GROWLING GRASS FROG CONSERVATION MANAGEMENT DISCUSSION PAPER

QUINN LAND DEVELOPMENT, OFFICER

(EPBC ACT PERMIT 2006/3001)

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ecocentric

Growling Grass Frog Conservation Management Discussion Paper: Quinn Land Development, Officer

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ACRONYMS / ABBREVIATIONS

TERM	DEFINITION
ALA	Atlas of Living Australia
BoM	Bureau of Meteorology
BCS	Biodiversity Conservation Strategy
CaLP Act 1994 (Vic)	Victorian Catchment and Land Protection Act 1994
CMP	Conservation Management Plan
Cwlth	Commonwealth
DCCEEW	Federal Department of Climate Change, Energy, the Environment and Water (formerly DAWE)
DEECA	Victorian Department of Energy, Environment and Climate Action (formerly DELWP)
DV	Development Victoria Pty Ltd (formerly Places Victoria, formerly VicUrban)
EPBC Act 1999 (Cwlth)	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
EVC	Ecological Vegetation Class
FFG Act 1988 (Vic)	Victorian Flora and Fauna Guarantee Act 1988
GGF	Growling Grass Frog
GIS	Geographical Information System (mapping system)
MNES	Matter of National Environmental Significance
MSA	Melbourne Strategic Assessment
P&E Act 1987 (Vic)	Victorian Planning and Environment Act 1987
PSP	Precinct Structure Plan
VBA	DEECA's Victorian Biodiversity Atlas
VQA	Vegetation Quality Assessment

GLOSSARY

TERM	DEFINITION
Bioregion	Biogeographical areas that capture the patterns of ecological characteristics in the landscape or seascape, providing a natural framework for recognising and responding to biodiversity values.
Bioregional Conservation Status (of an EVC)	A state-wide classification of the degree of depletion in the extent and/or quality of an Ecological Conservation Class (EVC) within a bioregion in comparison to the State's estimation of its pre-1750 extent and condition.
Canopy tree	See 'Native Canopy Tree'.
Diameter at Breast Height (DBH)	The diameter of the trunk of a tree measured over bark at 1.3m above ground level.
Drip Line	The outermost boundary of a tree canopy (leaves and/or branches) where the water drips onto the ground.
Ecological Vegetation Class (EVC)	A type of native vegetation classification that is described through a combination of its floristic, life form and ecological characteristics, and through an inferred fidelity to particular environmental attributes. Each EVC includes a collection of floristic communities (i.e. lower level in the classification that is based solely on groups of the same species) that occur across a biogeographical range, and although differing in species, have similar habitat and ecological processes operating.
EVC Benchmark	A standard vegetation quality reference point relevant to the vegetation type that is applied in habitat hectare assessments. Represents the average characteristics of a mature and apparently long-undisturbed state of the same vegetation type.
General Offset	A General Offset is required when the removal of native vegetation does not have a significant impact on any habitat for rare or threatened species.
General Habitat Unit	A General Habitat Unit is a measure of loss (and Gain in an Offset Site) in overall biodiversity value of native vegetation (both patch and scattered tree).
General Habitat Unit Offset target	A General Habitat Unit Offset target is that quantity of General Habitat Units that are to be secured to ensure that there is 'no net loss' in biodiversity value associated with the clearance of native vegetation (both patch or scattered tree). The General Habitat Units secured for an Offset target must meet the following attribute requirements: ○ *Minimum strategic biodiversity value score:* the strategic biodiversity value score of the Offset Credits must be at least 80 per cent of the strategic biodiversity value score of the native vegetation to be removed; ○ *Vicinity:* the offset must be located within the same Catchment Management Authority boundary or municipal district as the native vegetation to be removed.
Habitat Hectare	A site-based measure of quality and quantity of native vegetation that is assessed in the context of the relevant native vegetation type.
Habitat score	The score assigned to a Habitat Zone that indicates the quality of the vegetation relative to the EVC benchmark – sum of the site condition score and landscape context score usually expressed as a percentage or as a decimal fraction of 1.
Habitat Zone	A discrete area of native vegetation consisting of a single vegetation type (EVC) with an assumed similar quality. This is the base spatial unit for conducting a habitat hectare assessment.
High threat weed	Introduced plant species (including non-indigenous 'natives') with the ability to out-compete and substantially reduce one or more indigenous life forms in the longer term, assuming on going current site characteristics and disturbance regime.

