WGGA Cowies Creek Conservation Area

Growling Grass Frog Conservation Management Plan

DRAFT REPORT

Prepared for the City of Greater Geelong

25 July 2024

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- Clare McCutcheon and Mitchell Deaves
- Michael Knudsen (mapping)
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1. Introduction

1.1. Project background

Biosis Pty Ltd (Biosis) was commissioned by the City of Greater Geelong (the City) to prepare a Growling Grass Frog (GGF) Conservation Management Plan (CMP) for the section of Cowies Creek within the Creamery Road Precinct Structure Plan (PSP), located in the north-eastern portion of the Western Geelong Growth Area (WGGA). The Creamery Road precinct is the first precinct proposed to be developed within the WGGA. The location of the Creamery Road precinct is shown in Figure 1.

In 2020, the City adopted the Northern and Western Geelong Growth Areas Framework Plan, which will guide future land use and the sequencing of essential infrastructure and services across the two growth areas. Notably, the Framework Plan outlines overarching actions to provide guidance for the management of biodiversity values of state and commonwealth significance.

The City is undertaking a strategic assessment under Part 10 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to assess impacts on Matters of National Environmental Significance (MNES) as part of development of the WGGA. The strategic assessment will require the City to make commitments to the Commonwealth Government to ensure the long-term protection and conservation of the relevant protected matters. This process is given effect through the *Northern and Western Geelong Growth Areas EPBC Plan* (the Plan) (City of Greater Geelong 2023a).

The Plan includes an outcome to ensure that populations of threatened species persist in the strategic assessment area. This includes GGF within Cowies Creek and one of the key commitments to protect the species is the establishment of the Cowies Creek Conservation Area (the 'conservation area'). A primary objective of the conservation area is to protect and regenerate biodiversity values along the creek corridor.

The objective of the conservation area is to support the persistence of GGF within the WGGA and to maintain the metapopulation dynamics with the broader Cowies Creek metapopulation downstream. It aims to achieve this by:

- Protecting high quality instream habitat
- Improving the condition of lower quality instream habitat
- Protecting and enhancing terrestrial habitat in areas adjacent to the creek
- Regenerating areas of terrestrial habitat that are degraded from historical land uses
- Providing for the creation of off-stream habitat.

In addition to supporting the persistence of GGF within Cowies Creek, the Plan identifies that the conservation area will contribute to the protection and ongoing management of potential habitat for Adamson's Blown-grass *Lachnagrostis adamsonii* (Open Lines Environmental Consulting, Biosis Pty Ltd 2023). The species has not been recorded within the Growth Areas in recent years but is assumed to be present based on historical records and habitat suitability (Ecology and Heritage Partners Pty Ltd 2021).

This GGF CMP has been prepared to give effect to the aims of the Cowies Creek Conservation Area outlined above.

1.2. Scope of the Conservation Management Plan

This GGF CMP addresses the ongoing monitoring and management of the conservation area during the construction of the Creamery Road Precinct and in the long-term, of the relevant portion of the Cowies Creek corridor to maintain its habitat value for GGF in perpetuity. The area directly covered by the CMP is shown in Figure 2.

Legend

Creamery Road precinct boundary

Figure 1 Overview of the Creamery Road Precinct

0 150 300 450 600 750

Metres

Scale: 1:15,000 @ A3

Coordinate System: GDA 1994 MGA Zone 55

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biosis

Matter: 40358,
Date: 24 June 2024 ,
Prepared for: ST, Prepared by: MK, Last edited by: mknudsen
Layout: 40358_F1_Overview
Project: P:\38500s\38542\Mapping\
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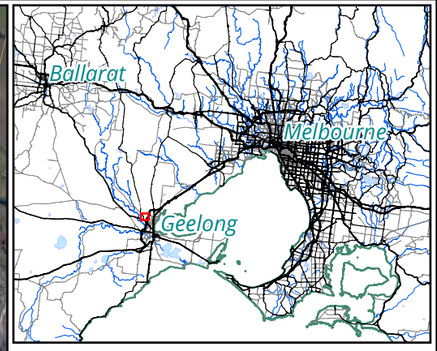

Legend

- Creamery Road precinct boundary
- Cowies Creek Conservation Area
- Stormwater treatment asset/ Bioretention basin

Figure 2 Boundary of the Cowies Creek Conservation Area

0 100 200 300 400 500

Metres

Scale: 1:10,000 @ A3

Coordinate System: GDA2020 MGA Zone 55

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1.3. Objectives

The objectives of this CMP are to:

- Describe the boundary of the conservation area
- Define native vegetation to be retained by the conservation area as identified in the Native Vegetation Precinct Plan (NVPP)
- Consolidate information on the existing conditions, including GGF records and habitat
- Identify locations suitable for public access points, walking paths/trails, and passive recreation, if appropriate
- Identify locations suitable for water management assets and associated infrastructure, if appropriate
- Provide guidance on protecting and enhancing terrestrial habitat within the conservation area
- Detail management actions and arrangements to protect GGF and its habitat, including management methods, standards and techniques, roles and responsibilities, timing for implementation, funding, monitoring, and reporting
- Identify actions for the rehabilitation for Plains Grassland (Ecological Vegetation Class (EVC) 132) and provide a weed management program for land within the Cowies Creek Conservation Area
- Describe the location of potential habitat for Adamson's Blown-grass, and detail management actions and arrangements to maintain suitability of the area for Adamson's Blown-grass, including the use of appropriate indigenous species for revegetation.

1.4. Timeframe and implementation

This GGF CMP will be implemented over a 10 year period, although the requirement to manage the Cowies Creek Conservation Area and to maintain habitat in accordance with this plan is permanent. The GGF CMP will be reviewed every 3 years (years 3, 6 and 9) by a qualified and experienced ecologist, or as needed based on the results of management and monitoring events.

Implementation of the plan will be the responsibility of the City and the landowners, unless or until such management is handed to the responsibility of another authority. Implementation of the actions outlined in this plan will then become the responsibility of the new land manager. However, direct management responsibility may be delegated to a designated site manager and/or managing ecologist. The landowner is responsible for engaging a qualified ecologist to conduct monitoring.

2. Background

2.1. Relevant documents

The following documents have been consulted in the preparation of this CMP:

- Existing Ecological Conditions: Northern and Western Geelong Growth Areas (Ecology and Heritage Partners Pty Ltd 2021)
- Northern and Western Geelong Growth Areas Draft EPBC Plan - Prepared by Open Lines, reviewed by Biosis 2023) (City of Greater Geelong 2023a)
- Cowies Creek Amphibian Survey and Targeted Growling Grass Frog (*Litoria raniformis*) Survey, Summer 2009-2010 (Beacon Ecological 2010)
- Growling Grass Frog Strategy for Cowies Creek – 20 Evans Road, Bell Post Hill (AECOM 2021)
- Growling Grass Frog Offset Evaluation: Bell Post Hill, Victoria (Tactecol Consulting 2022)
- Draft NWGGA Strategic Assessment Report – Park 4 Impact Assessment (Prepared by Open Lines, reviewed by Biosis) Chapter 19 Listed Threatened Fauna (Open Lines Environmental Consulting, Biosis Pty Ltd 2023)
- Draft Cowies Creek Landscape Masterplan (GbLA 2023)
- Growling Grass Frog Habitat Design Standards: Melbourne Strategic Assessment (DELWP 2017a)
- Growling Grass Frog Crossing Design Standards: Melbourne Strategic Assessment (DELWP 2017b)

2.2. Growling Grass Frog

The GGF is a species of national conservation significance. It is listed as vulnerable under the EPBC Act and Victoria's *Flora and Fauna Guarantee Act 1988* (FFG Act). Prior to European settlement, GGF were widely distributed across south-eastern Australia, including Tasmania. However, over the past three decades, the species has declined markedly across much of this former range. This is particularly evident in south and central Victoria where populations have experienced widespread declines and local extinctions (DEWHA 2009).

Factors that have contributed to the decline of GGF across its range include habitat loss, fragmentation and degradation of habitat, potentially predation by introduced species (e.g. Eastern Gambusia *Gambusia holbrooki*), infection by the amphibian chytrid fungus *Batrachochytrium dendrobatidis*, salinisation, pollution of waterbodies and waterways (e.g. fertilisers, pesticides and toxicants), and impacts from climate change (including direct and indirect/cumulative impacts (Heard et al. 2010). Populations are threatened by increasing urban or industrial developments, particularly throughout Melbourne's urban growth areas (DSE 2012).

Research on the species population structure and spatial occurrence emphasised the importance of landscape scale connectivity for the species (Heard & Scroggie 2009). Across most of Victoria, GGF occur in metapopulations made up of discrete populations connected by migration. Metapopulations exhibit changes over time and can go extinct and be recolonised from connected populations (Department of the Environment, Water, Heritage and the Arts 2009, Heard & Scroggie 2009).

The species relies on permanent or semi-permanent still or slow flowing waterbodies that typically support adequate emergent, submerged and floating vegetation. Open and partially rocky areas are often preferred for basking, and open grassland habitat surrounding waterbodies is required for foraging and dispersal. Individuals overwinter beneath thick vegetation, logs, rocks and other ground debris, and increase activity during warmer months as breeding occurs in spring and summer (DSE 2012).

2.2.1. Occurrence within the Cowies Creek corridor

Targeted GGF surveys were undertaken along Cowies Creek in the WGGA by Ecology and Heritage Partners (EHP) on 6 December 2019 and 12 January 2020. Approximately 50 individuals were detected over the two nights, primarily in areas of open water with fringing vegetation (Ecology and Heritage Partners Pty Ltd 2021). Based on the survey results, it was determined that an important population of GGF (as defined by DEWHA 2009) was present, and the extent of Cowies Creek within the WGGA is considered important habitat for the species.

The species has been documented in the WGGA just downstream of the Cowies Creek Conservation Area during a flora and fauna assessment undertaken by Beacon Ecological in 2009. Targeted GGF surveys were subsequently undertaken and a significant number of individuals were recorded at eight different sites in the stretch of Cowies Creek between the Princes Freeway and Anakie Road (Beacon Ecological 2010). The largest numbers were recorded at the wetland adjacent to the Council Depot, 299 Anakie Rd, Lovely Banks, with surveys detecting 47 and 41 individuals. Individuals were recorded from different life stages, including adults and metamorphs.

Database searches indicate that three individuals were recorded more recently in 2020 further downstream of Anakie Road towards Thompson Road.

The approximate locations of GGF records from Cowies Creek are shown in Figure 3. While the population at this location may be subject to natural fluctuations, the persistence of GFF in Cowies Creek for at least 10 years indicates that the area is a stronghold for the species and it provides important breeding habitat. Maintenance of suitable habitat within the conservation area and management of existing and emerging threats is therefore expected to retain a population of this species in the longer term.

There are no records of the species upstream from the WGGA, which may have more limited GGF habitat values due to historic land use (Open Lines Environmental Consulting, Biosis Pty Ltd 2023).

2.3. Adamson's Blown-grass

Adamson's Blown-grass is a species of national significance, listed as endangered under the EPBC Act and FFG Act. It is a tufted grass species growing up to 70 centimetres in height, typically flowering from November to December (DSE 2010). The species is endemic to south-western Victoria, where it is known from a limited number of sites on the Victorian Volcanic Plains from near Geelong in the east to Coleraine in the west. The species occurs along saline slow moving creeks, depressions and drainage lines that are seasonally inundated or waterlogged, and is thought to prefer sites that are sheltered from wind (DSE 2010).

Key threats listed in the species recovery plan (DSE 2010) include:

- Altered hydrology, including drought conditions and climate change.
- Weed invasion and competition.
- Habitat destruction.
- Grazing.

Extensive surveys for the species in the 1990's identified 68 populations, many of which are thought to have declined or been lost over the last two decades (DSE 2010).

2.3.1. Occurrence within the Cowies Creek corridor

Adamson's Blown Grass has been historically recorded along Cowies Creek. Biodiversity databases indicate that the species has been recorded within the conservation area west of Evans Road in 1995, and several records from 1996 to 2002 occur immediately upstream of the conservation area along Cowies Creek, north of Warners Road and the railway line. The population associated with Cowies Creek near Warners Road has been identified as an important population in the species recovery plan (DSE 2010). The approximate locations of Adamson's Blown-grass records from Cowies Creek are shown in Figure 3. Targeted surveys were undertaken for Adamson's Blown-grass by EHP in the WGGA from December 2019 to February 2020 (Ecology and Heritage Partners Pty Ltd 2021). The species was not detected during the field assessment, which occurred at an appropriate time of year when the species is most likely flowering and detectable. However, the species is assumed present within the Creekline Grassy Woodland vegetation along Cowies Creek given the availability of suitable habitat, albeit marginal, and historical records (Ecology and Heritage Partners Pty Ltd 2021).

The population upstream of Warners Road, if present, will also function as a seed source for recruitment within the conservation area. Potential habitat for Adamson's Blown-grass within the conservation area is defined as 'marginal' habitat based on the highly modified and degraded nature of the site, including abundance of exotic grasses, and historical land uses (cropping and grazing).

Given that the species is assumed to be present within suitable habitat in the conservation area, management actions for Adamson's Blown-grass have been incorporated into this CMP to ensure compatibility for both GGF and Adamson's Blown-grass.

The conservation area aims to positively contribute to the species conservation in the region by protecting and managing potential habitat that is likely to support the species (Open Lines Environmental Consulting, Biosis Pty Ltd 2023). The conservation area will retain and conserve 4.859 hectares of potential Adamson's Blown-grass habitat (Figure 4). Areas of potential habitat are defined as Creekline Grassy Woodland (EVC 68) and were mapped by EHP (Ecology and Heritage Partners Pty Ltd 2021) along Cowies Creek.

2.4. Existing conditions and habitat

The existing conditions of Cowies Creek are described based on reviewing relevant background information (see Section 2.1) and a brief site assessment of Cowies Creek undertaken by Biosis zoologists on 17 July 2023. Approximately one third of the area was accessed on foot through the south-eastern portion of the conservation area owned by L. Bisinella Developments (Bisinella). Access limitations prevented a broader visit to the remainder of the conservation area at that time, but the area was viewed from vantage points at the eastern boundary along Bluestone Bridge Road, and the western boundary along Evans Road, using binoculars where appropriate. An additional site assessment was undertaken by Biosis, the City, and various stakeholders on 6 March 2024. During this site visit, all properties along the conservation area were directly accessed on foot, which enabled the existing conditions and habitat, and potential wetland locations to be further ground-truthed,

Cowies Creek occurs from near Anakie and Ballan Road in the north, running south to south-east for approximately 11 kilometres and draining into Corio Bay, North Geelong. Within the WGGA, Cowies Creek runs along the northern border of the Creamery Road Precinct, directly adjacent to a VicTrack rail easement in the north. The conservation area is characterised by an undulating landform, with steep slopes leading into

Cowies Creek in some areas, gently sloping areas and sections of open flood plain. Elevation of the floodplain varies from approximately 30 to 40 metres, with steeper land to the south above the flood plain reaching at least 50 metres above sea level.

