedules).
- Drain wetlands and clean out (i.e. if required for sedimentation build up). This would also require a qualified zoologist and fish biologist to be engaged to advise on the appropriateness of this measure and to salvage native fauna during operations.
- Install and maintain sediment controls as required.
- Installation of additional rocks banks, boulders and logs to stabilise the soils in areas, as required.
- Chemical treatments (for rectifying acidity or alkalinity).

- Engaged a specialist contractor as required to clean up contaminants such as oil spills, etc.
- Increase planting of submergent and emergent vegetation.

Potential Degrading factor:

- Flood damage. Overflow from blocked stormwater drains during heavy rainfall events may be channelled into floodplain wetlands.

Management Response:

- Clearing of obstructions in the drainage system would be necessary to alleviate further floodplain inflows.

Potential Degrading factor:

- Low water levels. Dry or drying wetlands do not provide suitable habitat for the Growling Grass Frog (or the Dwarf Galaxias). The level of wetland inundation will be monitored during the annual Growling Grass Frog and Dwarf Galaxias habitat monitoring and population surveys.

Management Response:

- If appropriate, it is recommended that water be diverted from the creek (via a temporary pump mechanism) subject to Southern Rural Water surface water diversion permit. An appropriate fish filter must be used for all pumping to ensure that exotic predatory fish are not transferred into the wetlands.
- Investigate opportunities to redirect appropriately treated stormwater into the wetlands that are drying out.
- Supplementary plantings can be undertaken to ensure that adequate vegetation is maintained on the north and west sides of wetlands (i.e. to decrease evaporation).

Potential Degrading factor:

- Changes in water flow in Cardinia Creek or in the floodplain wetlands caused by the construction of barriers (mainly by children).

Management Response:

- Removal of any constructed barriers would be necessary to reinstate connectivity of desirable flow pathways.

Potential Degrading factor:

- Vegetation tramping from inappropriate public access and/or removal. People may damage riparian vegetation along Cardinia Creek and around floodplain wetlands in order to gain water access. Further trampling will prevent recovery. Restricted access and fencing (e.g. farm fencing with ring lock along the bottom to exclude dogs) may be necessary. Stray (or unrestrained) animals may cause damage to native vegetation fringing both Cardinia Creek and floodplains.

Management Response:

- Further installation and maintenance of fencing.
- Further installation and maintenance of signage.
- Increase maintenance and monitoring operations in affected areas.
- Undertaken replacement plantings as required.
- Further education of contractors and maintenance staff.

Potential Degrading factor:

- Natural and deliberately lit fires. Natural fires may sweep along Cardinia Creek and the floodplain. Illegal burning of wetland vegetation on the floodplain may occur, as some people believe this is appropriate for removing snake habitat.

Management Response:

- Action will be necessary to determine an appropriate clean up program to ensure that sedimentation of pools within Cardinia Creek is prevented and that floodplain channels/wetlands are not in-filled by silt and ash. Water quality protection of the waterways may be necessary to avoid dramatic short term loss of dissolved oxygen. Long term increases in water temperatures (due to less shading of the waterways) may require replanting of fringing vegetation.
- Replanting of appropriate vegetation may be necessary. Translocation of dwarf galaxias into nearby suitable habitat may be necessary.

Potential Degrading factor:

- Exotic fish incursions. This includes any fish species that might be illegally released into Cardinia Creek or to Cardinia Creek floodplain wetlands. Routine fish monitoring should be sufficient to identify whether an illegal stocking of fish has occurred. The fish may be illegally stocked by anglers or could result from the dumping of unwanted aquaria fish. Monitoring of the species and whether there is a need to determine the influence of the species on the Dwarf Galaxias, Australian Grayling or the Growling Grass Frog may require additional funding. Removal/control/eradication options and other management responses to explore include.

Management Response:

- Increase monitoring for the presence of exotic predatory fish within wetlands, in addition to the monitoring that will occur as part of the annual habitat monitoring.
- Wetland draining. Engage a qualified fish biologist to undertake salvage of native fish and other aquatic fauna during this operation.
- Supplementary planting of submerged aquatic vegetation to reduce suitability of habitat for exotic fish and provide dense cover for frogs and tadpoles.

- Increase public education of the impacts of fish introductions into wetlands (e.g. signage, pamphlets, etc.).

Population decline of Dwarf Galaxias[3]

Over the past 10 years, the dwarf galaxias has been found in floodplain wetlands after flood events. Populations of dwarf galaxias in Cardinia Creek are responsible for the movement of the dwarf galaxias into the Officer Precinct floodplain wetlands. Continued persistence of the dwarf galaxias can be expected until the wetlands dry out. Drying of the wetlands will result in the loss of the dwarf galaxias. Re-establishment of the dwarf galaxias into the wetlands will, in the future, occur whenever flooding of Cardinia Creek refills the wetlands (assuming Cardinia Creek continues to support a population of dwarf galaxias). Essentially dwarf galaxias presence in the Officer Precinct floodplain wetlands can be sporadic, as it is related to the wetting/drying cycle of the wetlands and the frequency of Cardinia Creek flood events.

A population of dwarf galaxias recently found in Grasmere wetland (McGuckin 2010), plus others known populations in Brisbane Creek and the Melbourne Water retarding basin at Beaconsfield can replenish the Cardinia Creek dwarf galaxias population during flooding events. In the event that the Cardinia Creek population was lost, dwarf galaxias could be translocated from one of the known upstream populations directly into the Officer Precinct floodplain wetlands.

[3] John McGuckin (Streamline Research Pty. Ltd.)

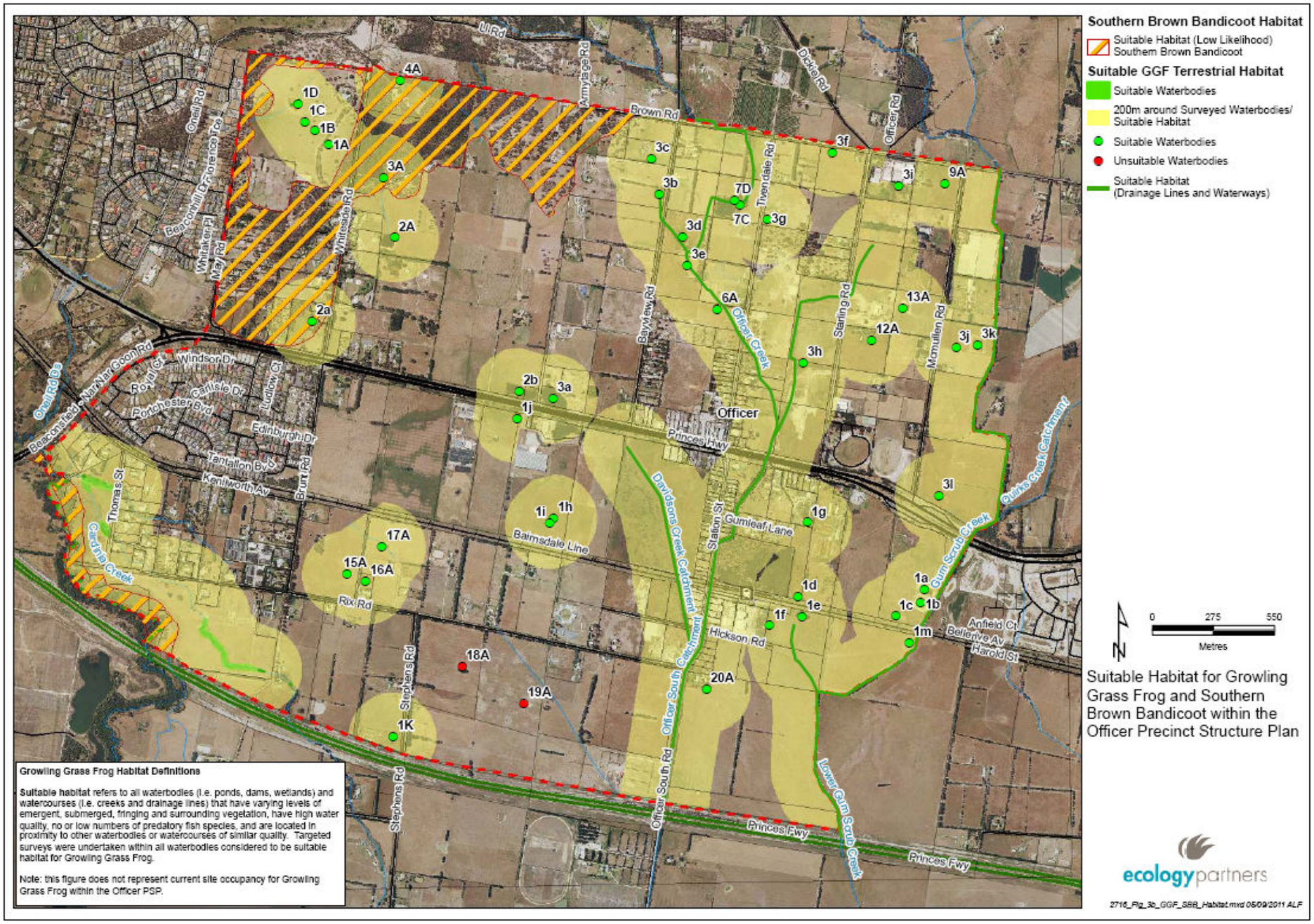

Figure 4 Officer PSP Cardinia Creek CMP: Growling Grass Frog and Southern Brown Bandicoot habitat in the wider Officer PSP area. Figure provided by Ecology Partners.