TERM	DEFINITION
Location Category	There are three location categories that indicate the potential risk to biodiversity from removing a small amount of native vegetation. These location categories are identified by DEECA as follows: ○ Location 3 – includes locations where the removal of less than 0.5 hectares of native vegetation could have a significant impact on habitat for a rare or threatened species. ○ Location 2 – includes locations that are mapped as endangered EVCs and/or sensitive wetlands and coastal areas and are not included in Location 3. ○ Location 1 – includes all remaining locations in Victoria.
Mapped wetlands	Mapped wetlands may or may not be visible on the ground and are treated as a patch of native vegetation for the purpose of Offsets unless they are covered by a hardened, man-made surface, for example, a roadway. The location and extent of mapped wetlands are available in NVIM and other DEECA GIS mapping systems.
Matters of National Environmental Significance (MNES)	There are nine MNES identified under the EPBC Act 1999 (Cwlth): World Heritage properties; National Heritage places; wetlands of international importance (listed under the Ramsar Convention); listed threatened species and ecological communities; migratory species protected under international agreements (protected under international agreements); Commonwealth marine areas, the Great Barrier Reef Marine Park; nuclear actions (including uranium mines); and water resources in relation to coal seam gas development and large coal mining development.
Native Canopy Tree	A native canopy tree is either: ○ a mature tree (able to flower) that is greater than three metres in height and is normally found in the upper layer of the relevant vegetation type (EVC); or ○ a standing dead tree (stag) if it has a trunk diameter of 40 centimetres or more at a height of 1.3 metres above the ground.
Native Vegetation	Native vegetation is defined in the Victoria Planning Provisions as 'plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses'.
No Net Loss	An outcome where a particular gain in the contribution to Victoria's biodiversity is equivalent to an associated loss in the contribution to Victoria's biodiversity from permitted clearing.
Offset	Protection and management (including revegetation) of native vegetation at a site to generate a gain in the contribution that native vegetation makes to Victoria's biodiversity. An Offset is used to compensate for the loss to Victoria's biodiversity from the removal of native vegetation. Offsets are to be secured in perpetuity with an on-Title conservation covenant.
Offset target	The amount of Offset required, measured in Habitat Units, to ensure permitted clearing of native vegetation results in no net loss in the contribution made by native vegetation to Victoria's biodiversity.
Patch of native vegetation	A patch of native vegetation is either: ○ an area of vegetation where at least 25 per cent of the total perennial understorey plant cover is native; or ○ any area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy; or ○ any mapped wetland included in the current wetlands layer available in NVIM and other DEECA systems.
Perennial Understorey	Plants that usually live for more than two years and are found in the lower layers of vegetation, like grasses and shrubs.
Plant cover	The proportion of the ground that is shaded by vegetation foliage when lit from directly above.