Photos from Biosis' site assessments are provided in Appendix A.

2.4.1. Aquatic habitat

Within the conservation area, Cowies Creek supports online pools of shallow to moderate depth which were evident during the winter site assessment, though sections may become partially dry during warmer months and periods of low rainfall. Dry sections of Cowies Creek have been recorded from previous assessments (Ecology and Heritage Partners Pty Ltd 2021). Locations of existing open pools are shown in Figure 3. Open pools of water provide adequate GGF habitat, supporting fringing, emergent and floating vegetation including Rushes *Juncus* spp., Common Reed *Phragmites australis,* Salt Club-sedge *Bolboschoenus caldwellii*, and Water Ribbons *Cycnogeton* sp. Australian Salt-grass *Distichlis distichophylla* is scattered throughout the banks of the corridor.

Exotic species including Spiny Rush *Juncus acutus* and Dock *Rumex* sp., are also present in some areas. Narrow sections of Cowies Creek are dominated by a high abundance of aquatic vegetation with little or no open water.

2.4.2. Terrestrial habitat

Land surrounding Cowies Creek comprises open farmland utilised for grazing and cropping. Invasive African Boxthorn *Lycium ferocissimum* is abundant in several sections particularly near the Bluestone Bridge Road end, and several Pine trees are growing along the creek corridor. Few native species occur surrounding the creek, likely due to historical modification and current land uses. Exotic species are abundant surrounding the creek, including Toowoomba Canary-grass *Phalaris aquatica*, Kikuyu *Pennisetum clandestinum,* Soursob *Oxalis pes-caprae,* Common Vetch *Vicia sativa*, and Common Sow-thistle *Sonchus oleraceus*. Invasive Serrated Tussock *Nassella trichotoma* is abundant particularly above the flood plain. Despite the abundance of exotic species, terrestrial habitat south of Cowies Creek is highly suitable for GGF given the abundance of open space, minimal shade and low height of terrestrial vegetation. This habitat provides foraging and dispersal opportunities for individuals during warmer months, though there is opportunity for habitat improvement throughout both aquatic and terrestrial habitats.

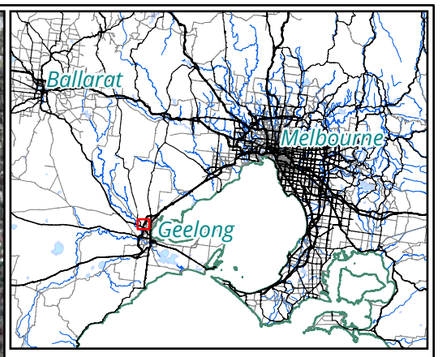
Terrestrial habitat north of Cowies Creek is limited due to the railway line occurring as close as several metres to Cowies Creek in some areas. The land slopes steeply uphill to the north between Cowies Creek and the railway easement, and erosion is evident in some sections. Several retaining walls are located where Cowies Creek directly abuts the railway easement.

2.5. Stakeholder consultation

This CMP has been revised to incorporate feedback from the City and other relevant external stakeholders who were provided with the draft document. The draft document received comments from DEECA, the Corangamite Catchment Management Authority, Barwon Water, developers and community groups. From the submissions received on the draft document, feedback directly relevant to the CMP was reviewed and incorporated as required in consultation with the City. Additionally, a community engagement session for the Cowies Creek CMP was held in November 2023. A number of comments from stakeholders were beyond the scope of this document and hence not directly addressed within this CMP, but may be considered for further discussion and response by the City outside of this document.

In addition to minor revisions and clarifications, the following key revisions were made in response to stakeholder consultation and feedback:

- Recommendations for minimising impacts to the conservation area from the construction and maintenance of stormwater infrastructure (Section 3.4.2).
- Explicit discussion on the Biodiversity Conservation Strategy (Section 3.7). Additional triggers from GGF population and habitat monitoring that may warrant a review of the CMP and adaptive management intervention, to detect potential longer term population declines (Section 4.1).
- Additional consideration for overall connectivity of Cowies Creek, including consideration for crossing infrastructure at Evans Road and Bluestone Bridge Road, the 'Clever and Creative Corridor' (Section 3.6), further detail on recommendations for retaining informal creek crossings.
- Additional section explicitly outlining anti-chytrid wetland properties (Section 3.2.2).
- Management actions for Adamson's Blown-grass incorporated to ensure compatibility for both GGF and Adamson's Blown-grass (Section 4.7)
- Revised mapping, including location of stormwater treatment assets, finalised conservation area boundary, and Adamson's Blown-grass records.



Legend

- Creamery Road precinct boundary
- Cowies Creek Conservation Area
- Stormwater treatment asset/ Bioretention basin
- VBA Record - Adamson's Blown-grass

Growling Grass Frog

- EHP Records (2019)
- Beacon Ecological Records (2009 - 2010)
- VBA Records (2009 - 2020)

Figure 3 Existing Growling Grass Frog and Adamson's Blown-grass records from Cowies Creek, Victoria

0 150 300 450 600 750

Metres

Scale: 1:15,000 @ A3

Coordinate System: GDA2020 MGA Zone 55

N

biosis

Matter: 38542,
Date: 24 June 2024 ,
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Project: P:\38500s\38542\Mapping\
38542_CMP_GGA.aprx

3. Conservation area design

3.1. Boundary of the conservation area

The boundary of the conservation area as of June 2024 is proposed as a 100 metre buffer surrounding Cowies Creek. The boundary described measures 100 metres across the terrain from the centreline of Cowies Creek. The term 'conservation area' used throughout this document is inclusive of the land north of Cowies Creek to the railway easement, and 100 metres south from the centreline of Cowies Creek, accounting for the topographic changes and minor encroachment of a stormwater treatment facility. The conservation area discussed in this CMP is reflective of the boundary provided by the City on 18 June 2024, which includes native vegetation patches identified through the NVPP. It should also be noted that the land north of Cowies Creek is restricted by the railway line, and as such this section of the conservation area is much more variable in width with the buffer area as narrow as approximately 20 metres in some locations.

The conservation area boundary has been clearly defined as part of the Part 10 Strategic Assessment (shown in the EPBC Plan and Biodiversity Conservation Strategy). Following approval of the Part 10 Assessment, the boundary will be set. Precinct Structure Plans and subsequent development will then be required to follow the Part 10 approved documents and this CMP. The boundaries of the conservation area outlined in this CMP are subject to change by the City or following approval by the Commonwealth Government under the EPBC Act. Any further changes would be for the purpose of GGF habitat improvement.

Biosis provided advice to the City relating to the conservation area boundary, in support of adopting a minimum 100 metre buffer area (Biosis Pty Ltd 2021). The proposed 100 metre buffer is less than the 200 metre buffer zone recommended to avoid impacts as per the *Significant impact guidelines for the vulnerable growling grass frog* (DEWHA 2009). However, the proposed buffer is considered suitable to protect and conserve GGF habitat in the context of Cowies Creek as discussed here, and will be further enhanced by providing off-stream wetland breeding habitat. Along its length through the WGGA the floodplain is generally less than 100 metres in width. To the south of the creek and particularly to the north, the gradients of surrounding slopes rise evenly and relatively steeply above those contour levels. If a reserve of 200 metres width from Cowies Creek was to be required as proposed by EHP, it would encompass land on the slopes that does not provide suitable primary habitat for GGF as it does not offer the humid microenvironments and terrestrial habitat resources required by the species. The topography and isolated nature of Cowies Creek is such that there is little or no existing capacity for GGF to disperse to habitats within other catchments. The most important purpose for maintenance of the population will be for frogs moving up- and downstream, and for gene-flow, along the length of Cowies Creek and to enhance existing breeding habitat potential. Providing terrestrial habitat surrounding Cowies Creek and the proposed GGF wetlands for foraging, basking, overwintering, and movement is also critical for protecting the local population.

The unnamed tributary of Cowies Creek at the eastern end of the WGGA is unlikely to provide breeding habitat for GGF. It is narrow and incised and on a steep gradient such that surface water flows are likely to occur only in the immediate period after rainfall events and open-water pools will not occur or persist. However, enhancement of ephemeral waterways outside of the conservation area may be ecologically beneficial and terrestrial habitat enhancement throughout this area should be considered.

Maintaining a buffer of at least 100 metres on the southern bank of the creek and the maximum possible within constraints of the railway easement to the north is important in order to encompass the aquatic and vast majority of terrestrial habitat likely to be currently utilised by GGF. In this respect, the buffer area fully encompasses the humid microenvironments required by the species along the length of Cowies Creek and its floodplain within the PSP. Beyond this to the north and south the hillslopes and surrounding degraded land

rapidly become unsuitable for GGF as they do not offer the humid microenvironments and resources required by the species. The conservation area as proposed also provides sufficient area for habitat creation and enhancement, and protection of native vegetation identified in the Creamery Road Native Vegetation Precinct Plan (Biosis Pty Ltd 2023). A buffer of 100 metres provides further benefit in that it maximises the proximity from disturbance associated with developments including lighting, increased pollution, human and vehicle traffic. It also provides additional capacity for inclusion of management tracks, lookout locations, or other suitable infrastructure to be located away from primary habitat. Location of such infrastructure will be provided in the Cowies Creek Landscape Master Plan (LMP).

Given these factors, the boundary of the conservation area has been suitably determined by considering site specific characteristics of Cowies Creek and guidelines around buffers for breeding, overwintering and terrestrial foraging habitat. The conservation area boundary as proposed in the current Framework Plan, will adequately provide habitat for GGF and will permit the existing population of the species to remain viable if managed appropriately.

3.2. Habitat creation

The series of small open in-stream pools within Cowies Creek currently provides adequate habitat for GGF, likely utilised for breeding. However, opportunities exist for additional habitat creation and improvement within the conservation area. The creation of additional habitat is likely to increase the suitability of the site for GGF and assist in mitigating negative impacts associated with adjacent urbanising landscapes. It is expected that the dedicated GGF wetlands will be naturally colonised by individuals from the Cowies Creek population overtime, if constructed and managed suitably.

The GGF habitat wetlands described in this section as proposed align with the *Growling Grass Frog Habitat Design Standards: Melbourne Strategic Assessment* (DELWP 2017a) as requested by the City. The timing of habitat creation is yet to be determined, but construction activities must occur outside of the species key breeding period (generally September to February). New habitats take time to establish and become suitable for GGF. Construction of the GGF wetlands needs to occur prior to the commencement of construction of the residential development, to ensure that it will be available for GGF throughout the development timeframe. The GGF dedicated wetlands must be constructed as per the habitat creation recommendations in Section 3.2 at least six months prior to works commencing for land containing the conservation area, unless otherwise approved by the relevant authority. Construction of the GGF wetlands can be staged so that off-stream GGF habitat is established prior to stormwater catchments created from urban development commence discharging into Cowies Creek.

The proposed development of wetlands will involve construction or maintenance activities that may affect beds and banks of Cowies Creek, riparian vegetation or quality or quantity of water in Cowies Creek. Works will require a Works on Waterways permit from the Corangamite Catchment Management Authority for any future construction of assets in, on or adjacent to the designated waterways that traverse the conservation area (both named and unnamed).

The following briefly describes ways in which wetlands can be appropriately designed to incorporate key habitat variables suitable for GGF.

3.2.1. Wetland locations

The draft LMP (GbLA 2023) has proposed a total of four GGF off-stream wetlands to be created within the conservation area. It is recommended that at least two additional wetlands be constructed in the up-stream

half of the conservation area to supplement existing habitat, such that the conservation area will provide six off-stream wetlands.

The proposed locations for these wetlands are shown in Figure 4. Wetland location, shape and size depicted in Figure 4 provide a layout, which is not intended to be used for specific design purposes. The locations of the six wetlands are based on providing off-stream habitat distributed through the Cowies Creek conservation area and in areas where there is suitable terrain. Detailed design of wetlands, including specification of sizes and exact locations is beyond the scope of this CMP and requires further input from experts and consideration of constraints. Information detailed in this section should be provided to the relevant engineering experts who will consider appropriate habitat criteria for GGF during the detailed design phase.

Created wetlands aim to promote the metapopulation dynamics of the species by creating clusters of breeding wetlands to support multiple interacting populations. The following factors have been taken into consideration regarding wetland locations:

- Topography of the area including location of natural flood plains
- Proposed maintenance tracks and creek crossing locations
- Flood levels
- Existing GGF habitat and previous records

The four downstream constructed wetlands will be located within approximately 200 to 340 metres of each other, accounting for limitations on where wetlands can be feasibly constructed. Distances between wetlands are within the species dispersal capabilities. The Design Standards (DELWP 2017a) state that its preferrable to include the creation of least 10 off-stream breeding wetlands to support the species metapopulation dynamics, taking into account limitations in where wetlands can actually be constructed. Given the topographical constraints of the conservation area, constructing 10 wetlands is not likely to be feasible. The six wetlands are proposed as a high level, minimum target for what may be feasible, without detailed feasibility analysis and input from other technical experts. Incorporation more than six off-stream wetlands into the conservation area would further enhance habitat for the metapopulation. Additional wetlands require further consideration of financial, engineering (topography and hydrology) and cultural heritage constraints.

Creation of six GGF wetlands will enhance the existing habitat within Cowies Creek, which currently provides a series of in-stream pools that are utilised for breeding. The off-stream GGF wetlands are proposed to be located primarily in the mid to downstream reaches of the conservation area where the topography is suitable, there is sufficient terrestrial space and wetlands can be safely constructed and managed. Wetlands are also located near previous clusters of GGF recorded from the 2019 surveys.The additional following factors should be applied to the detailed wetland location design:

- At least four of the six wetlands should be permanent, containing water all year round with consideration to ensure they hold adequate water during the GGF breeding period (generally September to February). Semi-permanent and ephemeral wetlands may be acceptable where there is limited capacity to provide a permanent wetland, although all wetlands should be permanent if possible.
- Wetlands to include various wetland types to provide suitable conditions for each lifecycle stage.
- New wetlands to be constructed offline, not within or hydrologically connected to a stream other than during exceptional floods. If wetlands cannot be located an appropriate distance from Cowies Creek to ensure this, incorporation of bund walls should be considered to reduce the potential for incursion of predatory fish.