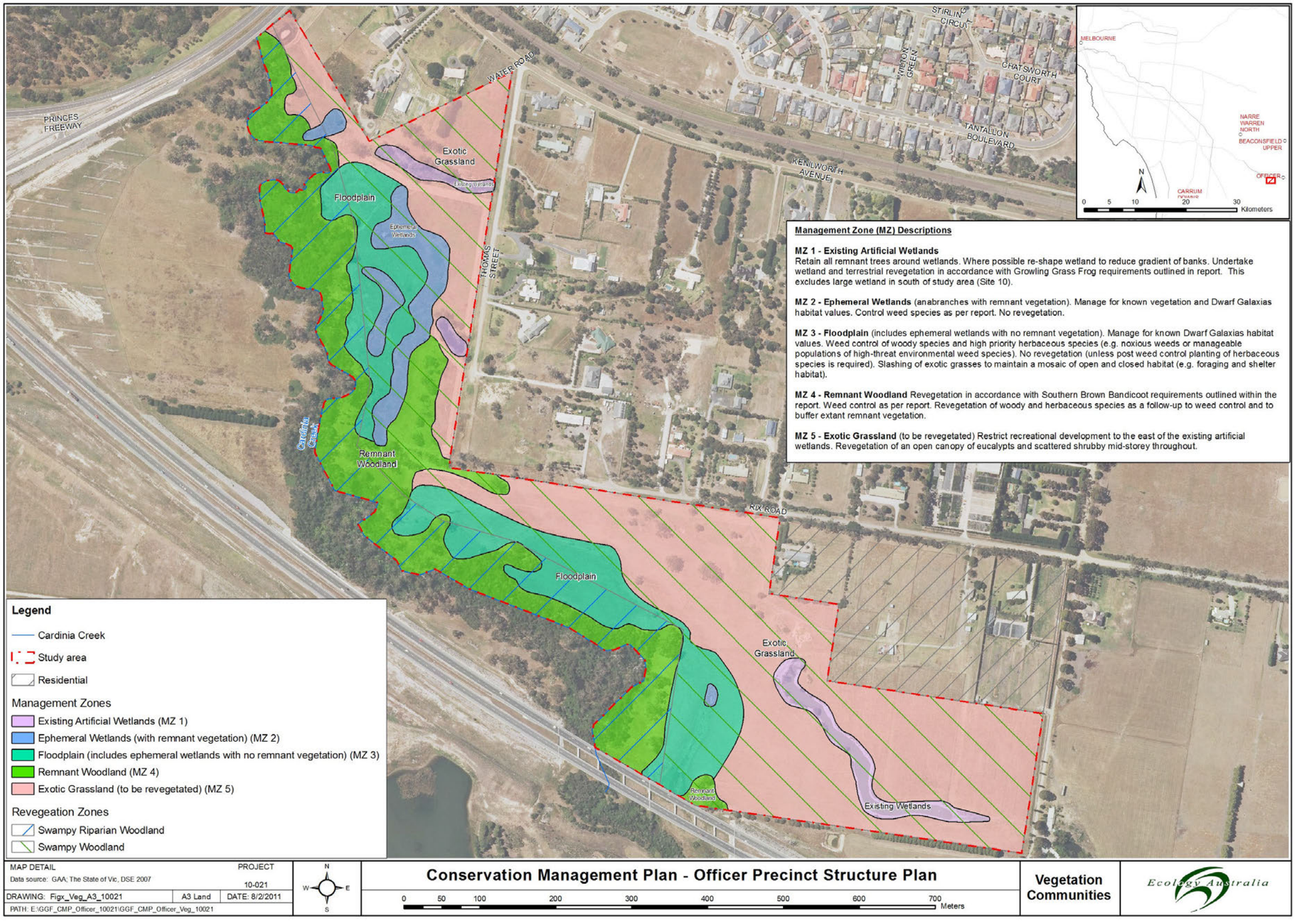

Figure 5 Officer PSP Cardinia Creek CMP: Vegetation communities, proposed revegetation and Management Zones within the study area.

Figure 6 Officer PSP Cardinia Creek CMP: Dedicated habitat for threatened fauna species

Note: The threatened species habitat along and adjacent to Cardinia Creek as shown in Figure 6 is more detailed compared with that shown by Ecology Partners (e.g. Figure 4).

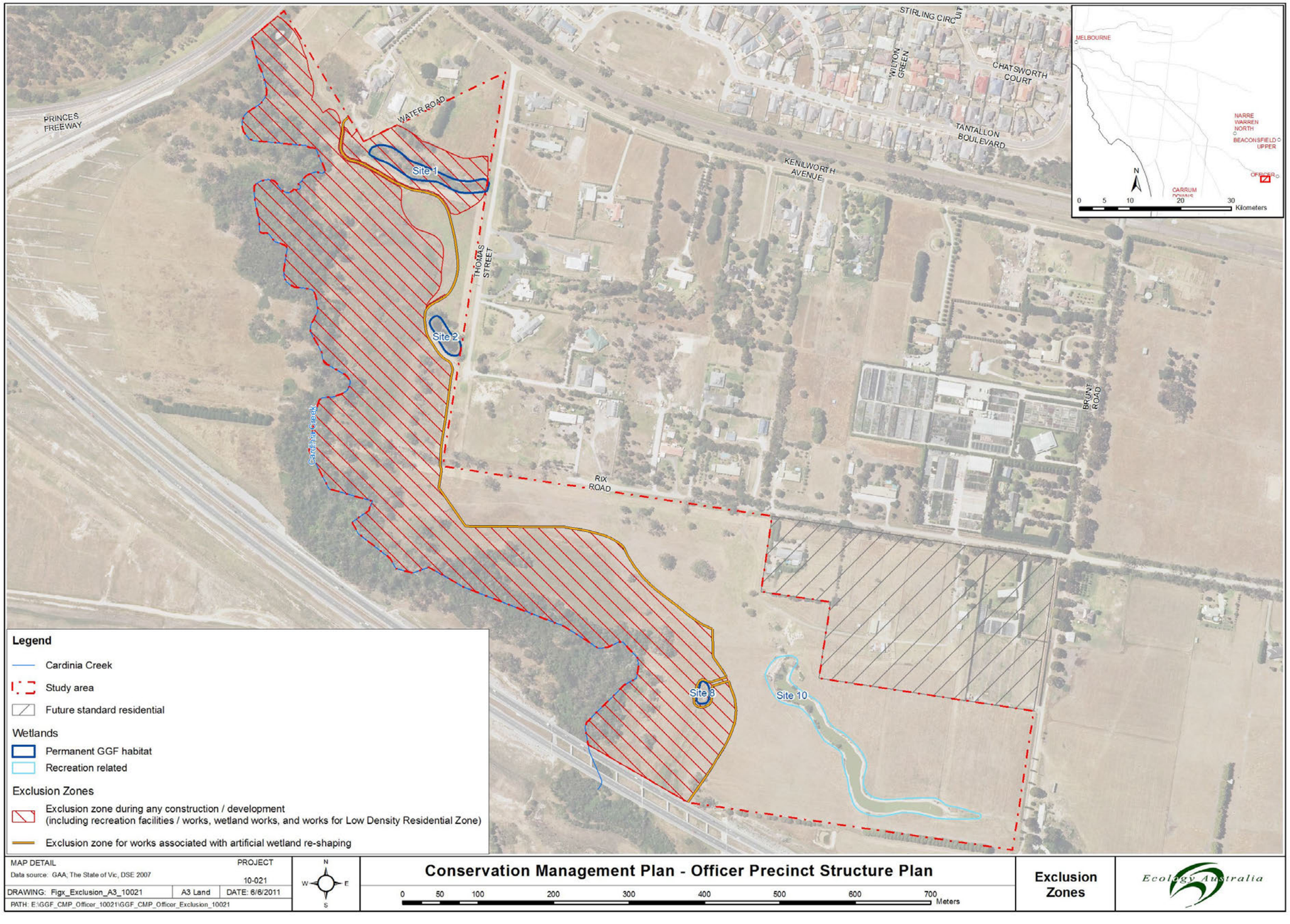

Figure 7 Officer PSP Cardinia Creek CMP: No-Go Zones during construction periods (corridor, wetland modification and future residential development)