TERM	DEFINITION
Protection (of a tree)	An area with twice the canopy diameter of the tree(s) fenced and protected from adverse impacts: grazing, burning and soil disturbance not permitted, fallen timber retained, weeds controlled, and other intervention and/or management if necessary, to ensure adequate natural regeneration or planting can occur.
Recruitment	The production of new generations of plants, either by allowing natural ecological processes to occur (regeneration etc.), by facilitating such processes, or by actively revegetating (replanting, reseeding). See revegetation.
Revegetation	Establishment of native vegetation to a minimum standard in formerly cleared areas, outside of a remnant patch.
Scattered trees	A scattered tree is a native canopy tree (see 'Native Canopy Tree' above) that does not form part of a patch. Scattered trees have two sizes, small and large: ○ a small scattered tree is less than the large tree benchmark for the species in the relevant EVC; ○ a large tree is equal to or greater than the large tree benchmark for the species in the relevant EVC; ○ a standing dead tree that does not form part of a patch is treated as a large scattered tree if it has a trunk diameter of 40 centimetres or more at a height of 1.3 metres above the ground.
Species – General Offset Test	The species-general offset test measures the proportional impact from the removal of native vegetation on the habitat of rare or threatened species, according to the *Habitat importance maps*, and compares this to the species offset threshold.
Species Habitat Unit	A Species Habitat Unit is a measure of loss (and Gain in an Offset Site) in biodiversity value of native vegetation (both patch and scattered tree) for a particular rare or threatened species.
Species Habitat Unit Offset target	A Species Habitat Unit Offset is required when the removal of native vegetation has a significant impact on habitat for a rare or threatened species. Species Offsets must compensate for the removal of that particular species' habitat.
Strategic Biodiversity Value (SBV)	The Strategic Biodiversity Value is a rank of a location's complementary contribution to Victoria's biodiversity, relative to other locations across the state with regard to its condition, extent, connectivity and the support function it plays for species.
Tree Protection Zone (TPZ)	Calculated area (based on AS 4970-2009 (Protection of trees on development sites)) of soil volume required to encompass sufficient absorbing tree root systems to ensure the long-term survival of a tree. Trees may be considered as lost (and may require an Offset) if impacts of greater than 10% intrusion into the TPZ occur.
Vegetation Quality Assessment (VQA)	A site-based vegetation assessment method that measures the condition of native vegetation against a benchmark for the same vegetation type or Ecological Vegetation Class (EVC), where the benchmark represents the average mature condition of the EVC being assessed prior to European settlement. This is the method approved by the Department of Energy, Environment and Climate Action (DEECA) for assessing native vegetation for the purposes of regulation and investment. Qualified assessors undertake VQAs to determine the loss from clearing native vegetation and gains available at offset and investment sites.
Wetlands	See 'Mapped wetlands'.

1. INTRODUCTION

The following discussion paper seeks to provide a platform for consultations around the future direction of conservation efforts for Growling Grass Frog (GGF; see species description in Appendix 8.1.1), as conducted by Development Victoria Pty Ltd (DV) at the Quinn Land site within the Officer Precinct Structure Plan (PSP) area (SPI: 1/TP134961 (part); SPI: B/PS614262; SPI: RES3/PS614262; RES2/PS614262 (part)).

Development Victoria was instrumental in the initiation of development within the Officer PSP area south of the Quinn Land site including:

- Construction of infrastructure and establishment of open space and conservation reserves across the Development Victoria landholdings within the PSP;
- Rehabilitation of the Gum Scrub Creek waterway and riparian corridor and naturalisation of the (former) trapezoidal channel;
- The creation of new GGF aquatic and terrestrial habitat within the Officer and neighbouring PSP areas;
- Revegetation of the riparian corridor; and
- Development of shared-use pathways and public access infrastructure.

Construction work within the Gum Scrub Creek riparian corridor on Development Victoria landholdings commenced in early 2012, with works incorporating the development of wetland habitat specifically tailored to meet provisions for the GGF. In addition, sites known to support GGF prior to the commencement of works were retained and conserved in an effort to maintain a baseline GGF population for the region and as a population source for the constructed habitat sites.

The Gum Scrub Creek rehabilitation program and implementation of the *Growling Grass Frog Conservation Management Plan for the VicUrban Development at Officer, Victoria* (Biosis Research 2008; hereafter referred to as the Conservation Management Plan (CMP)) was carried out in accordance with a Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999 (Cwlth)) Controlled Action Permit 2006/3001 (hereafter referred to as the EPBC Permit) for the PSP. Whilst the rehabilitation of Gum Scrub Creek is now complete, there have been no records of GGF from the region since the 2013/2014 breeding season (discussed below).

Conditions 1(c), 1(e), 2, 3 and 4 of the aforementioned EPBC Permit were revoked by the Federal Department of Agriculture, Water and the Environment (DAWE; now the Federal Department of Climate Change, Energy, the Environment and Water (DCCEEW)) in March 2022 with the addition of Clause 4A as follows (see also Appendix 8.2 for a copy of the EPBC Permit Variation):

> *4A. The person taking the action must ensure that a Growling Grass Frog study is undertaken by a suitably qualified expert to determine:*
>
> *a) the factors likely to have contributed to the loss of Growling Grass Frog on the site of the action since the approval of the action;*
>
> *b) management measures that, if implemented, are likely to prevent loss of other populations of Growling Grass Frog in the Officer region and more broadly; and*
>
> *c) measures that future residential or industrial developments should implement to avoid, minimise and mitigate impacts to Growling Grass Frog and to enable populations to survive or thrive despite development.*
>
> *The person taking the action must publish the report of the Growling Grass Frog study on its website within 12 months of this variation decision, using metadata that will assist its discovery in relevant internet searches. The person taking the action must provide evidence of publication to the Department within 7 days of the report being published on its website.*

This discussion paper is therefore raised in order to address Clause 4A of the EPBC Permit Variation. It also provides an update on the status of GGF in the region, and recommendations for GGF conservation as part of the development of the Quinn Land site.