An equal number of wetlands are recommended to be constructed on the northern and southern sides of Cowies Creek. This is recommended in consideration of potential negative impacts on GGF habitat on the northern side of Cowies Creek nearby the railway line, whilst considering that wetlands on the southern side are closer to impacts from new development.

Some infrequent disturbance of the conservation area may occur from the railway line along the northern boundary. Possible impact pathways include noise, vibration, pollution, and runoff. However, it should be noted that GGF have continued to persist in Cowies Creek despite the ongoing operation of the railway line. At its present capacity, the railway corridor is not anticipated to significantly deter GGF from the conservation area and off-stream GGF wetlands located on the northern side of Cowies Creek. Sediment fencing will assist to mitigate impacts of pollution and runoff from the railway corridor (see Section 4.4).

3.2.2. Wetland attributes

The attributes of each wetland are to be carefully considered and designed to maximise suitability for GGF. The designs should replicate the ideal microclimates, physical and chemical attributes of optimal GGF habitat, whilst promoting wetland properties that reduce susceptibility of GGF populations to chytrid fungus and assist in the control of predatory fish. This section provides a discussion on the ideal attributes to be incorporated into each created wetland, and are summarised in Table 1. Figure 5 provides a visual example of the attributes to be incorporated.

The size of each wetland should be designed to ensure permanence of water and increase likelihood of GGF using the wetland, and maximise quantity and diversity of food and shelter resources (Heard et al. 2010). The shape of wetlands should be designed to maximise areas of deep water and promote submerged vegetation growth and establishment. Ideally, wetlands should be long rectangular shapes for a high edge to area ratio, and smaller areas of open water. This configuration will maximise the refuge area around the perimeter of the waterbody.

The wetlands shown in Figure 4 are indicative of the proposed location only, and the wetland size at each location should be as large as feasible respective of topographical and hydrological constraints during the detailed design phase.

Water depth of wetlands must incorporate:

- A deep water submergent vegetation zone at least 50 percent of the wetland and preferably 60 to70 percent of the total surface area at normal water level, maintained at a depth of over 1.5 metres. The maximum depth of each wetland will vary depending on the upstream catchment area and topography constraints
- Emergent vegetation zone to encompass the remainder of the area at approximately 30 to 40 percent, including a littoral zone with seasonally fluctuating water levels
- A variety of slopes to be incorporated into the design of banks, where feasible.

A water balance analysis that considers inflows, outflows and rainfall and evaporation at a minimum should be undertaken for each GGF wetland. This will also determine the required depth of open water for each wetland to ensure that they do not dry out. A water depth gauge must be installed in each wetland to allow for efficient depth monitoring.

New wetlands should be designed to allow them to be periodically dried out for management and maintenance purposes, such as if pest species are identified within wetlands (see Section 4).

Wetlands should be lined usually with clay to minimise leakage, with a layer of soil placed over the liner to promote growth of and permanently establish aquatic plants. The substrate used should not result in high

water turbidity. Wetlands should have a perimeter of over 20 percent rocky habitat (ideally 50 percent), utilising excavated rocky material on site where possible. Rock piles should extend into the wetland at least one metre from the normal water level.

Target values for water quality in created wetlands are summarised in Table 1.

Table 1 Summary of best practice GGF wetland design attributes, based on the *Growling Grass Frog Habitat Design Standards Melbourne Strategic Assessment* (DELWP 2017a)

Attribute	Design principals	Aims and justification
Size	As large as feasible.	To maximise quantity and diversity of food and shelter vegetation types. Each wetland surface area ideally >0.3 ha, and if possible one larger wetland of approximately 0.7 ha where space allows.
Shape	Variable.	To maximise areas of deep water to promote submerged vegetation growth, enhancing potential breeding habitat.
Water depths and gradients	• Deep water submergent vegetation zone 60-70% of wetland, with depth maintained >1.5 m. • Emergent vegetation zone 30-40% of wetland, with a littoral zone of fluctuating water levels. • Variety of slopes where feasible. • At least three quarters of wetlands should be permanent. • Install depth gauges in each wetland for ease of depth monitoring.	Provide deep water areas with dense submergent and floating vegetation and a permanent water supply. Prevents over establishment of emergent species (e.g. Common Reed) which can choke out shallow wetlands. Shallow areas provide warm microhabitats to promote flora and fauna growth, and increased wetland productivity. Fluctuating water levels promote nutrient cycling. Permanent water is critical for the complete lifecycle of GGF.
Lining and substrate	• Line wetlands with substrate (usually clay) • Lining topped with suitable substrate (e.g. clay soil) for aquatic plants.	Lining to prevent leakage, and suitable soil to promote the establishment and ongoing growth of aquatic plants. Soil used should not result in high turbidity of wetlands.
Thermal properties	• Perimeter of wetlands with >20% rocky habitat, ideally 50%. • Provide large, deep areas and shallow littoral zones to promote thermal inertia. • Shallow areas free of shading from dense vegetation.	Thermal properties of wetlands should be maintained to discourage the establishment of chytrid fungus, as warm and moderately saline wetlands reduce chytrid fungus infection rates (Heard et al. 2014).
Water quality	• Minimise pollutant input. • pH 6.0 to 8.5. • Minimise soluble and total metals. • Moderately saline, up to 5000 µS/cm. • Turbidity <40 NTUs. • Ammonia < 0.01 mg/L (N-1) as NH4+.	Promote suitable water quality for GGF and discourage chytrid fungus infection.

Attribute	Design principals	Aims and justification
	• Total Nitrogen <1.0 mg/L. • Total phosphorous <0.1 mg/L. • *E. coli* orgs/100 ml Primary Contact < 150, Secondary Contact < 1000.	

Water sources

Potential water sources for GGF wetlands in order of general suitability include:

- Groundwater (preferred water source, if appropriate)
- Rainwater (surface runoff)
- Stream water
- Treated stormwater
- Rainwater (from roofs)
- Potable water
- Recycled water

Each potential water source has benefits and limitations relating to factors such as availability and feasibility, cost, and GGF suitability including water quality and risks of pests and pollutants. The habitat design standards recommend most wetlands to be supplied with groundwater where feasible. Groundwater is likely to be moderately saline which is beneficial in decreasing the risk of chytrid fungus infection (Heard et al. 2014) and it is also free of predatory fish such as Eastern Gambusia. Treated stormwater is less favourable as a water source as it may contain unacceptable levels of nutrients and contaminants, has relatively low salinity and is likely to contain predatory fish. If wetlands are fed by treated stormwater, treatment must remove gross pollutants and filter out suspended solids, excess nutrients, heavy metals and chemical pollutants. Wetlands fed by treated stormwater must also incorporate fish exclusion mechanisms such as sand and gravel filters, to reduce the probability of predatory fish establishment.

Permanent GGF wetlands are to include an effective drainage mechanism installed if topographical constraints allow, to facilitate draining them of water if necessary. If wetlands cannot be drained with gravity and a manual outlet valve system, a water pump with a suitable filter fitted to ensure that any GGF tadpoles are not pumped out of the waterbody may need to be used. Wetlands are also to be designed such that they receive no or minimal water from Cowies Creek during frequent flood events (i.e. 10 year Average Recurrence Interval (ARI)). This will reduce the chance of wetlands becoming colonised by GGF predators such as fish and yabbies.

Water source for each wetland is to be confirmed in consultation with the City. We recommend that wetland developers experienced in GGF or frog wetland creation be engaged to assist in designing wetlands that incorporate the attributes outlined above. Further catchment and water flow analysis may be required to finalise the location of GGF wetlands.

Anti-chytrid wetland properties

The detailed design of wetlands will incorporate characteristics thought to assist in control of chytrid disease (Heard et al. 2014, DELWP 2017a). In general, waterbodies that are larger, slightly saline and warmer provide

important anti-chytrid refuges for GGF populations, decrease the rates of infection and mortality, and of overall likelihood of population extinction. The following attributes should be incorporated into a minimum of three GGF wetlands within the conservation area to reduce the likelihood of chytrid fungus infection in the population:

- Moderate salinity (up to 5000 µS/cm) which is beneficial in decreasing the risk of chytrid fungus infection (Heard et al. 2014).
- Warmer temperatures within wetlands (up to 27 degrees in summer) to slow rates of chytrid fungus infection (Heard et al. 2015). Warmer temperatures can be created by incorporating gently sloping batters with rocks piles around the margins and in the shallows) to provide warm and shallow basking sites.
- Incorporating rock piles within and around the margins of wetlands. This feature could be incorporated into the design along the western batters where rocks will be exposed to morning and midday sun, or in other appropriate locations around wetlands. Rocks also act as heat banks and assist with elevating water temperatures, which is an important feature to reduce prevalence and intensity of chytrid infection. Rock piles should extend at least one metre into the wetland from the normal water level into the shallows. Rocks should not be shaded by surrounding vegetation, and be positioned to maximise exposure to sunlight.
- Consider installation of embankments or shelterbelts to reduce potential cooling effects of prevailing winds (eg. strong and frequent coastal winds). This may not be necessary depending on wetland location and detailed design, as the topography of the conservation area may provide some natural shelter.

3.2.3. Aquatic vegetation

Wetlands must support a high abundance of native semi-aquatic and aquatic vegetation, including floating and submergent lifeforms, as this is a critical component of GGF habitat. Deep sections of the wetlands that support aquatic vegetation are unlikely to become overgrowth with dense emergent species. Wetlands should be structured with three zones:

- An ephemeral littoral zone that supports fringing vegetation
- A permanent shallow/emergent vegetation zone
- A deep water zone of 1.5 to 2 metres.

Vegetation is to be planted with the following guidelines:

- Planting density of approximately 4 to 6 plants per square metre, and reduced to 3 to 5 plants for submergent vegetation may be lower
- Include a diversity of native species
- Account for local water quality conditions, including salinity, to select suitable species
- The deep water zone must include Water Ribbons *Cycnogeton procerum* and Pondweed *Potamogeton* spp.
- Minimum 50 percent cover of submergent, floating and emergent vegetation established after two years
- Common Reed and Bulrushes *Typha* spp. Do not require planting and are likely to naturally establish
- No exotic species.

Aquatic vegetation will be monitored and replanted as necessary to ensure suitable establishment.

Species should be local to the region (i.e. the Victorian Volcanic Plain Bioregion) and sourced from local provenancee if possible. A recommended planting list for GGF wetlands is provided in Appendix B, and a diverse variety of vegetation should be planted for each GGF wetland.

3.2.4. Terrestrial habitat

Open areas surrounding both Cowies Creek and the proposed GGF wetlands must be maintained within the conservation area. Such areas provide GGF with important dispersal corridors and foraging habitat, with the primary terrestrial habitat encompassing approximately 100 metres from waterbodies (Heard et al. 2010) though individuals are capable of moving much greater distances (DSE 2012).

In accordance with the habitat design standards (DELWP 2017a), a buffer of at least 50 metres from development should be maintained around habitat, and a buffer of at least 30 metres from minor infrastructure such as passive recreation and stormwater infrastructure. The guideline buffer areas are achievable within the current proposed boundary of the conservation area and have been considered in the proposed wetland locations (see Section 3.2.1).

Terrestrial habitat is to be maintained primarily as short, open grassy vegetation which should encompass as much of the conservation area as possible. Grassy vegetation may comprise native or exotic species, and tree and shrub cover within the conservation area should not exceed 10 percent each. No mulch is to be used within 50 metres of GGF wetlands or Cowies Creek. The following standards should be applied for the terrestrial habitat within 10 metres of the normal water level of created wetlands and Cowies Creek (the 10 metre buffer):

- Approximately 50 percent of the area designed to be maintained as low, grassy vegetation up to 10 centimetres high
- Approximately 20 percent of the area can comprise tussock-forming grasses and sedges
- No shrubs within 10 metres of GGF wetlands or Cowies Creek
- Creekline Grassy Woodland along Cowies Creek must have a combined tree canopy cover and shrub cover less than 10 percent
- Rocky habitat to constitute rock piles >1 metre deep, extending into waterbodies at least one metre.

The remainder of the terrestrial habitat beyond the 10 metre buffer of Cowies Creek and wetlands, or beyond the Creekline Grassy Woodland, should be maintained as low, open grassy habitat.

3.3. Existing habitat improvements

In addition to habitat creation, opportunities for improving the existing habitat and enhancing its value for GGF and other native fauna have been identified. GGF typically occur in habitat with minimal shading from surrounding vegetation. Unshaded areas support dense submergent vegetation, facilitate thermoregulation and decrease risks of chytrid fungus infection due to increased sun exposure and warmer waters (Heard et al. 2014, Heard et al. 2015). Areas of Cowies Creek presently support overabundant emergent vegetation that has choked out sections of Cowies Creek. Such areas are less favourable for GGF as they have increased shading and do not provide any open water. Targeted and careful removal of overabundant emergent vegetation will be beneficial to improve habitat quality in these areas. A small number of exotic Pine trees currently present along Cowies Creek should be pruned to decrease shading, potentially reduce water uptake, and remove input of dropped pine needles. These trees could be pruned into stags carved with nest

boxes to provide habitat for native fauna in the local area. Removal should focus on trees directly impacting in-stream habitat, for example those within five metres of the creek edge.

Some scattered loose and embedded rocks are present along sections of Cowies Creek. Rocks are an important habitat component for GGF as they provide sites for basking, shelter and overwintering. Increasing the area of rocky habitat along Cowies Creek will provide increased refugia for frogs, opportunities for basking and enhance thermoregulation. Rocks should be sourced from the local area where possible, for example rocks removed from the landscape during the precinct development earthworks may be repurposed within the conservation area. Sourcing rocks from adjacent development would only be applicable to supplementing rocky habitat along Cowies Creek, and would not be possible for wetlands, as wetlands must be established prior to development works commencing. Rocky areas should be incorporated at regular intervals along the creek where suitable and convenient, for example at areas of the bank that experience disturbance from the removal of Pine trees, or near areas where formal maintenance tracks will be constructed (see Section 3.5.3). Locations of rock piles will be detailed in and guided by the Cowies Creek LMP, and in consultation with a qualified and experienced Ecologist if necessary.

Additionally, appropriate weed management will aid in maintaining and improving the existing habitat values for GGF. See Section 4.5 for discussion on weed management.

3.4. Stormwater infrastructure

Stormwater retention and treatment basins will be required to be located outside of the conservation area due to:

- Very little relatively flat terrain suitable for their construction.
- Steeper slopes have been identified as either high or medium susceptibility to landslip.
- Risks posed to any GGF that may colonise these basins due to impact from maintenance activities.