2.9 Conservation Management Plan - Phase Two

The implementation of Phase Two will commence at the completion of Phase One (i.e. 10 years post construction). Phase Two will require on-going management and monitoring actions that may be sufficiently fulfilled under normal maintenance regimes and/or with some additional actions. These will include:

- Maintenance of the Conservation Zone managed by Parks Victoria in to ensure maintenance of habitat for Growling Grass Frog, Dwarf Galaxias, Southern Brown Bandicoot, and Australian Grayling. ;
- Maintenance of the beds and banks of Cardinia Creek by Melbourne Water in accordance with their standard waterway maintenance policies and programs;
- Monitoring of Growling Grass Frog, Dwarf Galaxias and Australian Grayling every five years during Phase Two of the CMP implementation or as required in consultation with DSE;
- Implementation of contingency actions (if required) as outlined within Section 2.7; and
- Assessment of all future works within the study area and determination of their potential impacts on EPBC-listed fauna species and their habitats.

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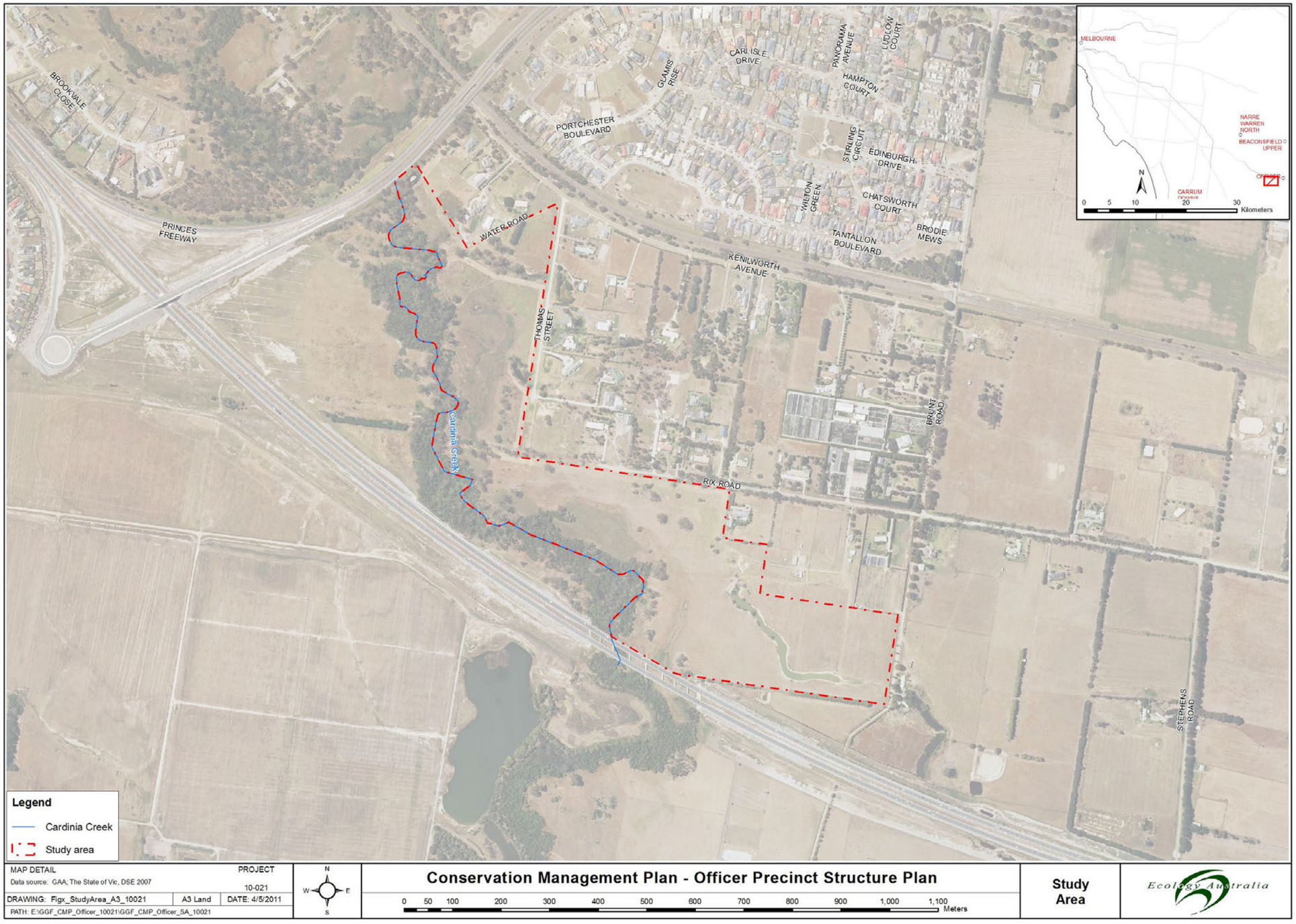
Appendix 1: Location of Conservation Management Plan Area



Appendix 2 Officer PSP Cardinia Creek CMP: plant species suitable for use in terrestrial revegetation of the study area (includes some species of ephemeral wetlands)

Structural Role of Plants

- **A** Structural dominant of the vegetation stratum – the sole or predominant species locally or across broader expanses or the whole vegetation zone; with high overall cover within particular location
- **B** Localised structural co-dominant (with other species) in vegetation stratum
- **C** Scattered thinly or discontinuously as small groups or isolated individuals (trees/shrubs and perennial herbs); with low overall cover.
- **D** Scattered and infrequent across a wide area
- **E** Localised stands/aggregates in defined environment

Ecological Vegetation Classes (planting zones)

- **SRW** Swampy Riparian Woodland
- **SW** Swampy Woodland

Species	Common Name	Ecological Vegetation Classes		Structural Role of Plants	Notes
		SRW	SW		
Trees					
Acacia mearnsii	Black Wattle	✓	✓	C	
Acacia melanoxylon	Blackwood	✓	✓	C	
Eucalyptus cephalocarpa	Silver-leaf Stringybark		✓	C	
Eucalyptus fulgens	Green Scentbark		✓	C	
Eucalyptus melliodora	Yellow Box		✓	C	
Eucalyptus ovata var. *ovata*	Swamp Gum	✓		C	
Eucalyptus radiata ssp. *radiata*	Narrow-leaf Peppermint		✓	C	
Eucalyptus viminalis ssp. *viminalis*	Manna Gum	✓		C	
Large and medium shrubs					
Acacia verticillata ssp. *verticillata*	Prickly Moses	✓	✓	C	
Bursaria spinosa ssp. *spinosa*	Sweet Bursaria	✓	✓	C	
Cassinia aculeata	Common Cassinia	✓		C	
Cassinia arcuata	Drooping Cassinia		✓	C	
Coprosma quadrifida	Prickly Currant-bush	✓		C	
Goodenia ovata	Hop Goodenia	✓	✓	C	
Gynatrix pulchella	Hemp Bush	✓		C	
Hakea nodosa	Yellow Hakea	✓	✓	C	
Leptospermum continentale	Prickly Tea-tree	✓	✓	C	
Leptospermum lanigerum	Woolly Tea Tree	✓		E	Plant in ± permanently moist soils
Leptospermum scoparium	Manuka	✓	✓	C	
Melaleuca ericifolia	Swamp Paperbark	✓		A	
Melaleuca squarrosa	Scented Paperbark	✓	✓	B	
Melicytus dentatus	Tree Violet	✓	✓	C	
Myrsine howittiana	Mutton-wood	✓		C	
Olearia lirata	Snow Daisy-bush	✓		C	
Ozothamnus ferrugineus	Tree Everlasting	✓	✓	C	
Ozothamnus rosmarinifolius	Rosemary Everlasting	✓		C	
Pomaderris aspera	Hazel Pomaderris	✓		C	
Pomaderris racemosa	Cluster Pomaderris	✓		C	
Prostanthera lasianthos	Victorian Christmas-bush	✓		C	
Rubus parvifolius	Small-leaf Bramble	✓		C	
Solanum laciniatum	Large Kangaroo Apple	✓	✓	C	
Viminaria juncea	Golden Spray	✓		C	
Perennial herbs					
Acaena novae-zelandiae	Bidgee-widgee	✓	✓	C	
Senecio glomeratus ssp. glomeratus	Annual Fireweed	✓	✓	C	
Senecio minimus	Shrubby Fireweed	✓		C	
Urtica incisa	Scrub Nettle	✓		C	