1.1 SCOPE OF DISCUSSION

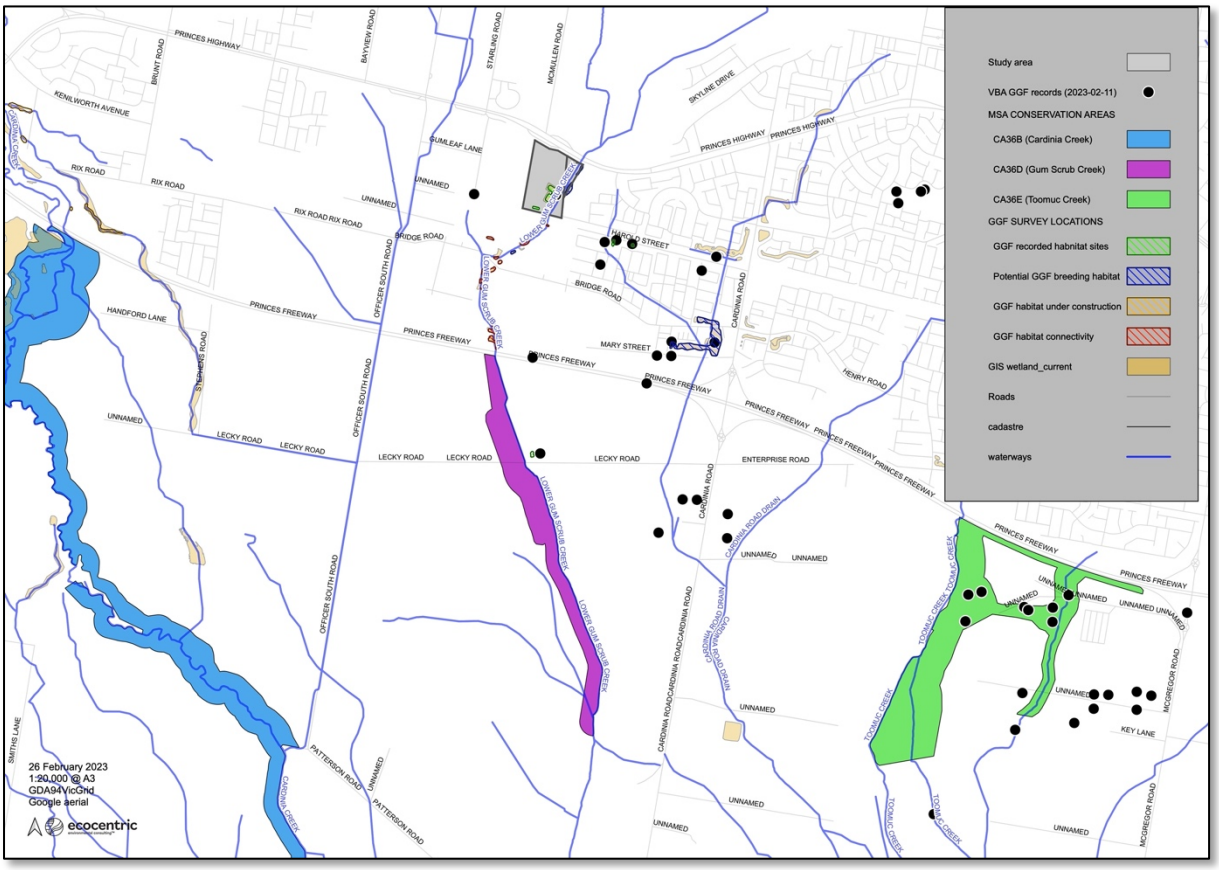
This discussion paper will provide an update of GGF in the region, including:

- The Quinn Land site and two 'turkey dams' on the west side of Gum Scrub Creek;
- Wetlands constructed in the Arena development on the east side of Gum Scrub Creek;
- Constructed GGF wetlands and sites within the riparian corridor of Gum Scrub Creek to the south of the Quinn Land site; and
- A known population of GGF at Harewood, a privately owned property at the southern end of Cardinia Creek (approx. 16km south of the Quinn Land site) which acts as a reference site for this study.