Locating stormwater retention basins away from GGF critical habitat is important to reduce the likelihood of the species occurring within these areas so periodic sediment maintenance can be carried out without potential harm to individuals. Locating stormwater assets outside the conservation area will further ensure industry best practice water quality standards are able to be met. This will enable design and maintenance standards to focus on the primary purpose of meeting best practice water quality standards regardless of GGF habitat requirements. There may be situations where it is appropriate for GGF wetlands to harvest treated stormwater, noting that the primary function, maintenance, and operation of the drainage asset must not be compromised.

Whilst GGF may occasionally utilise stormwater assets, stormwater treatment wetlands do not typically function as, and are not considered to be suitable GGF habitat. This is largely due to the dominance of emergent vegetation, pollution and input of high nutrients, and abundance of exotic fish that predate GGF eggs and tadpoles (DELWP 2017a). Stormwater treatment wetlands are likely to become increasingly unsuitable for GGF over time as pollution, nutrient and sediment input increase with the surrounding development. Additionally, GGF habitat wetlands and stormwater retention ponds have different primary purposes, design and maintenance requirements.

All stormwater and surface flow inputs from catchments surrounding the conservation area will be directed to bioretention ponds or treated to best practice standards prior to entering Cowies Creek.

3.4.1. Location of WLRB-08

The Creamery Road Precinct stormwater assets have been proposed to be located primarily outside of the conservation area, with the exception of wetland retarding basin 8 (WLRB-08), which is proposed to be located west of Evans Road encroaching into the conservation area and will outfall into Cowies Creek. Revised designs of WLRB-08 asset have split the wetland to incorporate an additional smaller bioretention basin east of Evans Road (Figure 4).

Whilst the GGF habitat design standards developed for the Melbourne Strategic Assessment (MSA) allow for the incorporation of stormwater assets into GGF conservation areas, stormwater wetlands must be at least 30 metres away from the normal water level of GGF breeding habitat. Given the local topography including steep slopes surrounding Cowies Creek, incorporating additional stormwater treatment wetlands is unlikely to be feasible due to landslip potential, and risk of impacts to Cowies Creek during construction. The current draft layout of stormwater infrastructure (Alluvium 2022) has designed stormwater management assets to avoid steep escarpment areas to reduce design complexity and earthworks, and manage stormwater outside of the stream valley to protect Cowies Creek.

Engineering constraints and criteria relating to the position of drainage asset WLRB-08 require this asset to encroach the conservation boundary. It has been determined that there is no practical solution other than this location to fulfil the key requirements of being outside the 1% Annual Exceedance Probability (AEP) area or floodplain, at the lowest point of the catchment, whilst ensuring discharge upstream of GGF habitat and stormwater is treated appropriately. This will be the only exception where a drainage asset will be within the 100 metre buffer. Access to WLRB-08 for maintenance purposes will be restricted to outside the conservation area.

Locating other stormwater assets outside of the conservation area is preferred as described above, and to minimise the associated disturbances within the conservation area.

3.4.2. Construction and maintenance

Stormwater infrastructure and associated assets required to be constructed and maintained within and nearby the conservation area must consider potential impacts to GGF. The specific location of stormwater outfalls and headwalls will be determined during the detailed design phase, in consultation with experienced ecologists as necessary. It is considered that direct impacts will be relatively small scale and localised. Items outlined below are intended to reduce the impact of construction and maintenance activities on the GGF population, and relevant points will be incorporated into the site-specific Construction Environmental Management Plan (CEMP).

- Avoid construction and major earthworks activities during the species active season (late August / early September through to late April inclusive) where possible.
- General works management protocol to be adopted, including appropriate erosion and sediment control measures, and establishment of a clear hygiene procedure for footwear, vehicles and equipment to prevent the introduction and/or spread of any amphibian diseases (see Section 4.2).
- Construction works have the potential to negatively impact fauna habitat within and surrounding Cowies Creek, resulting in runoff, sedimentation, and degradation of nearby habitat if not managed appropriately. Consideration must be given to best practice erosion and sediment control in specific relation to mitigating impact to GGF and contamination of the creek. Where possible, establish strict 'no-go-zones' outside of the construction footprint and avoid construction during and immediately after rain.

- Minimise the impact to creek banks during installation and maintenance activities, including preservation or reformation of bank form following works and the retainment of critical habitat features such as scattered rocks and large woody debris.
- If frogs are detected within the works area, a suitable qualified ecologist is to attend the site to relocate the frog away from the works zone, following the relocation protocol in Section 4.3.

3.5. Landscape management plan considerations

Biosis has conducted a review of the draft LMP (GbLA 2023) to ensure that the conservation area boundary (see Section 3.1) and infrastructure locations are appropriately located. The LMP will be finalised in accordance with the CMP, and will detail the locations of shared paths and lookouts in relation to the conservation area.

3.5.1. Passive recreation space

A shared path is proposed to be located outside of conservation area and along the southern boundary. The path is required to be located outside of the conservation area due to constraints associated with site topography including high landslip susceptibility, and to ensure reduced disturbances to the area associated with pedestrian traffic, off-lead dogs, litter, and noise. This path will connect the Creamery Road Precinct to the conservation area and the Cowies Creek bike trail east of Bluestone Bridge Road. The shared path will incorporate toilet facilities near the Coolangatta Homestead, and a series of drinking water fountains. These features are appropriately located more than 30 metres from the normal water level of Cowies Creek as required by the GGF Habitat Design Standards (DELWP 2017a).

Public access to the conservation area will be restricted to tracks leading to viewing points located along the fringe of the conservation area. Limited access has been proposed with the aim of protecting important habitat and native vegetation, and minimising ongoing maintenance issues commonly associated with public open spaces. Fencing will be installed along the southern boundary of the conservation area to assist in preserving the area. Fence design should consider being effective in preventing dogs off leash from entering the conservation area. The '*DEECA requirements for permanent fencing around conservation areas under the Melbourne Strategic Assessment: Growling grass frog conservation management category*' (DEECA 2023) may be used as a guide.

It is important to note that restricting public access poses the risk of potential increased disturbance resulting from members of the public informally accessing the conservation area. Potential impacts to the conservation area should be monitored incidentally during management activities and by the City. If impacts to native vegetation and/or GGF habitat are noted such as the creation of informal tracks or other inappropriate activity in the conservation area, the City should reconsider formalising public access to Cowies Creek to avoid ongoing impacts, or adopt measures to rehabilitate impacted areas. Any change in access arrangements to the conservation area and associated infrastructure would need to be undertaken in consultation with regulators and ensure no adverse impacts to GGF, Adamson's Blown-grass or habitat will ensue.

3.5.2. Lookouts and public awareness

Lookout or viewing deck locations will be incorporated along the shared path at various points along Cowies Creek, to provide an overview of the conservation area and surrounding landscape. Lookout locations are recommended to incorporate interpretative signage on GGF and habitat value of the area and should be located appropriately, such as adjacent to the created GGF wetlands. Informative signage is important to promote public awareness, understanding and appreciation of the conservation area.

3.5.3. Maintenance tracks and creek crossings

A series of informal crossings currently exist along the length of Cowies Creek for access to the northern side of the creek. The existing informal creek crossings have formed over time likely from land management use and animal activity. They vary in width of up to several metres and are characterised by open rocky and muddy substrate (see Appendix A). Two of these crossings will be removed and six are required to be retained and upgraded to facilitate maintenance access to the northern side of Cowies Creek (Figure 4). Land north of Cowies Creek can alternatively be accessed via the railway easement. However, establishing management access to the conservation area independent of VicTrack permissions is the City's preferred option to ensure guaranteed ongoing access as required.

The crossings and associated maintenance tracks are appropriately located and cover the minimum area required for access to the northern sections of the conservation area between Cowies Creek and the railway line. Formalising crossings where existing informal crossings are located is likely to be the most efficient and low impact option. Most of these crossings will be maintained as low ford crossings, which are anticipated to be infrequently used only several times annually by management personnel and will provide a low impact access route across Cowies Creek. Ford crossings must be designed and constructed to minimise the disruption of water flow and not result in flooding or blockage from a build-up of debris, or inhibit movement of aquatic fauna. Ongoing monitoring and maintenance of the ford crossings will be required, and is particularly important in the first few years of use for early identification of potential issues. Ford crossings will be as low as practical to avoid disrupting flows, the surface of the ford ideally at the same level or no more than 100 millimetres higher than the waterway, and filled with a clean, hard angular rocks. Appropriate sediment and pollution control measures for crossings and maintenance tracks should be incorporated into the CEMP. Additional design specifications will be incorporated into the Cowies Creek LMP.

Any larger or highly trafficked crossings should be designed in accordance with the *Growling Grass Frog Crossing Design Standards - Melbourne Strategic Assessment* (DELWP 2017b) as to maintain the existing connectivity along Cowies Creek. Use of maintenance tracks and ford crossings will be restricted to management personnel only.

All crossings should be maintained at the minimum width required for safe access. Maintenance tracks will be maintained as unsealed rocky or low grassy tracks that will not inhibit dispersal or movement of frogs. Whenever possible, traversing the creek crossings should be undertaken on foot. Traversing ford crossings in vehicles should be undertaken during periods of low flow and not following heavy rainfall events. If crossings are required to be frequently used by heavy machinery, for example during wetland construction and if the railway easement cannot be utilised, a formal culvert bridge crossing should be considered to reduce in-stream impacts. The use of temporary bridge crossings should be considered to facilitate movement of construction vehicles or heavy equipment during wetland construction and minimise disturbance to the creek and water flows. These can be removed following wetland construction to avoid the need for permanent culvert crossings and hence minimise potential disturbance to Cowies Creek.

A large, constructed crossing / levee spans Cowies Creek just west of Evans Road. This crossing is not essential to be retained as the northern areas can be accessed from Evans Road. Aerial imagery of this area suggests that the crossing acts as a levee and retains a large pool of water upstream due to its elevation above Cowies Creek. Such crossings can impact the instream water flow by forming a barrier, altering water quality, and consequentially impact habitat and connectivity for aquatic fauna. Removal of this crossing may be beneficial to reinstate the natural flow regime of Cowies Creek, although impacts on GGF habitat are unknown. Historical aerial imagery indicates that this crossing has been maintained since at least 2009.

It is difficult to determine the impact of removing the levee on GGF and their habitat. Removal would impact habitat both upstream from modification to the large instream pool, and downstream from increased water

flows. Significant modifications to Cowies Creek such as removing the levee also make it difficult to infer the potential causes of GGF population changes. If the crossing is to be removed, further consideration and impact assessment of removing the levee must be undertaken to determine the changes in water flow, sediment deposition and erosion, and subsequent impacts on GGF habitat. Consultation with an experienced hydrologist is recommended in this instance.

3.6. Crossing structures and connectivity

Cowies Creek underpasses Evans Road near its western extent, and Bluestone Bridge Road downstream at its eastern extent. During the site assessment undertaken by Biosis on 17 July 2023, the existing conditions of the culverts at these locations were assessed. The crossing structure at Evans Road consists of three small box culverts each approximately one metre wide, and the Bluestone Bridge Road crossing consists of a narrow cement pipe largely overgrown with dense vegetation. Photos from Biosis' site assessment are provided in Appendix A.

The ability of GGF to move along a corridor depends on barriers in the landscape, and crossings can impact on populations by modifying the hydrology or acting as a dispersal barrier (DELWP 2017b). Crossing structures at these underpasses should be regularly maintained to facilitate connectivity, including:

- Removal of litter.
- Removal of overabundant vegetation or other debris choking the passages.

Any modification to the Bluestone Bridge Road or Evans Road crossing and construction of associated infrastructure, such as the shared path, must consider and incorporate the *Growling Grass Frog Crossing Design Standards* (DELWP 2017b). At the detailed design phase, consideration should be given to incorporating natural surfaces, and suitable humidity, temperature, and light levels.

A 'Clever and Creative Corridor' is proposed to be incorporated along Evans Road towards the western end of the conservation area. This corridor of approximately 20 metres wide will utilise the existing road easement at this location to provide a boulevard-style transit corridor for commuters in the local area. The detailed design and management of the Clever and Creative Corridor should incorporate appropriate considerations for GGF where it runs adjacent to the conservation area, including:

- Avoid excessive planting of trees and large shrubs to maintain less than 10% coverage. This will avoid excessive shading of the creek corridor as vegetation becomes established over time.
- Establish and maintain protective fencing (eg. metal pickets and wire mesh or similar) approximately 20 metres perpendicular to Cowies Creek on either side of Evans Road. Fencing should connect to the Evans Road culvert underpass and extend north and south approximately 20 metres. Fencing should be designed to facilitate safe movement of GGF along Cowies Creek, discouraging any GGF from entering the Clever and Creative Corridor and ultimately traversing over Evans Road.
- Undertake weed management in accordance with specifications in Section 4.5.

A shared path is proposed to be constructed under the eastern span of Bluestone Bridge. The shared path is proposed to be three metres wide and will be designed to maintain habitat attributes for GGF. The path will be constructed and designed to minimise impacts on the creek and its verges, including specific features such as a boardwalk or decking design to allow light and moisture through to the creek, to maintain climactic equilibrium (DELWP 2017b).

3.7. Biodiversity Conservation Strategy

The draft *Northern and Western Geelong Growth Areas Biodiversity Conservation Strategy* (City of Greater Geelong 2023b) identifies 'opportunity areas' for additional biodiversity protection and restoration within the Creamery Road Precinct. The unnamed tributary that runs into Cowies Creek near the eastern end of the conservation area has been identified as opportunity Area 3 of the Creamery Road Precinct. The primary purpose of opportunity areas is not for conservation, although they may contribute to biodiversity protection and enhancement (City of Greater Geelong 2023b). The intention of Area 3 is to look for opportunities to:

- Create and enhance potential movement and foraging habitat for GGF within the tributary connected to the conservation area through the design of stormwater infrastructure and sympathetic management of the drainage line
- Restore and/or retain native grasslands
- Improve water quality and stream flow outcomes for Cowies Creek through the tributary
- Provide biodiversity linkages across the Growth Area

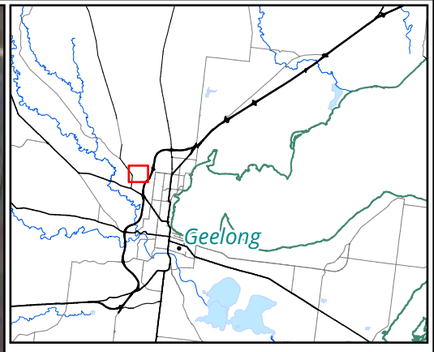
Area 3 may provide an opportunity for habitat creation and enhancement for GGF, connecting through to the conservation area. The potential development of this tributary of Cowies Creek in a way that supports movement or provides refuge for GGF may help to support the long-term viability of the Cowies Creek metapopulation. The tributary itself is unlikely to directly provide breeding habitat, primarily due to its steep and degraded attributes, and lack of standing water. However, habitat improvement in this area may provide additional suitable foraging and dispersal habitat for GGF complimentary to the primary habitat within the conservation area. Restoration and management of this area may assist in enhancing biodiversity more broadly and provide habitat for other native fauna including common frogs and reptiles, birds, and invertebrates. In general, actions to enhance biodiversity values of the unnamed tributary should follow the recommendations provided by this CMP, including:

- Weed control and removal of overabundant vegetation.
- Terrestrial habitat enhancement guided by recommendations in Section 3.2.4.
- Retain the existing scattered surface and embedded rocks present along the tributary, and supplement to provide basking, shelter and overwintering GGF habitat if necessary.
- Restoration of native vegetation guided by recommendations in Section 4.6. Revegetation may provide additional benefits of bank stabilisation and erosion prevention.