Species	Common Name	Ecological Vegetation Classes		Structural Role of Plants	Notes
		SRW	SW		
Grasses and graminoids					
Carex appressa	Tall Sedge	✓	✓	C	Seasonally moist soils (e.g. ephemeral drainage lines on floodplain)
Gahnia radula	Thatch Saw-sedge	✓		C	
Gahnia sieberiana	Red-fruit Saw-sedge	✓		C	
Hemarthria uncinata var. uncinata	Mat Grass	✓	✓	C	
Juncus amabilis	Hollow Rush		✓	C	Seasonally moist soils (e.g. ephemeral drainage lines on floodplain)
Juncus gregiflorus	Green Rush	✓	✓	C	Seasonally moist soils (e.g. ephemeral drainage lines on floodplain)
Juncus pauciflorus	Loose-flower Rush	✓	✓	C	Seasonally moist soils (e.g. ephemeral drainage lines on floodplain)
Juncus sarophorus	Broom Rush	✓	✓	C	Seasonally moist soils (e.g. ephemeral drainage lines on floodplain)
Juncus pallidus	Pale Rush	✓	✓	C	
Juncus procerus	Tall Rush	✓		E	Sheltered situations in damp, well-drained soil (SGAPM 1991)
Lepidosperma laterale var. *majus*	Variable Sword-sedge	✓		C	
Lepidosperma longitudinale	Pithy Sword-sedge	✓		C	
Lomandra longifolia ssp. *longifolia*	Spiny-headed Mat-rush	✓	✓	C	
Poa ensiformis	Sword Tussock-grass	✓		B	
Poa labillardierei var. *labillardierei*	Common Tussock-grass	✓	✓	B	
Vines and climbers					
Calystegia sepium	Large Bindweed	✓		D	
Cassytha pubescens	Downy Dodder-laurel	✓	✓	D	
Clematis aristata	Mountain Clematis	✓		C	
Clematis microphylla	Small-leaf Clematis		✓	D	
Ferns					
Blechnum minus	Soft Water fern	✓		E	
Calochlaena dubia	False Bracken	✓		C	
Pteridium esculentum	Austral Bracken	✓	✓	C	

Appendix 3: Officer PSP Cardinia Creek CMP: plant species suitable for use in wetland revegetation

Structural Role of Plants

- **A** Structural dominant of the vegetation stratum – the sole or predominant species locally or across broader expanses or the whole vegetation zone; with high overall cover within particular location
- **B** Localised structural co-dominant (with other species) in vegetation stratum
- **C** Scattered thinly or discontinuously as small groups or isolated individuals (trees/shrubs and perennial herbs); with low overall cover.
- **D** Scattered and infrequent across a wide area
- **E** Localised stands/aggregates in defined environment

Revegetation Zones

- **Zone 1** Permanently moist or seasonally wet margins; shallow seasonal inundation in lower part of zone.
- **Zone 2** Shallow inundation; upper minimum depth of inundation c. 10 cm; amphibious and emergent aquatic herbs, some straddling Zones 1 and 2.
- **Zone 3** Permanent water; submergent and emergent aquatic-herbs, some straddling Zones 2 and 3.

Species	Common Name	Vegetation Zones			Structural Role of Plants	Notes
		Zone 1	Zone 2	Zone 3		
Perennial herbs						
Alisma plantago-aquatica	Hairy Willow-herb		✓		C	
Alternanthera denticulata	Lesser Joyweed	✓				
Centella cordifolia	Centella	✓			C	
Crassula helmsii	Swamp Crassula	✓			C	
Epilobium billardierianum subsp. billardierianum	Smooth Willow-herb	✓			C	
Epilobium hirtigerum	Hairy Willow-herb	✓			C	
Gratiola peruviana	Austral Brooklime	✓			C	
Lycopus australis	Australian Gipsywort	✓	✓		C	
Lythrum salicaria	Purple Loosestrife	✓	✓		C	
Marsilea drummondii	Common Nardoo	✓	✓	✓	C	If submerged plant only in shallow water (<30 cm deep) (SGAPM 1991)
Myriophyllum crispatum	Upright Water-milfoil			✓	C	
Myriophyllum verrucosum	Red Water-milfoil			✓	C	
Ottelia ovalifolia subsp. ovalifolia	Swamp Lily			✓	C	
Persicaria decipiens	Slender Knotweed	✓	✓		C	
Persicaria praetermissa	Spotted Knotweed	✓			C	
Persicaria subsessilis	Hairy Knotweed	✓			C	
Potamogeton pectinatus	Fennel Pondweed			✓	C	
Potamogeton tricarinatus s.l.	Floating Pondweed			✓	C	
Ranunculus inundatus	River Buttercup	✓	✓		C	
Triglochin procerum s.l. (broad erect leaves)	Water-ribbons	✓	✓		C	
Triglochin procerum s.l. (long floating leaves)	Water Ribbons			✓	C	
Triglochin striatum	Streaked Arrow-grass	✓			C	
Vallisneria americana var. *americana*	Eel Grass			✓	C	
Villarsia reniformis	Running Marsh-flower	✓	✓		C	
Grasses and graminoids						
Amphibromus fluitans	River Swamp Wallaby-grass		✓			
Baumea rubiginosa s.l.	Soft Twig-rush	✓	✓		C	
Bolboschoenus medianus	River Club-sedge	✓	✓		C	
Carex appressa	Tall Sedge	✓			C	
Carex fascicularis	Tassel Sedge	✓	✓		C	
Carex gaudichaudiana	Fen Sedge	✓			C	
Cladium procerum	Leafy Twig-sedge	✓			C	
Cyperus lucidus	Leafy Flat-sedge	✓	✓		C	
Eleocharis acuta	Common Spike-rush	✓	✓		C	
Eleocharis sphacelata	Tall Spike-sedge	✓	✓		C	
Glyceria australis	Australian Sweet-grass	✓			C	
Isolepis fluitans	Floating Club-sedge		✓		C	

Species	Common Name	Vegetation Zones			Structural Role of Plants	Notes
		Zone 1	Zone 2	Zone 3		
Juncus holoschoenus	Joint-leaf Rush	✓			C	
Juncus amabilis	Hollow Rush	✓			C	
Juncus gregiflorus	Green Rush	✓			C	
Juncus pauciflorus	Loose-flower Rush	✓			C	
Juncus sarophorus	Broom Rush	✓			C	
Juncus procerus	Tall Rush	✓			C	
Phragmites australis	Common Reed	✓	✓		C	
Poa labillardierei var. labillardierei	Common Tussock-grass	✓			B	
Schoenoplectus tabernaemontani	River Club-sedge		✓		C	

The table below shows a list of native plants found on the fringe of Cardinia Creek and in floodplain wetlands near the Pakenham Bypass (McGuckin, 2005a). These species are desirable for planting in the Officer Precinct floodplain wetlands.

Officer PSP Cardinia Creek CMP: Native flora in Cardinia Creek areas where the Dwarf Galaxias has been recorded near the Pakenham Bypass (McGuckin, 2005).