This discussion paper will also address Condition 4A of the Permit (see Appendix 8.2 for a copy of the EPBC Permit Variation) and the appropriateness of further GGF habitat development and rehabilitation within the Gum Scrub Creek corridor within the Quinn Land site.

Figure 1 below identifies the study area and the key locations addressed in this discussion paper.

Figure 1. Study area



1.1.1 LIMITATIONS

The targeted fauna surveys reviewed and conducted for this discussion paper were carried out during suitable conditions for the detection of the target species. Whilst it is possible that other threatened vertebrate fauna species not recorded during the surveys may occasionally visit or occur within the site, it is unlikely that any of these additional species regularly occur on, or rely upon, the site.

Please also note that surveys were not limited to the target species at the time of assessment; rather, all flora and fauna taxa observed on site were recorded and assessed for their habitat requirements, capacity to be found within the development area, and their conservation significance.

No targeted surveys for significant flora were conducted. Site assessments were undertaken utilising the 'random meander' process of undertaking assessment of suitable sites whilst selectively traversing preferred habitat for threatened species. Ecocentric is confident that this survey methodology meets the objectives of the project brief and criteria.

This report is limited to a discussion of factors influencing GGF conservation requirements in the study area; this is not a management plan nor a conservation management plan.

This report does not consider development implications that relate to environmental and non-environmental zoning and overlay requirements. Similarly, this report does not consider development implications which may apply to the property under the Aboriginal Heritage Act 2006 (Vic).

This report relies on contributions from several consultancies and information provided by Development Victoria. Findings contained herein are therefore based on the reports provided at the date of publication; Ecocentric will not be held accountable for post-publication variations associated with report updates from external consultancies, agencies or parties.

This report assumes that the reader is familiar with the proposed development and its objectives, and the planning and financing context that brought about its instigation.

2. GGF POPULATION CHANGES

It is important to firstly determine changes to GGF populations within the works area and the wider region over time. Data on GGF populations is derived from searches of publicly available records on the Victorian Biodiversity Atlas (VBA) and the Atlas of Living Australia (ALA), and from the results of targeted surveys conducted by Biosis Research, Ecocentric and other ecological consultancies.

2.1 REGIONAL GGF POPULATION

Historically, a large GGF metapopulation extended across the former Koo Wee Rup Swamp and north to the Pakenham area, but by the time of issue of the EPBC Permit, associated with the development of Officer, the species had become largely restricted to artificial waterbodies such as farm dams and agricultural drains in the region (Hamer & Organ 2008). Whist there were remnants of the former aquatic and adjacent terrestrial habitat that had once supported this species still present throughout the study area, much of that habitat was now highly modified due to clearing and agricultural land use and channelization of the waterways. Habitat modification and habitat connectivity losses have continued through to more recent times, associated with urbanisation and construction of roadways.

The majority of aquatic habitat suitable for GGF within the Officer PSP area is now found as a network of drains and channels across the area, farm dams, constructed wetlands and stormwater treatment systems within the urban development areas, and Gum Scrub Creek, which provides some connectivity across the broader region. More broadly, the larger, southeast regional metapopulation of GGF is effectively linked to the study area by a network of creeks and drains which provide movement and dispersal corridors and connectivity to breeding sites, as well as sheltering habitat during the non-breeding season. Many drains and channels across the broader region play an important role in the viability of the population by facilitating dispersal and gene flow, thereby linking sub-populations within the larger regional metapopulation of Koo Wee Rup Swamp.

The GGF population inhabiting the area between Pakenham and Koo Wee Rup (the Cardinia population) is genetically distinct from other remnant metapopulations in the greater Melbourne region, exhibiting high genetic diversity and several unique haplotypes (Keely *et al.* 2015). Given its genetic uniqueness, size, connectivity and viability, this GGF population is considered to be a large and important population, according to EPBC Act 1999 (Cwlth) criteria. It is this factor, among others, which triggered the requirement for an EPBC Permit associated with the development of Officer, and the resultant rehabilitation works on Gum Scrub Creek and the provision of GGF habitat ponds within the Officer PSP area immediately to the south of the Quinn Land.