3.8. Artificial lighting

Light pollution from artificial lighting can negatively impact frogs by interfering with local movements, dispersal, foraging and abundance of invertebrate prey species(DCCEEW 2023). Lighting within the conservation area and at Evans and Bluestone Bridge Road crossings should be avoided or minimised where possible, and the impact of lighting from nearby developments must be carefully considered. No artificial lighting is proposed within the conservation area.

Lighting from nearby developments and open spaces should utilise directional lighting and be designed with consideration of minimising light dispersing into the conservation area, as per the *Growling Grass Frog Crossing Design Standards* (DELWP 2017b).



Legend

- Creamery Road precinct boundary
- Cowies Creek Conservation Area
- Stormwater treatment asset/ Bioretention basin
- Indicatave GGF wetland location
- 30m wetland buffer

Informal creek crossing

- Infromal creek crossing - retained
- Infromal creek crossing - proposed to be removed

Growling Grass Frog

- EHP Records (2019)

Habitat zone (EVC)

- 0068 Creekline Grassy Woodland
- 0132 Plains Grassland / 0132_61 Heavier-soils Plains Grassland

Figure 4.Overview Indicative locations of Growling Grass Frog Wetlands

0 50 100 150 200 250

Metres

Scale: 1:6,500 @ A3

Coordinate System: GDA2020 MGA Zone 55

N

biosis

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Date: 24 June 2024 ,
Prepared for: CT, Prepared by: MK, Last edited by: mknudsen
Layout: 38542_F4_wetlands
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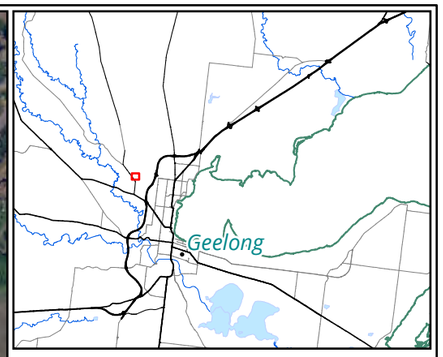

Legend

- Creamery Road precinct boundary
- Cowies Creek Conservation Area
- Stormwater treatment asset/ Bioretention basin
- Indicatave GGF wetland location
- 30m wetland buffer

Informal creek crossing

- Infromal creek crossing - retained

Growling Grass Frog

- EHP Records (2019)

Habitat zone (EVC)

- 0068 Creekline Grassy Woodland

Figure 4.1 Indicative locations of Growling Grass Frog Wetlands

0 20 40 60 80 100

Metres

Scale: 1:2,500 @ A3

Coordinate System: GDA2020 MGA Zone 55

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Date: 24 June 2024 ,
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Legend

- Creamery Road precinct boundary
- Cowies Creek Conservation Area
- Indicatave GGF wetland location
- 30m wetland buffer

Informal creek crossing

- Infromal creek crossing - retained
- Infromal creek crossing - proposed to be removed

Growling Grass Frog

- EHP Records (2019)

Habitat zone (EVC)

- 0068 Creekline Grassy Woodland
- 0132 Plains Grassland / 0132_61 Heavier-soils Plains Grassland

Figure 4.2 Indicative locations of Growling Grass Frog Wetlands

0 20 40 60 80 100

Metres

Scale: 1:2,500 @ A3

Coordinate System: GDA2020 MGA Zone 55

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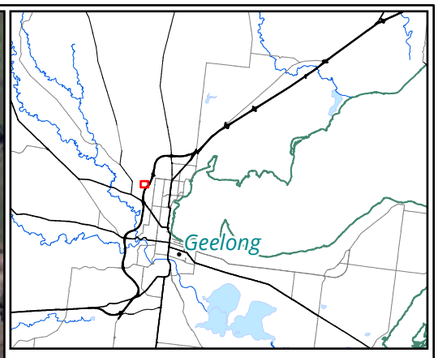
Acknowledgements: VicMap BaseMap©State of Victoria



Legend

- Creamery Road precinct boundary
- Cowies Creek Conservation Area
- Indicatave GGF wetland location
- 30m wetland buffer

Informal creek crossing

- Infromal creek crossing - retained
- Infromal creek crossing - proposed to be removed

Growling Grass Frog

- EHP Records (2019)

Habitat zone (EVC)

- 0068 Creekline Grassy Woodland
- 0132 Plains Grassland / 0132_61 Heavier-soils Plains Grassland

Figure 4.3 Indicative locations of Growling Grass Frog Wetlands

0 20 40 60 80 100

Metres

Scale: 1:2,500 @ A3

Coordinate System: GDA2020 MGA Zone 55

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Matter: 38542,
Date: 24 June 2024 ,
Prepared for: CT, Prepared by: MK, Last edited by: mknudsen
Layout: 38542_F4_wetlands
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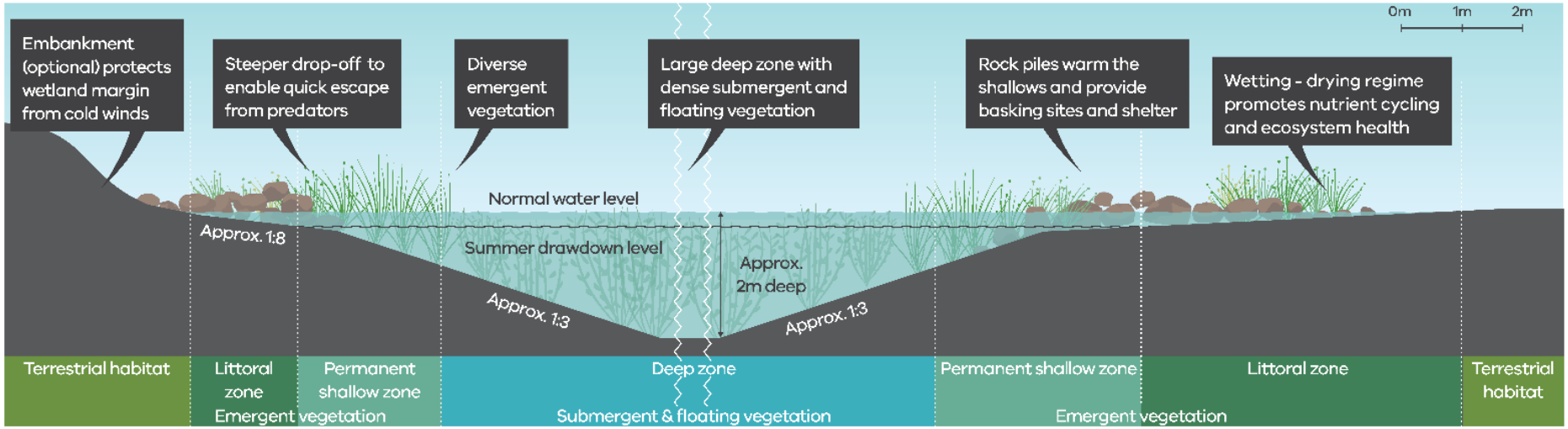
Figure 5 Example of suitable GGF wetlands design, taken from the *Growling Grass Frog Habitat Design Standards Melbourne Strategic Assessment* (DELWP 2017a)



4. Management plan

Key actions identified in this CMP as being critical for the successful management of Cowies Creek for GGF are as follows:

- Protection of Cowies Creek and its surrounding terrestrial habitat
- Appropriate management of aquatic and terrestrial habitat
- Ongoing population and habitat monitoring to provide valuable information on the success of the management plan and identify any additional management that might be required.

4.1. GGF population monitoring

4.1.1. Surveys

Monitoring during the breeding season for GGF is considered essential to determine the efficacy of the actions taken to protect this species. Monitoring the GGF population within the conservation area will occur in the first breeding season (November to December) after the approval of this CMP by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW). Monitoring will record the number of individuals observed from spotlight counts. Numbers should be considered a lower estimate only as it is unlikely that all individuals will be seen or heard calling during surveys. Whilst the site visit conducted by Biosis in 2023 confirmed suitable habitat, the population has not been monitored since the 2019 breeding season. Baseline monitoring data on the distribution and abundance of GGF within Cowies Creek is therefore recommended to be collected during the 2024 breeding season and the success of that breeding determined in early 2025. Repeated monitoring in subsequent years and every year for the duration of this CMP will also be required to evaluate the persistence, abundance and population fluctuations of GGF.

A monitoring event includes four GGF surveys over four nights to document the occurrence and abundance of GGF within Cowies Creek, or later in the created wetlands. The results of these surveys will be compared to the original baseline surveys (first monitoring event following implementation of this CMP) and those of the previous monitoring events. Two surveys will be undertaken during the GGF breeding season (typically November to December) and two during the emergence and dispersal of metamorphs (typically January to February). Any observations of GGF during monitoring for vegetation condition and during inspections by the landowner or the City will also be recorded.

Surveys will be conducted by at least two appropriately experienced personnel under suitable conditions. Suitable conditions are defined as times when daytime air temperatures reach greater than 15ºC, with moderate to no wind, and when night time air temperatures greater than 12ºC, with moderate to no wind (DEWHA 2009). Surveys will use a combination of call playback and night time visual encounter surveys. Small water bodies (<50 metres at greatest length) should be covered in a period of about one hour, including searches of banks and emergent vegetation. Larger water bodies (>50 metres) should be searched by sampling subsets of the whole waterbody in a systematic manner. If the length of Cowies Creek is unable to be surveyed over one night, monitoring points may be established and should target the open pools of water. Two late summer surveys will be conducted to ascertain whether GGF successfully bred at the site. Survey for tadpoles and metamorphs of GGFs in late summer (January to February). Survey will use dip-netting and overnight bait-traps if dip-netting fails to record individuals. Surveys will sample all aquatic habitat suitable for GGF tadpoles. Surveys will occur at up to 20 sample sites (in Cowies Creek and created GGF wetlands) depending on the extent of waterbodies at the time.

If possible, the downstream reaches of Cowies Creek where GGF have been recently recorded (see Figure 3) should be monitored in conjunction with the conservation area, to assess any source (or sink) effects of the conservation area and management actions. Biosis notes that this is beyond the scope of this management plan which applies to land within the conservation area, however annual population reporting will consider recent GGF records along Cowies Creek from biodiversity databases, or any information on GGF downstream in Cowies Creek from local environmental groups, which may assist to inform the metapopulation condition more broadly.

4.1.2. Population fluctuations

An assessment of any trends in the population size or extent should be documented in the annual report (Section 4.9). If the population declines without an apparent reason, or explanation as to how it may recover, a review of the CMP and ecological management parameters should occur. One or more of following triggers warrants a review of this CMP and may require adaptive management interventions:

- An apparent decline in the adult population abundance by 50% or more from one year to the next.
- Medium to long term incremental declines in adult population abundance, for example 2-3 years of general population decline of 20% or more.
- No evidence of breeding success (detection of tadpoles and/or metamorphs in late summer or early autumn) in any given year.
- Significant deterioration of water quality and/or aquatic vegetation health from one year to the next, as determined by ongoing habitat monitoring.

The population dynamics of GGF are largely driven by stochastic environmental events (e.g., rainfall, disease), which may in turn be exacerbated by the effects of habitat destruction and fragmentation (Heard et al. 2004). Sub-populations of GGF often function as part of a meta-population (Hale et al. 2013), where a local population may go extinct, but is later recolonised through dispersal from nearby source populations (Robertson et al. 2002, Heard et al. 2004). GGF relies on the availability of permanent waterbodies for survival and reproduction (Clemann and Gillespie 2012). Therefore, altered hydrological regimes and inter-annual variation in rainfall influence reproductive success, and hence population numbers (Heard et al. 2004).

Furthermore, the detectability of GGF is known to be highly variable both within and between sites. For example, spotlight surveys of GGF populations in Merri Creek, Victoria, have yielded within-site counts ranging from zero to 45 individuals (Heard et al. 2004). Such variability can be attributed to the sudden emergence of metamorphs in large numbers, resulting in relatively high population counts. Natural inter-annual population variation, coupled with variation in the success of population monitoring between years, makes it problematic to detect a legitimate and significant population decline.

Taking a precautionary approach, a population decline exceeding 50 percent relative to any previous year (provided that sufficient baseline data is available for comparison) would be considered significant and warrant a review of this CMP. This 50 percent threshold is set with the view that GGF populations are known to fluctuate considerably between years in accordance with environmental conditions, particularly with regard to the timing and intensity of rainfall (Robertson et al. 2002, Heard & West 2016). In light of past monitoring results, a 50 percent decline threshold is high enough to account for natural variation in population size between years, yet is conservative enough to allow sufficient breadth to halt a perceived population decline. Additional triggers that may warrant adaptive management intervention have been incorporated to detect longer term population decline that may not be detected by the 50 percent decline threshold, as recommended by DEECA.

If GGF are not detected over three seasons, is it likely that the population has become locally extinct based on existing understanding of the species ecology (Koehler et al. 2015). The City may be required to consult with the regulators to determine the appropriate response in this instance, such as securing an offsite offset.

4.2. Chytrid fungus management

The City is committed to implementing strict hygiene protocols during any activities to avoid the spread of chytrid fungus when working in and nearby the conservation area. The *Hygiene protocols for the control of diseases in Australian frogs* (Murray et al. 2011) can be used as a suitable guide. Relevant points should be incorporated into the site-specific CEMP and contractor inductions to limit biosecurity risks and reduce the spread of pathogens and invasive weeds. It is important to note that precautions are aimed at minimising potential for infection of all locally occurring frog species as the pathogen may be spread between species.