Plant list		Cardinia Creek fringe	Floodplain wetlands	Desirable plantings
		dwarf galaxias presence		
Scientific name	**Common name**			
Alisma plantago-aquatica	water plantain			
Arthropodium spp.	lily	**X**	**X**	
Callitriche stagnalis	common starwort	**X**	**X**	
Carex gaudichaudiana	fen sedge		**X**	**X**
Carex inversa	knob sedge	**X**		**X**
Eleocharis acuta	common spike-sedge	**X**	**X**	**X**
Isolepis inundatus	swamp club sedge		**X**	**X**
Juncus bufonius	toad rush	**X**	**X**	
Juncus spp.	rush		**X**	
Juncus subsecundus	finger rush		**X**	**X**
Melaleuca ericifolia	swamp paperbark	**X**	**X**	**X**
Myriophyllum crispatum	upright water milfoil		**X**	**X**
Persicaria decipiens	slender knot weed	**X**	**X**	**X**
Phragmites australis	common reed		**X**	
Potamogeton tricarinatus	floating pondweed	**X**	**X**	**X**
Ranunculus glabrifolius	shining buttercup	**X**		
Ranunculus inundatus	river buttercup	**X**	**X**	**X**
Ranunculus lappaceus	Australian buttercup	**X**	**X**	
Rumex brownii	slender dock	**X**	**X**	
Triglochin procerum	water ribbons	**X**	**X**	**X**

Appendix 4: Officer PSP Cardinia Creek CMP: Weed species identified for elimination or control within the Precinct

Life form (mostly after Carr et al. 1992)

T	Tree	A	annual	Pt	perennial herb (tufted or tussock forming)	B	biennial	Gc	cormous geophyte	V	vine
Ea	emergent aquatic	Ls	large shrub	Pr	perennial herb (rhizomatous or stoloniferous)	S	shrub	Gt	tuberous geophyte	Ss	subshrub

Noxious weed/WONS

C – listed as a Controlled weed species under the Catchment and Land Protection Act 1994 for the Port Phillip and Westernport Catchment Management Authority region

R - listed as a Restricted weed species under the Catchment and Land Protection Act 1994 for the Port Phillip and Westernport Catchment Management Authority region

Control method(s)

A Herbicide treatments

1 Herbicide applied to foliage with spray, wick applicator, etc.; annuals must be sprayed well before seed ripening.

2 Cut down and concentrated herbicide immediately applied to stump or stems, or bark "frilled" and herbicide applied.

3 Stem drilled and injected with concentrated herbicide.

B Physical treatments

4 Physical removal – most plants can be physically removed by hand-weeding or with tools when small and/or isolated but soil disturbance is kept to a minimum.

5 Cut off at ground level (species that will not resprout from basal buds).

8 Ringbarking

9 Biological control with suitable agent (e.g. rust fungus or leaf hopper for *Asparagus asparagoides*)

Control/eliminate

E – eliminate all populations

C – control weed populations

Ctn – contain weed populations

Timing (preferred timing only, many species may be successfully controlled at other times)

Sp	spring	W	winter	(f)	when in flower
S	summer	All	Year round	(bl)	before leaves discolour
A	autumn	(bf)	before flowering	D	when water-body is dry

Miscellaneous

▲ Control only within wetlands (c.f. Cardinia Creek).

♦ Eliminate from all wetlands. Contain to banks of Cardinia Creek (i.e. control from top-of-bank landwards).

Species	Common Name	Life form	Family	Control Methods	Timing	Control/ eliminate
Asparagus asparagoides R	*Bridal* Creeper	Gt	Asparagaceae	1,4 (small infestations),9	W – Sp	E
Cirsium vulgare C	Spear Thistle	B	Asteraceae	1,4	Sp (bf)	C
Cortaderia selloana	Pampas Grass	Pt	Poaceae	1,4 (small plants)	All	E
Cyperus eragrostis ▲	Drain Flat-sedge	Pt	Cyperaceae	1,4	All	C
Festuca arundinacea	Tall Fescue	Pt	Poaceae	1	All	E
Lonicera japonica	Japanese Honeysuckle	V/S	Caprifoliaceae	1,2,4 (small infestations)	Sp - A	E
Lycium ferocissimum C	African Box-thorn	Ls	Solanaceae	2	All	E
Paspalum distichum ▲	Water Couch	Ea	Poaceae	1	All	C
Pittosporum undulatum	Sweet Pittosporum	T	Pittosporaceae	2,3,4 (young plants)	All	E
Prunus cerasifera	Cherry Plum	T	Rosaceae	2	Sp - S	E
Rosa rubiginosa C	Briar Rose	S	Rosaceae	1,2	Sp - S	E
Rubus anglocandicans C	Blackberry	Ls	Rosaceae	1,2	Sp – S (f)	E
Solanum pseudocapsicum	Madeira Winter-cherry	S	Solanaceae	1,2,4	All	C
Tradescantia fluminensis ♦	Wandering Tradescantia	Pr	Commelinaceae	1,4	All	E/Ctn

Appendix 5 Relocation protocols for the Growling Grass Frog for Officer Precinct

Salvage protocols

A recipient site for Growling Grass Frog has yet to be determined. Wetland (site one) is considered to be a possibility. A site will be selected in consultation with DSE. If site one is selected, all enhancement plantings and re-shaping must be completed before any further salvage and construction works can be implemented. Once enhancement works are completed, protection measures around the wetland should be installed e.g. fencing, sediment controls, signage illustrating No-Go Zone areas.

Pre-construction salvage of Growling Grass Frog during either the active and inactive period (see below) should be undertaken within construction zones: in the creek corridor for all infrastructure (e.g. pathways within 30 m of a waterbody); all major excavation in existing wetlands; major vegetation removal works (if required) before revegetation around wetlands; and for removal and/or disturbance impacts of native vegetation where potential Growling Grass Frog habitat is present within wetlands/dams/drainage lines within the greater Officer precinct area.

Works areas for pathways/facilities greater than 30 m from an existing wetland or creek can be salvaged during construction. Soil excavated from construction areas within these areas will be examined for Growling Grass Frogs. Two qualified zoologists will work in tandem with the excavator, to clear and sort through soil (and vegetation). One zoologist will monitor the excavation site. The second zoologist will sort through soil and vegetation in each bucket of the excavator.

Searches for the Growling Grass Frog during the active period (September to April)

- Searches will be undertaken within at least three days preceding commencement of construction activities.
- At least two night-time spotlighting surveys will be undertaken and each survey will involve two people searching for at least one hour. Night-time surveys (where possible) will be undertaken on nights of optimal weather for detecting the species (i.e. little or no wind, temperatures greater than 15oC, and relatively high humidity).
- A standard diurnal search will be undertaken in the habitat where construction activities will be taking place. Daytime searches will include investigation of potential shelter and basking sites and searching within dense vegetation, at the base of grass tussocks, on reed beds, under rocks and other surface debris. It is estimated that 30 person minutes would be required to search a 50 m x 5 m strip along the Creek (survey time may vary according to waterbody size and complexity).
- Footwear will be washed in disinfectant at the commencement and end of each survey to prevent the introduction and/or spread of diseases.
- Frog handling procedures, including wearing gloves, disinfecting footwear and using plastic bags for frog handling, will be followed as outlined above.

- If deemed appropriate (see 'Monitoring of relocated Growling Grass Frogs' section below), tagging or marking of frogs would occur at this stage prior to release.
- Captured frogs will be released as soon as possible (within 24 hours) within selected wetland (e.g. site one) in dense vegetation or under woody debris at the edge of the water body.

Searches for the Growling Grass Frog during the inactive period (May to August)

- Searches will be undertaken within at least three days preceding commencement of construction activities.
- A diurnal search will be undertaken along areas to be disturbed along Cardinia Creek and any areas adjacent to existing wetland habitats. Daytime searches will include investigation of potential shelter sites and searching within dense vegetation, at the base of grass tussocks, within reed beds, under rocks and other surface debris. It is estimated that 60 person minutes would be required to search a 50 m x 5m strip along the Creek (survey time may vary according to waterbody size and complexity).
- Footwear will be washed in disinfectant at the commencement and end of each survey to prevent the introduction and/or spread of diseases.
- Frog handling procedures, including wearing gloves, disinfecting footwear, using plastic bags for frog handling, will be followed as outlined above.
- If deemed appropriate (see 'Monitoring of relocated Growling Grass Frogs' section below), tagging or marking of frogs would occur at this stage prior to release.
- Captured frogs will be released as soon as possible (within 24 hours) within selected wetland (e.g. site one) in dense vegetation or under woody debris at the edge of the water body.
- Additional searches during construction

Relocation protocols

- If Growling Grass Frogs are found during the salvage operations, works will immediately stop, with the works referred to the Federal Environment Minister for approval under the EPBC Act.
- An appropriate wildlife permit, 'Management Authorisation' and appropriate ethics approval from DSE is required before relocation of Growling Grass Frogs can be undertaken. These permits and documentation would be required under the Victorian Wildlife Act 1975.
- The relocation operation must be undertaken by qualified zoologists, or someone who has knowledge and experience in handling and transporting frogs.
- The relocation operation should take place prior to and as close as possible (i.e. within a few days) to any disturbance adjacent to any existing wetland.
    - A long intervening period between the relocation of frogs and the construction works may result in frogs moving back into the area.