2.2 LOCAL GGF POPULATION

Whilst it is acknowledged that the GGF population and distribution had declined in the years leading up to the 2012 development of Officer (Hamer & Organ 2006; Hamer & Organ 2008; Heard *et al.* 2008; Heard *et al.* 2010, Heard *et al.* 2012; Heard & McCarthy 2012; Biosis Research 2012), there were two populations known to persist within the two turkey dams found on the Quinn Land. The nature of the turkey dams, being raised above the natural ground surface (as characteristic of turkey nests constructed out of mounded leaf-litter) and off-stream (not directly connected to the Gum Scrub Creek) meant that GGF were able to persist at these sites until the 2013/2014 breeding season.

Targeted surveys for GGF – both call-back and metamorph surveys – had therefore been conducted within the Quinn Land turkey dams ('Dam D' and 'Dam E') annually between the 2005/2006 and the 2016/2017 breeding seasons. During the last two of these breeding seasons, targeted GGF surveys were additionally conducted at the two newly constructed Officer GGF habitat ponds ('Northern GGF Pond' and 'Southern GGF Pond') south of the Quinn Land site. More recently, during the 2022/2023 season, a return targeted survey was conducted at the four aforementioned sites, as well as at the constructed 'Arena Northern Wetland' east of Gum Scrub Creek (see Figure 2 below for details). Whilst habitat conditions vary across these five survey sites, in general, the sites each sustain fringing vegetation that offers suitable GGF habitat. There is also a limited degree of connectivity between the five sites via the Gum Scrub Creek waterway and riparian corridor.

There is, however, little to no connectivity to adequate GGF habitat north or south of the local Officer area, other than via a few (less than 5) ephemeral drainage-lines and lower lying areas. Northern and southern reaches of Gum Scrub Creek are described as a highly modified, trapezoidal drainage channel that traverses open pasture and recently urbanized areas, and that was constructed in order to drain stormwater in order to facilitate agricultural land-uses. It is our understanding that much of the waterway creekline was modified and cleared prior to the 1940s (MapShare 2023), and that much of the previously available GGF habitat areas, such as wetland pools and ephemeral connectivity, was put to pasture to the detriment of GGF and other water dependent taxa such as native fish, amphibians and aquatic flora.

There are no records in the VBA of GGF within the Gum Scrub Creek riparian corridor upstream of the study area, despite the presence of several large farm dams at the head of the waterway. The absence of GGF in the upper catchment is attributable to agricultural land use, and in particular, stock access to the dams and aquatic margins leading to pugging and poor water quality.

Similarly, once past Lecky Road there are no GGF records in the VBA downstream of the study area until Ballarto Road, approximately 8km to the south, where Gum Scrub Creek is channelized and straightened into a narrow corridor along with the Cardinia, Toomuc and Deep Creeks. All four waterways run in parallel within a 250m wide corridor to their terminus with Westernport Bay. The absence of GGF in the lower catchment is attributable to channelization and the trapezoidal formation of the waterway, loss of suitable wetland habitat to agricultural land use, stock access to the riparian corridor and loss of habitat connectivity.

2.3 LOCAL GGF STUDY AREA SURVEY RESULTS

Monitoring of the GGF population within the local study area was conducted between 2005 and 2008 by Ecology Partners (as reported in Biosis Research 2012; unsighted by this study), between 2007 and 2012 by Biosis Research (all summarised in Biosis Research 2012), and between 2012 and 2016 by Ecocentric (all summarised in Ecocentric 2016). Biosis conducted a follow-up survey for GGF in the 2016/2017 season (Biosis 2017), and more recently Ecocentric has also conducted a targeted survey within the 2022/2023 season as part of this study.