Although the risk of transmission from vehicles is "generally unlikely to be a problem" (Murray et al. 2011), it should be considered when driving through any water body which could potentially be used by amphibians. As many frog species are known to breed in ephemeral roadside puddles etc., it is important to consider this risk whenever a vehicle is driven through large puddles which leave mud, debris or water under the car. If a vehicle requires cleaning, this should be undertaken using a high pressure hose, fitted with a soap dispenser (filled with a Benzalkonium chloride solution or equivalent). Murray et al (2011) provides recommended concentrations of benzalkonium chloride required to sterilize for chytrid. Care should always be taken to avoid water run off entering nearby waterways. Vehicle cleaning should not be undertaken in the field and chemical/debris runoff should be considered when cleaning a vehicle.

A CEMP will be prepared for construction activities within the conservation area, including the construction of GGF wetlands. The CEMP should include specific hygiene measures to minimise risk of introducing/spreading chytrid fungus and other diseases. The '*DELWP requirements for Construction Environmental Management Plans under the Melbourne Strategic Assessment*' may be used as a guide (DELWP 2020).

The City have adopted the following measures to avoid and reduce the spread of chytrid fungus:

- Avoid the importation of soils and organic materials into the conservation area as much as practical.
  - Building materials and landscaping substrates required for wetland construction should be sourced from repurposed materials in the precinct, or locally from a reliable quarry or supplier following strict hygiene protocols, to ensure materials are free of weeds, pests and diseases.
  - Rock piles for enhancing GGF habitat will be sourced locally where possible, including rocks removed during earthworks in the growth areas should be repurposed in the conservation area. Sourcing rocks from local development would only be applicable to supplementing rocky habitat along Cowies Creek, and would not be possible for wetlands, as wetlands must be established prior to development works commencing. Rocks should be free of soils and organic materials, and dried prior to installation.
- Clean vehicles coming on site and/or ensure vehicles have been washed down immediately prior to coming into the conservation area. If driving on site is required, vehicle wheels will be disinfected between waterbodies.
- Clean and disinfect equipment between waterbodies to minimise the risk of introducing or spreading chytrid fungus.
- Clean, disinfect and dry footwear between waterbodies.

- Any salvage procedures to be conducted in accordance with best practice hygiene protocols, and minimise direct handling of frogs.
- Incorporate GGF species information and appropriate hygiene protocols into induction materials for any personnel working within the conservation area.

4.3. Salvage protocol

For high impact works in the conservation area, a suitably qualified and experienced zoologist should be engaged to salvage and relocate any frogs that may be impacted by the works. This may be required for activities detailed in this CMP such as:

- Removal of dense emergent vegetation and weeds within Cowies Creek
- Construction of infrastructure directly impacting primary habitat (e.g. creek crossings, GGF wetlands)
- Ripping of rabbit warrens, if required
- Mechanical weed removal, if required
- Other high impact activities occurring in the vicinity of waterbodies that may impact GGF, such as installation of stormwater infrastructure.

The GGF salvage protocol will be incorporated into the site-specific CEMP, including induction material on the presence and identification of GGF within the conservation area, appropriate hygiene protocols and salvage measures to be implemented where impacts to GGF cannot be avoided. Salvage is not required for routine low impacts works such as targeted weed management or revegetation. Salvage must be undertaken under the appropriate permits issued by DEECA.

Salvage will be in accordance with the following salvage protocol:

- Salvage will be undertaken only by qualified zoologists
- Nitrile surgical gloves will be worn at all times when handling GGF
- Footwear/waders will be washed in disinfectant (e.g. Phytoclean or equivalent) at the beginning and end of each salvage day to prevent the introduction and/or spread of any diseases
- Active searching will be undertaken amongst potential refuge sites in the vicinity of the works on the day prior to works commencing
- Tadpoles will be captured using nets, while adult frogs will be captured by hand
- Frogs will be re-located near an appropriate refuge site, e.g. a reedbed or rock outcrop, in long grass with sufficient cover away from the area of works occurring
- Animals will be released as soon as practicable after capture, away from the disturbed area as deemed appropriate by the zoologist
- Individual animals will be retained in separate plastic bags between capture and relocation.

Salvage operations will take place prior to disturbance, such as earthworks, but as close as practical to periods of work activity. Timing will vary depending on season: during the cooler months when the frogs are essentially immobile, salvage could occur up to one week in advance of works; during the warmer months when the frogs are active, salvage will occur on the actual day when works are scheduled (i.e. immediately prior to the habitat being impacted). A long interval between salvage and construction may permit frogs to move back into the area.

Salvage will take into consideration seasonal behaviours of the species. GGF routinely hibernate during the cooler months of the year, so salvage will ideally be undertaken between September and April when GGF are active. However, in-stream works (eg. removal of weeds and overabundant vegetation) should ideally be avoided from October to March, the species peak active and breeding period.

If a frog(s) is detected during salvage operations prior to works occurring, or if it is considered the species could be using habitats within the impacted area, then active salvage during works will be conducted. This will involve actively searching soil, vegetation, and other ground debris for frogs immediately prior to, and during works.

If any frog(s) are discovered during other activities when a zoologist is not present and may be impacted by the works, activities should pause until a zoologist is contacted and present on site to supervise further activities. As such, is it important that personnel entering the conservation area are made familiar with the identification of GGF.

4.4. Fencing

Temporary protection fencing will be required during construction of wetlands to protect Cowies Creek and prevent frogs from entering the construction area. Fencing should be installed around the full perimeter of the works area, and may primarily act as sediment fencing. The sediment fencing will also act as 'frog-fencing' to deter frogs from entering the area. Fencing should be at least 400 millimetres high, and dug into the ground at least 100 millimetres.

Fencing should be installed prior to works occurring, and inspected daily for any damage. Permanent silt fencing should also be installed in the drainage or depression lines up slope from the GGF wetlands on the northern railway side of the creek to prevent and reduce contamination of GGF habitat.

4.5. Weed management actions

The management of weeds within the conservation area should be undertaken with the intent of managing for structure and function (i.e. habitat for GGF) rather than a return to pre-European settlement vegetation. It is acknowledged that the majority of the conservation area is dominated by introduced flora species, with a small number of discrete patches of native vegetation scattered along Cowies Creek (Ecology and Heritage Partners 2021). In saying that, a key objective should be to preserve existing ecological values, including remnant patches of native vegetation and restore, enrich and extend those as much as possible (see section 4.6).

The priority steps to implement are:

1. Undertake a detailed weed mapping assessment of the conservation area
2. Categorise each weed based on the groups outlined in this plan
3. Identify priority areas/objectives for weed control, that:
    - Preserve existing ecological values (i.e. patches of native vegetation, areas of valuable GGF habitat and other threatened species)
    - Target high threat weeds
    - Target new and emerging weeds before they become established
    - Target weeds that will prevent over shadowing of wetlands (i.e. woody weeds).

4. Develop an annual works plan that incorporates the results from the above assessments and prioritises accordingly.

The weeds are grouped into the following vegetation types and discussed below:

- Woody weeds
- Herbaceous weeds
- New and emerging weeds

4.5.1. Woody weeds

Elimination of all woody weeds

The following woody weeds have been recorded within the study area (noting a detailed flora survey has not been completed, there are likely to be more woody weed species present):

- African Box-thorn
- Cluster Pine *Pinus pinaster*

Woody weeds recorded on site should be eliminated appropriately and promptly. Any impact to native vegetation should be minimised during treatment of woody weeds. Woody weeds will be ideally controlled by being hand pulled. Extreme caution will be used if herbicides are used and any use will be minimised. Monitor for any re-sprouting or seedlings and eradicate. If Woody weeds are to be controlled using herbicides, then cut and paint or drill and fill techniques should be applied rather than broad herbicide application by way of spraying.

For extensive woody weed infestation, in the first instance material should be physically removed and any regeneration spot sprayed with the minimum amount of herbicide required to treat the infestation. Herbicide application can only occur in optimal conditions (i.e. little or no wind) and preferably in areas more than two metres away from open water. Cut and paint methods should be used in situations within two metres from open water. Ideally treatment would occur when nearby wetlands are dry.

New and emerging woody weeds

Monitoring for new and emerging woody weeds should be conducted throughout the year. Detailed records that capture the spatial data and density of new and emerging weeds should be kept. These records should, in turn, feed back into a detailed weed management plan. Refer to Information Sheet 8 – Standards for Management – Weeds (DELWP 2015) for more information. However, note that the general use of herbicides should be restricted as much as possible, particularly within two metres from wetlands and other waterbodies.

4.5.2. Herbaceous weeds

Terrestrial Growling Grass Frog habitat

The Victorian *Catchment and Land Protection Act 1994* (CaLP Act) lists noxious weeds and requires that all landowners take reasonable steps to prevent the spread of, eradicate and/or control noxious weeds on their land. The control of high threat and listed noxious weed species is a key management action that should be implemented across the study area.

Beyond the bed and banks of Cowies Creek, the terrestrial vegetation is largely dominated by introduced flora species including pasture grasses and high threat weeds such as Serrated Tussock. The overall objective within GGF terrestrial habitat is to maintain the vegetation so that it meets requirements listed in Section 3.2.4. Herbaceous species that put on large biomass should be managed so that they do not adversely impact on GGF habitat. This includes monitoring and management of Toowoomba Canary Grass and Kikuyu that have been recorded in the study area and should also apply to species that create similar dense structures. Preference should be given to the retention of tussock grasses and short herbaceous species.

High threat weeds should be treated before they have flowered and set seed. Impacts to native vegetation should be minimised during treatment. As with woody weeds, preference should be given to mechanical or hand removal of high threat herbaceous weeds. Residual herbicides should not be used near GGF aquatic habitat. If non-residual herbicides must be used, their use will be minimised and every available option to reduce the potential toxicity to amphibians of the product used should be taken (e.g. through use of Cyndan Glyphocyde 360 'Frog Friendly' or Roundup Biactive, in place of their more common and more toxic counterparts).

Aquatic Growling Grass Frog habitat

Weed control within aquatic habitat should also be strategic so that large areas of weeds that also provide habitat are not removed without an adequate revegetation plan to re-establish GGF habitat in a timely manner. Priority species to target during weed control activities include:

- Spiny Rush
- Lesser Reed-mace *Typha latifolia*.

Emergent vegetation such as these species can be detrimental to GGF habitat (Heard et al. 2010). This also applies to native species including Common Reed *Phragmites australis* that can be invasive, choke out wetlands, provide excess shade and outcompete more beneficial species such as submerged herbs that are important for GGF.

New and emerging herbaceous weeds

Monitoring for new and emerging herbaceous weeds should be conducted throughout the year and any new and emerging herbaceous weeds eliminated. This should include any noxious weeds listed under the CaLP Act and any other weeds that should be considered high threat in the EVCs present.

4.6. Plains Grassland restoration

Three patches of native vegetation will be retained by the conservation area, as identified in the draft NVPP (Biosis Pty Ltd 2023) (see Figure 4). Additional areas for revegetation and restoration of native vegetation are detailed in the Cowies Creek LMP.

The following priority tasks should be undertaken to restore remnant patches of Plains Grassland EVCs:

- Identify and map the extent of Plains Grassland within the study area (see maps in Ecology and Heritage Partners 2021).
- Assess the condition (i.e. the quality) of each remnant patch and prioritise restoration of:
  - Patches that contain threatened species.
  - Higher quality remnant patches.

  - Larger remnant patches.
- Identify major threats to each patch of native vegetation.
- Control all noxious and high threat weeds within remnant vegetation.

Restoration of native grasslands should be undertaken with a holistic approach by applying effective and timely weed control, reducing soil disturbance as much as possible, managing biomass and through the implementation of a range of regeneration techniques: ecological burning and supplementary plantings (also referred to as enrichment planting). The most efficient and ecologically beneficial method to encourage natural regeneration is the application of an ecological burning regime. Natural regeneration should be monitored to ensure biodiversity is maintained. These methods are described below.

Ecological burning

The natural disturbance mechanism that would control the accumulation of biomass in grassland ecosystems is fire. The timely use of fire also has significant weed control benefits as the seed production from weedy annual grasses can be efficiently destroyed. Fire also stimulates actively growing plant material which provides a clear target for herbicide application. It removes any dead material produced by control works, provides opportunities for indigenous species to recolonise areas subject to control works and kills or disadvantages some weeds and their propagules. The use of fire is therefore an important weed control management action. Fire can also stimulate weed seed banks, which is also beneficial as long as management actions focus on post fire control works.

An ecological burn regime (subject to the City's approval) must include an appropriate inter-fire interval depending on seasonal conditions and biomass accumulation. A low-intensity mosaic approach to burning would be recommended.

Slashing

If ecological burning is inappropriate, then a strategic slashing or mowing program could be implemented to manage weeds and reduce biomass levels, noting this method is less desirable compared with burning. Slashing activities should be minimised outside of the GGF active period between September and April.

To reduce soil disturbance and spread of weed seeds and other propagules within areas of Plains Grassland, mowing should only be undertaken when soils are dry and hard and weed species do not support any seed. Indigenous species sensitive to repeated mowing, should be protected from mowing. It should also be undertaken once native seed has dropped.

Mowing is more likely to promote the spread of exotic species and have a negative impact on biodiversity values while fire, being the natural disturbance mechanism, will have a negative impact on the abundance of weeds and benefit the indigenous species present.

There is some potential for biomass control to negatively affect individual GGF through direct mortality (killed during slashing or burning) or indirectly (increased predation from being exposed following removal of vegetation). However, this is likely to be a relatively low risk and is more than offset by the increased improvements in habitat quality. To reduce this risk, no more than 50% of the total area should be burnt or slashed in any one year. This will provide a protected area where biomass control has not been undertaken and hence be a fire refuge for fauna such as GGF.

Revegetation and direct seeding

Direct seeding with local wallaby-grasses and Kangaroo Grass can also be used to manage weed invasion. This method should be considered in areas immediately adjacent to Plains Grassland and in areas that are currently low in groundcover.

A revegetation plan should be developed to determine appropriate species for the study area consistent with EVC 132_62 *Heavier soils* Plains Grassland. Seed should be of local provenance. Following weed control, tubestock planting or applying Kangaroo Grass thatch are effective ways of establishing native vegetation.

Appendix C (Table 4 provides a list of plant species that could be used in revegetation works within areas of Plains Grassland being restored. The species list is based on the DEPI benchmark for Heavier-Soils Plains Grassland and is tailored for local conditions. Other indigenous species can be added to this list if local material is available.

Table 5) provides a list of plant species that could be used in revegetation works within areas of Plains Grassland being restored. The species list is based on the DEECA benchmark for Heavier-Soils Plains Grassland and is tailored for local conditions. All tubestock should be sourced from locally collected seed. Ensure that no weeds are introduced via tubestock. Other indigenous species can be added to this list if local material is available.