- Different survey techniques may be required to find and subsequently re-locate the frogs (prior to construction), depending on the time of year:
    - If the relocation operation is to be undertaken during the period when frogs are more active (between September and March) spotlighting surveys will be required. If relocation occurs during the inactive period (between May and August), surveys will need to be undertaken during the day where frogs are searched for within vegetation, under rocks and other debris (see below).
- If frogs are not found prior to excavation, but are considered to be present, additional diurnal searches for frogs may also need to be undertaken during excavation works. This would include works such as major excavation works to existing wetlands. This is to search for frogs within the soil, vegetation and other ground debris during excavation works (see below).
- All relocation activities must be undertaken in accordance with the hygiene protocol for disease in frogs developed by the New South Wales Parks and Wildlife Service (NSW NPWS 2001), to help prevent the spread of the lethal chytrid fungus (Batrachochytrium dendrobatidis). Relocation activities must also make reference to the 'Threat Abatement Plan: Infection of amphibians with chytrid fungus resulting in chytridiomycosis' (Commonwealth of Australia 2006).
- Footwear will be washed in disinfectant at the commencement and end of each survey to prevent the introduction and/or spread of diseases.
- Frogs will be captured by hand; latex surgical gloves will be worn at all times when frogs are being handled; gloves will be disposed of and new gloves used for the next capture after each frog is handled.
- Captured frogs will be transported individually in plastic bags.
- If deemed appropriate (see 'Monitoring of relocated Growling Grass Frogs' section below), tagging or marking of frogs would occur at this stage prior to release.
- Captured frogs will be released as soon as possible (within 24 hours) within selected wetland in dense vegetation or under rocks or woody debris at the edge of the water body.
- Sick/injured/visibly distressed frogs will be taken to the Amphibian Research Centre at Werribee for analysis.

Monitoring of relocated Growling Grass Frogs

- Ideally monitoring of frogs relocated into selected wetland should be undertaken to determine the success of the relocation operation (also see Appendix 6 below).
- This can be achieved by marking frogs prior to release by subcutaneous injection of a passive integrated transponder (PIT).

  - PIT tagging is a cost-effective option which, has been undertaken during monitoring of the closely-related Green and Golden Bell Frog at Homebush Bay (NSW); and more recently for the Growling Grass Frog in the Koo Wee Rup-Pakenham area (Hamer and Organ 2006a), and in the Merri Creek corridor (Geoff Heard, pers. comm).

- Marking of frogs must be undertaken by personnel who have experience with these monitoring techniques.
- Prior to marking frogs, a DSE 'Management Authorisation' would be required under the Victorian Wildlife Act 1975; marking of frogs would need to be in accordance with DSE ethics approval.
- Landowner will be responsible engaging an appropriately qualified zoologist to monitor the success of translocated Growling Grass Frog. Monitoring of translocated frogs should occur one month after translocation (if during the active season) and then surveyed twice (two nights) during the active season each year. This can be undertaken concurrent with the regular annual monitoring. Translocated frogs should be monitored for at least 2 years after relocation.

Appendix 6 Monitoring Protocols for Growling Grass Frog

Growling Grass Frog Population Monitoring

In line with a recent detectability analysis in the Merri Creek corridor (Heard et al. 2006), and in accordance with protocols established with DSE and DEWHA during the Policy Statement workshop for the Growling Grass Frog in 2008, monitoring of the existing wetlands (and floodplain when inundated) would be conducted by a qualified zoologist(s) to determine whether Growling Grass Frogs have colonised the waterbodies and/or to determine the success of frog relocation (if required) into wetland **(site yet to be determined, possibility of site one)** (e.g. frogs with PIT tags). Parks Victoria will be responsible engaging an appropriately qualified zoologist to monitor frogs. Monitoring would be undertaken within all wetlands and along the floodplain (when inundated) during the breeding season (e.g. October – December). Each waterbody will be surveyed twice (two nights) during the active season each year from the date of approval of the CMP, throughout construction, and then for ten years post-construction. If frogs are found to be present during the initial two nocturnal surveys, an additional nocturnal survey (third night) would be undertaken in mid to late January or early February to determine the success of breeding (e.g. indicated by the presence of metamorphs). Monitoring of wetlands will commence at least one season prior to the construction of the wetlands and conducted annually for the 10 year post-construction period once modifications are complete (timing and frequency as above).

If salvage is undertaken, the monitoring of translocated frogs should occur one month after translocation (if during the active season) and then concurrent with the colonisation monitoring for a period of at least 2 years after relocation.

The following standard monitoring protocols will be implemented for each annual Growling Grass Frog habitat and population monitoring survey (and for translocated frogs as required):

- Two nocturnal surveys during the main activity period of the frog, between October and February;
- Two surveyors with a total of 60 person minutes spent at each site/water body (e.g. wetlands, floodplain and creek). The survey time may vary according to waterbody size and complexity;
- Survey will proceed in the following order:
    - Call recognition to see if any male frogs are calling (including call playback);
    - Undertake a visual inspection of the waterbody and vegetation with a spotlight and with the aid of binoculars; and
    - Search the perimeter of the waterbody or edge of the creek for frogs, scanning vegetation on the banks and within the water body;
- Records will include:
    - The AMG location, time and activity of each frog encountered/heard;

- The microhabitat (e.g. sitting on floating pond weed in middle of wetland);
- Where possible, identify the age class of individuals (e.g. snout to groin length = < 30 mm – metamorph; 30-50 mm sub-adult; and >50 mm adult); and
- The microchip number of captured PIT tagged animals (if appropriate) and indicative condition.

- Creek sections to be surveyed can be divided into transects of 50 m in length; and
- Measures to reduce the possible spread of infectious pathogens (e.g. 'chytrid' fungus) between the survey sites will be implemented in accordance with standards described by the New South Wales Parks and Wildlife Service (NPWS 2001).
- The methods, results and discussion, as well as recommendations for changes in management regimes will be presented in a report following the completion of the surveys.

Habitat monitoring procedures

An annual diurnal habitat assessment will be undertaken within all Growling Grass Frog habitats. The following proforma field sheet (or similar) will be used to record/monitor habitat elements for Growling Grass Frog.

GGF Habitat Assessment		
Location:		**AMG:**
Site Ref No:		**Time of Day:**
Personnel Present:		
Date:		
Type of Waterbody:		Pond Dam Swamp Creek Drain Ditch Wetland
Flow:		Still Slow Rapid
Substrate type:		
Dimensions (dam/wetland):		Length (m) X Width (m)
Length of stream (m):		
Stream Width (m):		
Stream Depth (m):		
Permanence (0 - 3):		0 = sporadic; 1 = ephemeral; 2 = semi-permanent; 3 = permanent
Vegetation Cover (%)		
Emergent:	Type:	
	% cover	
Submergent:	Type:	
	% cover	

Floating:	Type:
	% cover
Fringing	Type:
	% cover
Dominant Plant species:	
Substrate (%)	
Bare rock	
Bare ground/soil	
Rock rubble	
Logs/Fallen Timber	
Artificial	
General description of vegetation/habitat structure and quality:	
Evidence of grazing/disturbance/trampling:	
Water quality (poor, moderate, high)	
Fish species present:	
Frog species present:	
General description:	

Appendix 7 Cost estimate for Phase One works associated with the implementation of the Officer Precinct Structure Plan CMP

It is the intention of the CMP that Parks Victoria assume responsibility for delivering the Conservation Zone works/actions outlined by the CMP, and that Cardinia Shire Council assume responsibility for delivering the Recreation Zone works/actions (refer to Figure 2).

The estimate of cost below for Conservation Zone actions/works will be funded by land owners in the Officer PSP area that remove suitable threatened species habitat shown in Appendix 8. Land owners are to enter into an on-title agreement with DSE (or an alternative arrangement approved by DSE) to provide funding for the CMP works. Each land owner will be required to make a contribution to the overall cost of the CMP works which is proportional to the amount of suitable habitat that will be removed from their property as outlined in Appendix 8. The estimate of CMP costs outlined below will be indexed over time.