The targeted surveys were generally conducted in accordance with Federal survey guidelines for Growling Grass Frog, as outlined in the EPBC Act 1999 (Cwlth) Policy Statement 3.14 *Significant Impact Guidelines for the Vulnerable Growling Grass Frog* (DEWHA 2009), the *Survey Guidelines for Australia's Threatened Frogs* (DEWHA 2010) and the *Biodiversity Precinct Structure Planning Kit* (DSE 2010); including:

- **Call playback**: broadcasting male GGF calls during the breeding season (October – November and when GGF are recorded at suitable reference sites in the district) and then listening for replies over a period of at least five minutes. In most cases the broadcast / listening process was conducted at least three times at each of the survey sites over a 15 – 20 minute period.
- **Spotlighting / active searching**: spotlights were used to search for adult frogs within and near the water's edge, including areas within and around submerged and floating aquatic vegetation and in terrestrial areas within 10 metres of the water's edge. This method included searching for the yellowish-orange reflection from frog eye-shine under spotlight, and active searching for adult frogs.
- **Metamorph surveys**: bait traps with fluorescent lures were deployed overnight and the vegetated aquatic margins were dip netted over several cycles at each survey location searching for GGF tadpoles, metamorphs and/or juvenile frogs. Tadpole identification was consistent with Anstis (2007), looking for the distinctive green tinge common to this species.

The general survey area includes the two turkey dams, labeled and identified by Biosis Research (2008) as Dams D and E (being the northern and southern turkey dams respectively within the Quinn Land), the two constructed GGF ponds south of the Quinn Land ('Northern GGF Pond' and 'Southern GGF Pond'), and one of the Arena wetlands ('Arena Northern Wetland') constructed east of Gum Scrub Creek. Figure 2 below identifies the five (5) survey sites within the study area, as well as historical survey sites to the east and southeast of the study area where GGF have been recorded (not considered directly in this study and included for context only).

Figure 2. GGF survey sites

The results of the surveys for Dams D and E, Officer's constructed GGF ponds, and the Arena Northern Wetland, are summarized below in Table 1; survey results from sites within the region are available on request.

Table 1. Summary of GGF survey results

	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010
Northern turkey dam (Dam D)	31 adult males, 3 adult females & unknown number of metamorphs (Hamer & Organ 2006b (unsighted) as reported in Biosis Research (2012))	2 adult males. (Hamer & Organ 2007 (unsighted) as reported in Biosis Research (2012))	15 adult males, 2 adult females & 15 metamorphs. (Organ 2008 (unsighted) as reported in Biosis Research 2012))	4 adult males in Oct.; 5 adult males in Nov. (Biosis Research 2009)	5 adult males & 1 probable tadpole in Dec; 8 metamorphs in Feb.; 1 juvenile in March. (Biosis Research 2010) 4 adult males & 3 juveniles. (Ecology Partners pers. comm. as reported in Biosis Research 2012)
Southern turkey dam (Dam E)	1 adult male, 11 adult females & 2 juveniles. (Hamer & Organ 2006b (unsighted) as reported in Biosis Research (2012))	None recorded. (Hamer & Organ 2007 (unsighted) as reported in Biosis Research (2012))	2 adult males, 3 adult females. (Organ 2008 (unsighted) as reported in Biosis Research 2012))	None recorded. (Biosis Research 2009)	2 adult males & 4 juveniles in Feb.; 1 juvenile in March. (Biosis Research 2010) 2 adult males. (Ecology Partners pers. comm. as reported in Biosis Research 2012)

	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Northern turkey dam (Dam D)	4 adult males in Nov.; 4 adult males in early Jan. (Biosis Research 2011) 4 adult males & 1 metamorph in mid Jan. (Claire Keely 2011 pers. comm. as reported in Biosis Research 2012) 5 adult males, 1 adult female, 1 adult pair in amplexus & 1 late stage tadpole in late Jan. (Biosis Research 2011) 2 adult females in Feb. (Biosis Research 2011)	2 adult males in Oct.; 1 adult male in Nov.; 2 adult males & 1 adult female in Feb. (Biosis Research 2012)	2 adult males, no metamorphs. (Ecocentric 2013)	2 adult males, no metamorphs. (Ecocentric 2014)	None recorded (metamorphs not surveyed). (Ecocentric 2015)

	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Southern turkey dam (Dam E)	1 adult female in early Jan. (Biosis Research 2011) 3 adult females in mid Jan. (Claire Keely 2011 pers. comm. as reported in Biosis Research 2012)	None recorded. (Biosis Research 2012)	None recorded, no metamorphs. (Ecocentric 2013)	None recorded, no metamorphs. (Ecocentric 2014)	None recorded (metamorphs not surveyed). (Ecocentric 2015)