4.7. Adamson's Blown-grass

Given that the species is assumed present within suitable habitat in the conservation area, management actions for Adamson's Blown-grass have been incorporated into this CMP to ensure compatibility for both GGF and Adamson's Blown-grass. Areas of suitable or potential habitat include all mapped areas of Creekline Grassy Woodland (EVC 68) along the Cowies Creek corridor (see Section 2.3, Figure 4).

Altered hydrology has been identified as a primary threat to the species recovery (DSE 2010). The potential indirect impacts of development on hydrology are addressed through the City's commitment to minimise the indirect impacts of the development on protected matters associated within waterways, riparian areas and wetlands, including Adamson's Blown-grass, as well as protection and management of potential Adamson's Blown Grass habitat as detailed by this CMP (Open Lines & Biosis 2023).

Other key threats relevant to the conservation area and addressed in this CMP include: weed invasion, grazing and habitat destruction. The following list provides management recommendations for the protection of Adams Blown-grass populations and habitat in response to those threats:

- Maintain the natural hydrological flows as much as practicable.
- Upon implementation of this CMP, exclude grazing from areas of suitable habitat which includes wetlands, stream beds and banks (including along ephemeral watercourses). This is recommended to occur as soon as practical prior to precinct development, on any properties that are presently grazed.
- Priority weed control of salt tolerant competitor species which include: Tall Wheat-grass *Thinopyrum obtusiflorum* and Tall Fescue *Festuca arundinacea.*
- Monitor for increased weed cover following grazing exclusion and implement a weed control strategy promptly to retain desirable habitat. Contractors engaged for weed control should be suitably experienced and made aware of suitable habitat for Adamson's Blown-grass.
- Protect stream banks from erosion through the revegetation with indigenous species (in conjunction with GGF guidelines provided in this report, using suitable species recommended in Appendix B).

4.8. Schedule of management actions

Actions required for the implementation of the CMP are summarised in Table 2, including the responsible stakeholders, to be confirmed in further consultation with the City, and likely timing of each action. Measurable outcomes have been identified for each management action, and actions apply to land within the conservation area. Monitoring and management actions should be undertaken for both Cowies Creek and the created GGF wetlands by suitably qualified persons. Most items are recommended to be undertaken immediately, prior to residential development or wetland construction commencing. This will assist in establishing a quantitative and current baseline for habitat quality, relative abundance and distribution of GGF, and improving habitat quality within the conservation area. This is important as the last targeted surveys were undertaken four years ago in 2019. The frequency of actions is recommended based on general ecological understanding of flora and fauna lifecycles and designs of other relevant CMPs.

Additionally, a detailed site-specific CEMP is required for any works within the conservation area, including construction of the proposed GGF wetlands, or within the Creamery Road Precinct more broadly. Due to the topography of the site, any construction works have the potential to negatively impact fauna habitat within and surrounding Cowies Creek. The slopes surrounding Cowies Creek are relatively steep and construction works nearby are likely to result in runoff, sedimentation, and degrade nearby habitat if not managed appropriately. The CEMP must comply with the Environment Protection Authority (EPA) Guidelines and should align with this CMP where appropriate. Consideration must be given to best practice erosion and sediment control in specific relation to mitigating impact to GGF. The extent of the conservation area should be established as a strict 'no-go zone' for the duration of nearby development works, and frog exclusion/sediment fencing used during wetland construction to exclude frogs and minimise runoff. Biosis recommends that a specialist experienced in managing GGF impacts be consulted during the preparation of the CEMP and to ensure consistency with this CMP.

Table 2 Summary of management and monitoring actions required for the implementation of the Cowies Creek GGF CMP

Management action/commitment	Frequency	Method for implementation	Responsibility for approval	Responsibility for delivery	Timeline for delivery	Measurable outcomes
GGF wetland creation • Construction and maintenance of GGF off-line wetlands as per habitat creation recommendations in Section 3.2, aligning with the *Growling Grass Frog Habitat Design Standards Melbourne Strategic Assessment* (DELWP 2017a).	Once.	Design and construction by suitably qualified personnel.	City of Greater Geelong & responsible authority.	City of Greater Geelong & developer works.	Unless otherwise approved in writing by the Responsible Authority, GGF wetlands will be constructed at least six months prior to urban development works commencing.	• GGF wetlands constructed within the Cowies Creek conservation area as per habitat creation recommendations in Section 3.2 (Table 1), aligning with the *Growling Grass Frog Habitat Design Standards Melbourne Strategic Assessment* (DELWP 2017a). • Created wetlands managed in accordance with this CMP.
Water quality and habitat monitoring • Water quality monitoring of wetlands as per targets in Table 1. • Water level monitoring of wetlands as per targets in Table 1. • Terrestrial and aquatic vegetation including common species, percent cover and vegetation structure. • Record percent cover of trees and shrubs. • Record percentage and types of terrestrial refugia (e.g. rocks/logs). • Record presence of rubbish or other pollution.	Four times annually (every season) for the first two years following wetland establishment. Biannually in spring and autumn before or after year 2 of wetland construction. Conduct opportunistic habitat monitoring during	Field based surveys.	City of Greater Geelong & responsible authority.	City of Greater Geelong &/or appointed ecologist.	Immediately upon CMP approval.	• Documentation of the condition of GGF habitat condition based on visual assessments. • Target of >50% submergent/floating vegetation in the deep water zone and patches of emergent vegetation within two years of wetland creation. • Tree and shrub cover <10% each. Creekline Grassy Woodland (EVC 68) along Cowies Creek must have a combined tree canopy cover and shrub cover less than 10 percent.

Management action/commitment	Frequency	Method for implementation	Responsibility for approval	Responsibility for delivery	Timeline for delivery	Measurable outcomes
	population surveys.					• Appropriate species composition maintained (see Section 3.2). • Remove and replace dead or dying plants as required. Revegetate areas to the appropriate densities. • Maintain water levels in the created GGF wetlands, including deep water zone >1.5 m and naturally fluctuating littoral zone. Water levels within 80% of targets. • Maintain water quality in created wetlands as per targets in Table 1. Monitor water quality in in Cowies Creek to identify existing conditions and any fluctuations or degradation from existing conditions.
GGF population monitoring • Undertake monitoring of existing GGF population within Cowies Creek. • Undertake monitoring of constructed wetlands following their establishment. • Conduct surveys in accordance with the *Survey Guidelines for Australia's Threatened Frogs* (DEWHA 2010).	Twice during breeding season (typically November - December), and twice in late summer (January to February).	Field based surveys.	City of Greater Geelong & responsible authority.	City of Greater Geelong &/or appointed ecologist.	Immediately upon CMP approval.	• Monitor population for a minimum of 10 years to determine if aims of the conservation area are met (see Section 1.1). Monitoring will assist in documenting outcomes of the breeding season each year and associated population fluctuations. • No significant reduction in GGF population estimate of

Management action/commitment	Frequency	Method for implementation	Responsibility for approval	Responsibility for delivery	Timeline for delivery	Measurable outcomes
						more than 50% in comparison to any previous year, ongoing evidence of breeding success, and no longer term declines in population (see Section 4.1). • Survey for tadpoles and metamorphs at the end of breeding season using dip-netting and overnight bait-traps if dip-netting fails to record individuals to evaluate breeding success.
Control and monitor pest species • Aquatic pests: monitor pest species within the created wetlands, particularly Eastern Gambusia. • Terrestrial pests: remove rabbit warrens and fox dens through fumigation and hand collapse. Incidental searches during all field activities.	Every three months. Combine with habitat and water quality monitoring if possible. Timing to respond post flooding where off-stream habitats are reconnected (1% AEP).	Field based surveys.	City of Greater Geelong & responsible authority.	City of Greater Geelong &/or appointed ecologist.	Within one month of GGF wetland establishment	• No establishment of pest species within the created wetlands. • If predatory fish are found in created wetland(s), drain wetland(s) outside of the GGF breeding season when few, if any eggs, tadpoles and metamorphs would be expected in the wetlands. Responsive management plan to sequentially dewater and re-instate permanent off-stream wetlands that have become infested with invasive micro-predatory species. • In the event of major floods when wetlands or Cowies Creek overflow, conduct an
	Opportunistically as required.	Field based surveys, on-ground management.	City of Greater Geelong & responsible authority.	City of Greater Geelong &/or appointed contractor & ecologist.	Immediately upon CMP approval.	

Management action/commitment	Frequency	Method for implementation	Responsibility for approval	Responsibility for delivery	Timeline for delivery	Measurable outcomes
						additional pest survey once water has receded. • Reduce abundance of terrestrial predators within the conservation area. No fresh ground disturbance by pest animals (particularly rabbits) observed. • No active rabbit warrens or fox dens within the conservation area.
Existing habitat improvement • Remove areas of over abundant emergent vegetation as required. • Manage weeds as required (see below). • Increase rock piles around the margins of Cowies Creek and in the shallows. • Prune large Pine trees growing in the Cowies Creek corridor. • Maintenance of creek underpasses at Bluestone Bridge and Evans Road including removal of litter and overabundant vegetation or other debris choking the passages.	Pine tree removal and increased rocky areas once upon CMP approval. Weed management and removal of over abundant vegetation opportunistically as needed, following recommendations from habitat monitoring.	On-ground management.	City of Greater Geelong & responsible authority.	City of Greater Geelong &/or appointed contractor.	Immediately upon CMP approval, and opportunistically as needed.	• Existing habitat to be maintained as suitable for GGF and overall improvement in habitat quality by controlling weeds, reducing shading from scattered Pine trees and African Boxthorn, and controlling over abundant emergent vegetation as it progresses. • Provide additional rocky habitat along the edges of Cowies Creek (target of 20 – 50%) for improved thermoregulation, basking and shelter sites which are currently limited. • Weed management as summarised below.

Management action/commitment	Frequency	Method for implementation	Responsibility for approval	Responsibility for delivery	Timeline for delivery	Measurable outcomes
Weed monitoring and management • Undertake a detailed weed mapping assessment of the conservation area. • Identify priority areas/objectives for weed control. • Conduct weed control in priority areas as required, preference should be given to mechanical or hand removal of high threat weeds. • If non-residual herbicides must be used, apply minimal amounts necessary and use non-toxic options (e.g. through use of Cyndan Glyphocyde 360 'Frog Friendly' or Roundup Biactive) only during no/low wind conditions, >2 m from aquatic habitat. • Undertake weed management in accordance with plants detailed in Section 4.5.	Undertake detailed weed mapping upon CMP approval, during first monitoring event. Monitoring biannually in spring and autumn. Weed management ongoing as necessary, biannually at minimum.	Field based surveys, on-ground management.	City of Greater Geelong & responsible authority.	City of Greater Geelong &/or appointed contractor & ecologist.	Immediately upon CMP approval.	• No mature woody weeds present within conservation area (<< 1% cover) after one year. • Herbaceous weed cover to not exceed current levels. • Minimise off-target species damage (avoid all native plants and herbicide input into creek/wetlands). • Record and control any woody weed regeneration/re-colonisation.
Adamson's Blown-grass suitable habitat management • Upon implementation of this CMP, exclude grazing from areas of suitable habitat which includes wetlands, stream beds and banks (including along ephemeral watercourses • Priority weed control of salt tolerant competitor species including Tall Wheat-grass and Tall Fescue. • Monitor for increased weed cover following grazing exclusion and	As above - undertake detailed weed mapping upon CMP approval, during first monitoring event. Monitoring biannually in spring and autumn.	Field based surveys, on-ground management.	City of Greater Geelong & responsible authority.	City of Greater Geelong &/or appointed contractor & ecologist.	Immediately upon CMP approval.	• Maintain suitable habitat for Adamson's Blown-grass. • Weed control targets as above, including gradual reduced cover of salt tolerant competitor species, and revegetation with indigenous species.

Management action/commitment	Frequency	Method for implementation	Responsibility for approval	Responsibility for delivery	Timeline for delivery	Measurable outcomes
implement a weed control strategy promptly to retain desirable habitat. • Protect stream banks from erosion through the revegetation with indigenous species.	Weed management ongoing as necessary, biannually at minimum. Grazing exclusion recommended to occur as soon as practical prior to precinct development, if any properties are currently grazed.					
Maintain terrestrial habitat • Mow any areas maintained as grassy habitat, avoiding the GGF active period between September and April, and areas of potential habitat for Adamson's Blown Grass. • Weed management as above. • Revegetate with native tussock-forming grasses and sedges following weed control as needed (see Section 4.6).	As required, may vary with seasonal conditions and rainfall.	On-ground management.	City of Greater Geelong & responsible authority.	City of Greater Geelong &/or appointed contractor.	As required.	• Approximately 50% of the 10 m buffer area maintained as low, grassy vegetation up to 10 centimetres high. • Tussock-forming grasses and sedges comprise up to 20% of the 10 m buffer area. • Creekline Grassy Woodland (EVC 68) along Cowies Creek must have a combined tree canopy cover and shrub cover less than 10 percent. • Remainder of terrestrial habitat maintained as low, open grassy habitat.

Management action/commitment	Frequency	Method for implementation	Responsibility for approval	Responsibility for delivery	Timeline for delivery	Measurable outcomes
Chytrid fungus management • Clean vehicles coming on site and/or ensure vehicles have been washed down immediately prior to coming on site. If driving on site is required, vehicle wheels will be disinfected between waterbodies. • Clean and disinfect equipment between waterbodies to minimise the risk of introducing or spreading chytrid fungus. • Clean and disinfect footwear between waterbodies. • Any salvage procedures to be conducted in accordance with best practice hygiene protocols, and minimise direct handling of frogs. • Develop and implement a site-specific CEMP addressing relevant biosecurity risks including actions to minimise the spread of weeds and diseases. • Incorporate GGF species information and appropriate hygiene protocols into induction materials for any personnel working within the conservation area.	Ongoing	All workers in the conservation area to carry/use disinfectant as needed.	City of Greater Geelong & responsible authority.	All personnel working in the conservation area.	Immediately upon CMP approval.	• Minimise the spread and likelihood of chytrid fungus infection.
GGF salvage and relocation • Qualified and experienced wildlife specialist/zoologist to be present during any works required inside the conservation area, such as removal of dense emergent vegetation within Cowies Creek or construction of infrastructure directly impacting	As required.	Field based surveys.	City of Greater Geelong & responsible authority.	City of Greater Geelong &/or appointed ecologist.	As required.	• Minimise mortality of GGF during works. • Individuals released as close as possible to capture location following works, in areas with suitable cover.

Management action/commitment	Frequency	Method for implementation	Responsibility for approval	Responsibility for delivery	Timeline for delivery	Measurable outcomes
primary habitat (e.g. creek crossings, GGF wetlands). • Captured frogs to be moved to nearest suitable habitat within Cowies Creek. • If any GGF are identified during other site activities, works should pause until a zoologist is present and commence under their supervision. • Conduct in accordance with the salvage protocol detailed in Section 4.3.						• Best-practice hygiene protocols followed during salvage activities to reduce the risk of spreading chytrid fungus.