Officer PSP Cardinia Creek CMP - Phase One Preliminary Indication of Probable Cost

Prepared by Growth Areas Authority
6 September 2011

Conservation Zone

Item	Description	Unit	Qty	Rate	Total
1.0	DESIGN COSTS				
	Design development, construction documentation, tendering and contract administration (8% of construction cost)	item	1	$ 86,471.23	$ 86,471.23
	Input by ecological consultants	item	1	$ 5,000.00	$ 5,000.00
	Interpretive signage design	item	3	$ 2,200.00	$ 6,600.00
	Design subtotal				**$ 98,071.23**

2.0	**IMPLEMENTATION COSTS**					
2.1	**Management Zone 1 - Artificial Wetlands**					
	Pond 1 (Site 1) implementation					
	Excavation and shaping of 50% of pond banks	m^3	2,513	$	40.00	$ 100,520.00
	Topsoiling of reshaped pond banks	m^2	2,872	$	20.00	$ 57,440.00
	Supply and install jute matting to perimeter of ponds (1m above and 1m below water level)	m^2	718	$	7.00	$ 5,026.00
	Wetland planting to all banks (6 plants per m^2)	No.	21,540	$	3.85	$ 82,929.00
	Terrestrial planting around ponds (6 plants per m^2) 15m width	No.	32,310	$	3.85	$ 124,393.50
	Trees planting around perimeter (1 tree every 15m)[A]	No.	24	$	11.00	$ 263.27
	Selective fencing to 50% of pond to prevent access	m	359	$	60.00	$ 21,540.00
	Rock placement to pond banks (1 rock per $5m^2$)	m^3	144	$	145.00	$ 20,822.00
	Log placement (1 per pond)	No.	1	$	2,000.00	$ 2,000.00
	Pond 2 (Site 2) implementation					
	Excavation and shaping of 50% of pond banks	m^3	994	$	40.00	$ 39,760.00
	Topsoiling of reshaped pond banks	m^2	1,136	$	20.00	$ 22,720.00
	Supply and install jute matting to perimeter of ponds (1m above and 1m below water level)	m^2	284	$	7.00	$ 1,988.00
	Wetland planting to all banks (6 plants per m^2)	No.	7,686	$	3.85	$ 29,591.10
	Terrestrial planting around ponds (6 plants per m^2) 15m width	No.	12,780	$	3.85	$ 49,203.00

Trees planting around perimeter (1 tree every 15m)[A]	No.	9	$	11.00	$	104.13
Selective fencing to 50% of pond to prevent access	m	142	$	60.00	$	8,520.00
Rock placement to pond banks (1 rock per 5m^2)	m^3	51	$	145.00	$	7,429.80
Log placement (1 per pond)	No.	1	$	2,000.00	$	2,000.00
Pond 3 (Site 8) implementation						
Excavation to increase depth of pond (to 1m)	m^3	300	$	40.00	$	12,000.00
Excavation and shaping of 50% of pond banks	m^3	114	$	40.00	$	4,560.00
Topsoiling of reshaped pond banks	m^2	304	$	20.00	$	6,080.00
Supply and install jute matting to perimeter of ponds (1m above and 1m below water level)	m^2	152	$	7.00	$	1,064.00
Wetland planting to all banks (6 plants per m^2)	No.	2,736	$	3.85	$	10,533.60
Terrestrial planting around ponds (6 plants per m^2) 15m width	No.	6,840	$	3.85	$	26,334.00
Trees planting around perimeter (1 tree every 15m)[A]	No.	5	$	11.00	$	55.73
Selective fencing to 50% of pond to prevent access	m	76	$	60.00	$	4,560.00
Rock placement to pond banks (1 rock per 5m^2)	m^3	18	$	145.00	$	2,644.80
Log placement (1 per pond)	No.	1	$	2,000.00	$	2,000.00
Management Zone 1 subtotal						**$ 646,081.93**
2.2 **Management Zone 2 - Ephemeral Wetlands**						

	No implementation works required					
	Management Zone 2 subtotal				$	-
2.3	**Management Zone 3 - Floodplain**					
	No implementation works required				$	-
	Management Zone 3 subtotal				$	-
2.4	**Management Zone 4 - Remnant Woodland**					
	Weed control to areas to be revegetated (allow 10% of area)	m^2	7,430	$	2.85	$ 21,175.50
	Planting of groundcover/grasses 10% of area @ 6 tubestock per m2	No.	44,580	$	3.85	$ 171,633.00
	Planting of shrubs/trees 10% of area @ 1 tubestock per $m2^A$	No.	6,500	$	11.00	$ 71,500.00
	Management Zone 4 subtotal					**$ 264,308.50**
2.5	**Management Zone 5 - Exotic Grassland**					
	No implementation works required				$	-
	Management Zone 5 subtotal				$	-
2.6	**Miscellaneous**					
	Preliminaries & Site Establishment	item	1	$	20,000.00	$ 20,000.00
	Interpretive signage	No.	3	$	2,500.00	$

					7,500.00
	Preparation of Cultural Heritage Mangement Plan to cover CMP works	item	1	$ 143,000.00	$ 143,000.00
	Miscellaneous subtotal				**$ 170,500.00**
3.0	**ESTABLISHMENT COSTS (10 years)**				
	Park Establishment Costs[B]				
	Removal and realignment of fencing	item	1	$ 10,000.00	$ 10,000.00
	Pest plant control	item	1	$ 6,000.00	$ 6,000.00
	Fire prevention works	item	1	$ 3,000.00	$ 3,000.00
	Slashing	item	1	$ 2,500.00	$ 2,500.00
	Zone 1 - Artificial Wetlands				
	Monthly maintenance including weed control for first 2 years	Month	24	$ 2,000.00	$ 48,000.00
	Replacement of failed plants in first 2 years (5% of total)	No.	4,195	$ 3.85	$ 16,149.21
	Monthly maintenance for years 3 - 10	Month	96	$ 500.00	$ 48,000.00
	Zone 2 - Ephemeral Wetlands				
	Quartely maintenance including weed control and slashing	Quarter	40	$ 500.00	$ 20,000.00
	Zone 3 - Floodplain				

Quarterly maintenance including weed control and slashing - includes biomass removal in drainage lines	Quarter	40	$	500.00	$ 20,000.00
Zone 4 - Remnant Woodland					
Monthly maintenance including staged weed control/removal	Month	120	$	1,500.00	$ 180,000.00
Replacement of failed plants in first 2 years (5% of total)	No.	2,554	$	3.85	$ 9,832.90
Miscellaneous					
Fox, cat and rabbit control	Year	10	$	3,000.00	$ 30,000.00
Establishment subtotal					**$ 393,482.11**
4.0 MONITORING COSTS (10 years)					
Growling Grass Frog [C]					
Two nocturnal surveys and diurnal habitat monitoring (Nov/Dec)	Year	15	$	4,608.00	$ 69,120.00
One additional nocturnal survey and diurnal habitat monitoring (Jan/Feb) if GGF found	Year	15	$	2,224.00	$ 33,360.00
Dwarf Galaxias and Australian Grayling [C]					
Annual monitoring and water quality testing	Year	15	$	8,000.00	$ 120,000.00
Monitoring of 2 flood events over 10 year period	Year	2	$	8,000.00	$ 16,000.00
Southern Brown Bandicoot					
No monitoring required for this species					

Monitoring subtotal				**$ 238,480.00**
TOTAL				$ 1,810,924
Contingency (20%)				$ 362,184.76
Project Management (20%)				$ 362,184.76
GRAND TOTAL (excl GST)				$ 2,535,293