4.9. Reporting

To document the management actions undertaken and reflect the progress of the conservation area, reports must be prepared by the appropriate person and submitted to the City and relevant authorities in a timely manner, for a minimum 10-year management period. Annual reports should be submitted no later than two months after the CMP approval anniversary date. Reporting is proposed as follows:

- **Habitat and population monitoring report** – one annual report summarising the results of habitat monitoring and population surveys as per Table 2. Report should also include any recommendations of new or adaptive management as required, and the report written by suitably qualified and experienced ecologists.
- **Maintenance activities report** – one annual report summarising maintenance activities undertaken within the conservation reserve, including weed mapping and management, revegetation works, slashing and pest control. Report should also include any recommendations for new or adaptive management as required.
- **Additional reports** (as needed) – any GGF salvage and relocation works undertaken within the conservation area including an overview of works undertaken, methods and results. One summary report may represent a series of consecutive salvage days from works undertaken.

4.10. Costs and funding source

It is proposed that the management, monitoring, rehabilitation, and public amenities within the conservation area will be funded via the Strategic Assessment's environmental mitigation levy. A summary of costs associated with implementation of this CMP has been prepared. Rates are based on the anticipated costs for the 2023/2024 financial year. Costs and assumptions are approximate only and subject to change.

Note that the fee estimates include only costs associated with the implementation of this GGF CMP and do not include costs of creation of wetlands, maintenance tracks, or other infrastructure such as fencing. No allowance has been made for additional technical investigations required to finalise the wetland design and locations, removing soil/other materials from site, cost escalation or inflation, or any other factors that may alter the estimated prices. The costs of GGF wetland creation, maintenance access tracks and other infrastructure will be included in the Cowies Creek LMP.

The frequency of adaptive management interventions such as draining and refilling wetlands, ecological burning, additional weed control, revegetation of planted native vegetation, and opportunistic or 'as needed' events such as weed management, pest control and GGF salvage have been estimated based on what might reasonably be required, but may change based on monitoring results and recommendations of what is actually required. These items are marked with an asterisk (*). Frequency and indicative fees are presented in Table 3 assume that 'year 1' commences with GGF wetland construction. Additional anticipated fees such as mileage and field costs have been estimated where necessary.

Table 3 High-level estimated fees for implementation of the Cowies Creek GGF CMP over 10 years

Action	Assumptions	Year 1		Year 2		Years 3-10	Indicative annual fee (ex. GST)								TOTAL
		Annual event frequency	Indicative annual fee (ex. GST)	Annual event frequency	Indicative annual fee (ex. GST)	Annual event frequency	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Monitoring and management activities															
Water quality and depth monitoring	2 people/1 day per event	4	$18,000	4	$18,000	2	$9,000	$9,000	$9,000	$9,000	$9,000	$9,000	$9,000	$9,000	**$108,000**
Habitat monitoring	2 people/2 days per event	4	$36,000	4	$36,000	2	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	**$216,000**
GGF population monitoring	2 people/1 night per event	4	$18,000	4	$18,000	4	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	**$180,000**
Pest species monitoring	2 people/1 day per event	4	$18,000	4	$18,000	4	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	**$180,000**
Weed monitoring	2 people/2 days per event	2	$18,000	2	$18,000	2	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	$18,000	**$180,000**
***Weed management**	Throughout conservation area	5	$150,000	4	$120,000	4	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000	**$1,230,000**
***Maintenance of terrestrial habitat (biomass control/slashing)**	1x year one initial removal of mature woody weeds	2	$127,000	2	$127,000	2	$127,000	$127,000	$127,000	$127,000	$127,000	$127,000	$127,000	$127,000	**$1,270,000**
***Pest animal control**	Ongoing quarterly control of high threat weeds	2	$27,000	2	$27,000	1	$13,500	$13,500	$13,500	$13,500	$13,500	$13,500	$13,500	$13,500	**$162,000**
***Plains Grassland restoration**	Approx. 50% of conservation area	2	$127,000	2	$127,000	2	$127,000	$127,000	$127,000	$127,000	$127,000	$127,000	$127,000	$127,000	**$1,270,000**
***GGF salvage and relocation**	1 warren per hectare	2	$27,000	2	$27,000	1	$13,500	$13,500	$13,500	$13,500	$13,500	$13,500	$13,500	$13,500	**$162,000**
Pine tree pruning	Reassess/as needed years 2-10	1	$7,500	0	$0	0	$0	$0	$0	$0	$0	$0	$0	$0	**$7,500**
Adaptive management (estimated frequencies only)															
***Re-planting of aquatic or terrestrial vegetation**	1 day tubestock approx. 0.82 ha (2 plants/m2)	0	$0	0	$0	2 (years 4 & 8)*	$0	$126,000	$0	$0	$0	$126,000	$0	$0	**$252,000**
***Ecological burning**	1 team/1 day per event	0	$0	0	$0	1 (year 3 & 7)*	$15,000	$0	$0	$0	$15,000	$0	$0	$0	**$30,000**
Reporting															
Habitat and population monitoring report	1 person/2 days per event	1	$4,000	1	$4,000	1	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	**$40,000**
Maintenance activities report	1 person/2 days per event	1	$4,000	1	$4,000	1	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	**$40,000**
GGF salvage report	1 person/1 day per event	2	$4,000	2	$4,000	1	$4,000	$1,800	$1,800	$1,800	$1,800	$1,800	$1,800	$1,800	**$24,600**

Action	Assumptions	Year 1		Year 2		Years 3-10	Indicative annual fee (ex. GST)								TOTAL
		Annual event frequency	Indicative annual fee (ex. GST)	Annual event frequency	Indicative annual fee (ex. GST)	Annual event frequency	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
***GGF CMP review/revisions**	1 person/2 days per event	0	$0	1	$4,000	1 (years 3, 6 & 9)	$4,000	$0	$0	$4,000	$0	$0	$4,000	$0	**$16,000**
Project management															
Project management	Estimated at 10% of total annual costs	NA	$67,000	NA	$40,000	NA	$37,000	$48,000	$35,000	$36,000	$37,000	$48,000	$36,000	$35,000	**$419,000.00**
Totals															
Total (ex. GST)															**$4,613,700**
Plus 15% contingency															**$692,055**
Total plus 15% (ex. GST)															**$5,305,755**
Total (inc. GST)															**$5,836,330**

*Estimated frequency/as needed action

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APPENDICES

Appendix A. Photos of the conservation area

Photo 1 **Eastern extent of the conservation area. Looking approximately east**

Photo 2 **Overview of the conservation area showing slopes. Looking approximately north-west**

Photo 3 **Overview of the conservation area showing floodplain and railway easement. Looking approximately north-east**

Photo 4 **Open water instream pools along Cowies Creek. Looking approximately north-east**

Photo 5 **Open water instream pools along Cowies Creek showing emergent vegetation and African Boxthorn. Looking approximately west**

Photo 6 **Example of over abundant emergent vegetation within Cowies Creek. Looking approximately west**

Photo 7 **Example of informal crossing along Cowies Creek with some scattered rock. Looking approximately north**

Photo 8 **Example of informal crossing along Cowies Creek with some scattered rock. Looking approximately north-west**

Photo 9 **Exotic Pine tree along Cowies Creek. Looking approximately east**

Photo 10 **Existing conditions of unnamed tributary draining into Cowies Creek. Looking approximately north-east**

Photo 11 Existing underpass of Cowies Creek at Evans Road. Looking approximately south

Photo 12 Existing underpass of Cowies Creek at Bluestone Bridge Road. Looking approximately south

Appendix B. Aquatic vegetation species list

This list of aquatic flora species is to be used for vegetation within the created GGF wetlands. They have been selected based on their value as GGF habitat, ease of cultivation and availability, adapted from the species listed in the *Growling Grass Frog Habitat Design Standards: Melbourne Strategic Assessment* (DELWP 2017a). The species listed here are adapted to ensure they are suitable for use within the Cowies Creek conservation area.

Table 4 Aquatic species suitable for GGF wetland creation (DELWP 2017a)

Species name	Common name	Lifeform*	Notes
Alisma plantago-aquatica	Water Plantain	E	Suitable for use throughout Geelong region.
Bolboschoenus caldwellii	Salt Club-rush	E	Suitable for use throughout Geelong region. Fast growing species suitable for brackish sites.
Carex appressa	Tall Sedge	E	Suitable for use throughout Geelong region.
Carex tereticaulis	Basket Sedge	E	Suitable for use throughout Geelong region.
Crassula helmsii	Swamp Crassula	E, S	Suitable for use throughout Geelong region. Fast growing species.
***Cycnogeton procerum* (formerly *Triglochin procera*)**	Common Water-ribbons	E, F, S	Suitable for use throughout Geelong region.
Eleocharis acuta	Common Spike-sedge	E	Suitable for use throughout Geelong region.
Eleocharis sphacelata	Tall Spike-sedge	E	Suitable for use throughout Geelong region.
Juncus amabilis	Hollow Rush	E	Suitable for use throughout Geelong region.
Juncus flavidus	Golden Rush	E	Suitable for use throughout Geelong region.
Machaerina arthrophylla	Fine Twig-sedge	E	Suitable for use throughout Geelong region.
Machaerina articulata	Jointed Twig-sedge	E	Suitable for use throughout Geelong region.
Machaerina juncea	Bare Twig-sedge	E	Suitable for use throughout Geelong region. Slow growing but can be grown by division.
Marsilea drummondii	Common Nardoo	E	Suitable for use throughout Geelong region.
Myriophyllum caput-medusae	Coarse Water-milfoil	E, S	Suitable for use throughout Geelong region. Can grow in quite deep water.
Myriophyllum crispatum	Upright Water-milfoil	E, F, S	Suitable for use throughout Geelong region.
Myriophyllum salsugineum	Lake Water-milfoil	E, S	Suitable for use throughout Geelong region. Grows best in brackish water

Species name	Common name	Lifeform*	Notes
Myriophyllum simulans	Amphibious Water-milfoil	E, F, S	Suitable for use throughout Geelong region.
Myriophyllum verrucosum	Red Water-milfoil	E, S	Suitable for use throughout Geelong region.
***Ornduffia reniformis* (formerly *Villarsia reniformis*)**	Running Marsh-flower	E, F	Suitable for throughout Geelong region.
Ottelia ovalifolia* subsp. *ovalifolia	Swamp Lily	E, S	Suitable for use throughout Geelong region. Only suitable for freshwater environments.
Persicaria decipiens	Slender Knotweed	E	Suitable for throughout Geelong region.
Potamogeton cheesemanii	Red Pondweed	S	Suitable for throughout Geelong region.
Potamogeton crispus	Curly Pondweed	S	Suitable for throughout Geelong region.
Potamogeton ochreatus	Blunt Pondweed	S	Suitable for throughout Geelong region.
Ruppia megacarpa	Large-fruit Tassel	S, F	Suitable for throughout Geelong region. Grows best in brackish water.
Ruppia polycarpa	Many-fruit Tassel	S, F	Suitable for throughout Geelong region. Grows best in brackish water.
Stuckenia pectinata	Fennel Pondweed	S	Suitable for throughout Geelong region. Grows best in brackish water.
Utricularia australis	Yellow Bladderwort	F, S	Suitable for throughout Geelong region.
Vallisneria australis	Eel Grass	S	Suitable for throughout Geelong region.

*E = emergent, F = floating, S = submergent

Appendix C. Plains Grassland species planting list

Table 4 provides a list of plant species that could be used in revegetation works within areas of Plains Grassland being restored. The species list is based on the DEPI benchmark for Heavier-Soils Plains Grassland and is tailored for local conditions. Other indigenous species can be added to this list if local material is available.

Table 5 Plains Grassland planting list

Species	Common Name
Sub-shrubs	
Eutaxia microphylla	Common Eutaxia
Pimelea curviflora	Curved Rice-flower
Pimelea glauca	Smooth Rice-flower
Pimelea humilis	Common Rice-flower
Podolepis linearifolia	Basalt Podolepis
***Dianella longifolia* var. *grandis* s.l.**	Glaucous Flax-lily
Senecio macrocarpus	Large-fruit Fireweed
Herbs	
Bulbine bulbosa	Bulbine Lily
Brachyscome dentata	Lobe-seed Daisy
Caesia calliantha	Blue Grass-lily
Calotis anthemoides	Cut-leaf Burr-daisy
Calotis scabiosifolia	Rough Burr-daisy
Calotis scapigera	Tufted Burr-daisy
Geranium retrorsum	Grassland Cranesbill
Haloragis heterophylla	Varied Raspwort
Linum marginale	Native Flax
Pelargonium rodneyanum	Magenta Stork's-bill
Plantago gaudichaudii	Narrow Plantain
Ptilotus macrocephalus	Feather Heads
Ptilotus spathulatus	Pussy Tails
Tricoryne elatior	Yellow Rush-lily
Triptilodiscus pygmaeus	Common Sunray
Veronica gracilis	Slender Speedwell
Vittadinia gracilis	Woolly New Holland Daisy
***Wahlenbergia capillaris* s.s.**	Tufted Bluebell

Species	Common Name
Wahlenbergia luteola	Bronze Bluebell
Graminoides	
Arthropodium minus	Small Vanilla-lily
Arthropodium strictum	Chocolate Lily
Rytidosperma carphoides	Short Wallaby-grass
Rytidosperma eriantha	Hill Wallaby-grass
Rytidosperma geniculata	Kneed Wallaby-grass
Rytidosperma laeve	Smooth Wallaby-grass
Rytidosperma penicillatum	Slender Wallaby-grass
Rytidosperma pilosum	Velvet Wallaby-grass
Rytidosperma racemosum	Stiped Wallaby-grass
Austrostipa bigeniculata	Kneed Spear-grass
Austrostipa mollis	Supple Spear-grass
Austrostipa scabra* subsp. *falcata	Rough Spear-grass
Austrostipa semibarbata	Fibrous Spear-grass
Carex breviculmis	Common Grass-sedge
Carex inversa	Knob Sedge
Deyeuxia quadriseta	Reed Bent-grass
Dianella revoluta	Black-anther Flax-lily
Lomandra micrantha	Small-flower Mat-rush
Microlaena stipoides	Weeping Grass
Poa sieberiana* var. *sieberiana	Grey Tussock-grass
Schoenus apogon	Common Bog-sedge
Scramblers/Climbers	
Cullen parvum	Small Scurf-pea
Desmodium varians	Slender Tick-trefoil
Glycine tabacina	Variable Glycine