Notes

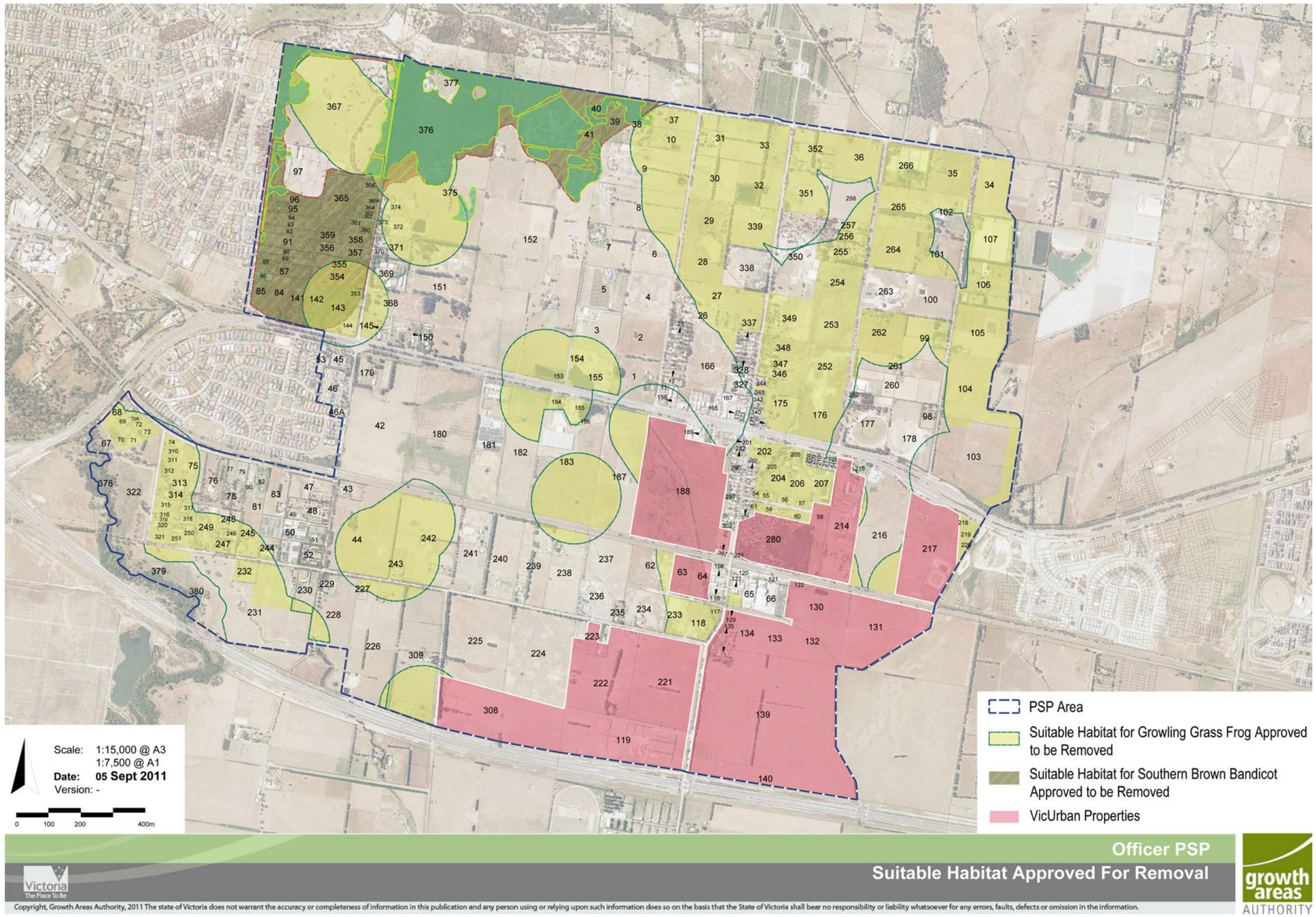
A Per unit tree and shrub estimate allows for 1 square of jute mat, staking and plant guard

B Park establishment costs have been included for land transferred to the Crown that is not currently managed by Parks Victoria.

C 15 years of monitoring allowed on basis monitoring occurs one year before construction commences, allowance for staggered construction of wetlands over a four year period and then annual monitoring over 10 year post-construction period

Appendix 8 Growling Grass Frog and Southern Brown Bandicoot habitat approved to be removed

The plan below outlines the Growling Grass Frog and Southern Brown Bandicoot habitat in the Officer Precinct Structure Plan area that has been approved to be removed. The following table outlines the percentage of this habitat that is located on each property. Land owners that remove this habitat will be required to pay the equivalent percentage of the total cost to implement the CMP works, as outlined in Appendix 7



Property Specific Area of Habitat Approved to be Removed - 7 Sep 2011

Property Number	Area of Habitat Approved to be Removed (Ha)	Percentage of Overall Habitat Approved to be Removed
Property		
1	0.534	0.16%
3	0.837	0.25%
6	0.787	0.23%
8	3.506	1.03%
9	4.843	1.42%
10	2.034	0.60%
26	1.485	0.43%
27	3.717	1.09%
28	4.011	1.17%
29	4.017	1.18%
30	4.047	1.19%
31	4.048	1.19%
32	4.058	1.19%
33	4.069	1.19%
34	4.061	1.19%
35	4.051	1.19%
36	4.025	1.18%
37	2.011	0.59%
38	1.173	0.34%
39	1.139	0.33%

40	0.408	0.12%
41	1.457	0.43%
44	7.923	2.32%
54	0.073	0.02%
55	0.355	0.10%
56	0.348	0.10%
57	0.347	0.10%
59	0.580	0.17%
60	0.617	0.18%
61	0.079	0.02%
62	1.115	0.33%
68	0.569	0.17%
69	0.820	0.24%
70	0.477	0.14%
70A	0.056	0.02%
71	0.436	0.13%
72	0.400	0.12%
73	0.571	0.17%
74	0.401	0.12%
75	1.204	0.35%
84	1.708	0.50%
85	1.170	0.34%
86	0.258	0.08%
87	1.423	0.42%
88	0.224	0.07%
89	0.813	0.24%
90	0.813	0.24%
91	1.537	0.45%
92	0.933	0.27%
93	0.657	0.19%
94	0.931	0.27%
95	1.129	0.33%
96	1.063	0.31%
97	0.988	0.29%
99	3.503	1.03%
101	2.486	0.73%

102	2.374	0.70%
103	2.561	0.75%
104	7.200	2.11%
105	5.851	1.71%
106	4.643	1.36%
107	4.426	1.30%
117	0.217	0.06%
118	2.013	0.59%
126	0.201	0.06%
127	0.200	0.06%
141	0.177	0.05%
142	1.837	0.54%
143	3.311	0.97%
144	0.020	0.01%
145	0.551	0.16%
146	0.426	0.12%
147	0.035	0.01%
151	2.111	0.62%
152	9.534	2.79%
153	0.383	0.11%
154	0.786	0.23%
155	2.898	0.85%
166	0.676	0.20%
175	3.688	1.08%
176	4.943	1.45%
181	0.643	0.19%
182	3.438	1.01%
183	8.206	2.40%
184	0.115	0.03%
185	1.048	0.31%
186	0.228	0.07%
187	7.295	2.14%
202	1.554	0.46%
203	0.491	0.14%
204	1.834	0.54%
205	0.207	0.06%

206	1.573	0.46%
207	1.996	0.58%
215	0.046	0.01%
216	2.825	0.83%
218	0.303	0.09%
219	0.433	0.13%
220	0.489	0.14%
225	0.096	0.03%
226	1.492	0.44%
227	0.270	0.08%
228	1.019	0.30%
230	0.471	0.14%
231	15.226	4.46%
232	1.000	0.29%
233	1.560	0.46%
234	0.057	0.02%
238	0.864	0.25%
239	0.297	0.09%
242	8.915	2.61%
243	0.980	0.29%
244	0.511	0.15%
245	1.341	0.39%
246	0.425	0.12%
247	0.616	0.18%
248	0.622	0.18%
249	1.743	0.51%
250	0.594	0.17%
251	0.486	0.14%
252	4.039	1.18%
253	4.045	1.18%
254	3.951	1.16%
255	2.198	0.64%
256	0.676	0.20%
257	0.622	0.18%
258	1.447	0.42%
260	0.154	0.05%

261	1.274	0.37%
262	4.063	1.19%
264	4.067	1.19%
265	4.031	1.18%
266	4.073	1.19%
309	5.216	1.53%
310	0.412	0.12%
311	0.404	0.12%
312	0.635	0.19%
313	0.884	0.26%
314	0.843	0.25%
315	0.623	0.18%
316	0.453	0.13%
317	0.343	0.10%
318	0.413	0.12%
319	0.090	0.03%
320	0.413	0.12%
321	0.670	0.20%
337	1.016	0.30%
339	3.976	1.16%
346	1.009	0.30%
347	1.011	0.30%
348	2.011	0.59%
349	4.022	1.18%
351	3.675	1.08%
352	3.989	1.17%
353	0.500	0.15%
354	1.647	0.48%
355	1.613	0.47%
356	0.836	0.24%
357	0.755	0.22%
358	0.845	0.25%
359	0.968	0.28%
360	0.191	0.06%
361	0.396	0.12%
362	0.091	0.03%

363	0.093	0.03%
364	0.240	0.07%
365	4.453	1.30%
366	0.577	0.17%
366A	0.072	0.02%
367	18.123	5.31%
368	1.237	0.36%
369	0.423	0.12%
371	0.968	0.28%
372	1.026	0.30%
373	0.274	0.08%
374	1.103	0.32%
375	8.346	2.44%
376	1.218	0.36%

TOTAL	341.434	100.00%