	2015/2016	2016/2017	2022/2023
Northern turkey dam (Dam D)	None recorded, no metamorphs. (Ecocentric 2016)	None recorded, no metamorphs, no sound records. (Biosis 2017)	None recorded. (Ecocentric current)
Southern turkey dam (Dam E)	None recorded, no metamorphs. (Ecocentric 2016)	None recorded, no metamorphs, no sound records. (Biosis 2017)	None recorded. (Ecocentric current)
Northern GGF pond	None recorded, no metamorphs. (Ecocentric 2016)	None recorded, no metamorphs, no sound records. (Biosis 2017)	None recorded. (Ecocentric current)
Southern GGF pond	None recorded, no metamorphs. (Ecocentric 2016)	None recorded, no metamorphs, no sound records. (Biosis 2017)	None recorded. (Ecocentric current)

GGF adults, as well as juveniles and/or metamorphs, are recorded at Dams D and E as late as the 2010/2011 and 2009/2010 breeding seasons respectively (Biosis Research 2012), but there is no evidence of successful breeding by this species since that time.

The survey data indicates that the local GGF population had been in decline since before implementation of the Officer PSP and associated Gum Scrub Creek riparian corridor works / GGF wetlands construction, and indeed the population status of GGF in the region had already been identified as being in severe decline (Hamer & Organ 2006; Hamer & Organ 2008; Heard *et al.* 2008; Heard *et al.* 2010; Heard *et al.* 2012; Heard & McCarthy 2012; Biosis Research 2012).

Biosis, in the report following their 2016/2017 survey (2017), goes on to state:

> *Despite four nocturnal surveys at 18 waterbodies, no Growling Grass Frogs were recorded anywhere within the study area in 2016/17. This is consistent with results in 2014/15 and 2015/16 (Ecocentric 2015; Richard Coffey, pers.comm.). Failure to detect the species over three consecutive seasons suggests that the population may have gone extinct.*

This finding accords with the findings of our recent targeted survey and suggests that GGF are no longer found locally. It is our opinion therefore that GGF are not expected to be found within the Quinn Land site, neither at the two turkey dams nor the Gum Scrub Creek riparian corridor.

3. FACTORS CONTRIBUTING TO LOSS OF GGF

The following section outlines factors that are considered likely to have contributed to the loss of GGF in the study area, and more broadly across the region. This section addresses Clause 4A(a) of the EPBC Permit Variation and provides an insight into options to address the decline.

It is likely that a combination of threats and pressures have contributed to the local and regional declines of GGF, including:

- Prolonged drought conditions in the years leading up to 2010;
- Degradation of Dams D and E by stock prior to 2010, and degradation of aquatic margins by stock more generally across the region;
- Modification of fringing terrestrial (over-wintering) habitats, and removal of dams in the Officer precinct;
- Modification of connective habitat and declining habitat connectivity between aquatic habitat and refuges;
- Habitat fragmentation associated with modification and removal of terrestrial and aquatic habitats throughout the Officer / Pakenham region;
- Increased mortality from domestic animals and vehicles, due to increased urban development in the surrounding area;
- The disease chytridiomycosis, caused by the fungal pathogen *Batrachochytrium dendrobatidis* (hereafter referred to as chytrid fungus), found regionally within the frog population (Biosis 2012); and
- Predatory fish impacts, including those of Eastern Gambusia (*Gambusia holbrooki).*

These threats to GGF are discussed below. Options to address these threats are provided in Section 5.

3.1 HABITAT LOSS, FRAGMENTATION AND DECLINING CONNECTIVITY

Of the threats listed above, the declining conditions of remaining aquatic habitat (namely at the dams), and the loss of connectivity between different locations of aquatic habitat, is arguably the greatest detrimental factor on the population and the long-term viability of GGF in the region. Populations of species such as GGF that are threatened with habitat loss and fragmentation, are not only reduced in size but also in ability to disperse, severing the genetic links that contribute to the long-term viability of populations through diversity of genes (Keely *et al*. 2014; Stevens *et al*. 2018). This leaves populations prone to the detrimental effects of genetic drift and inbreeding depression, compounded by increased exposure to predators and other edge effects (Reed *et al*. 2004; Keely *et al*. 2014).

Stock impacts, weed invasion and declining water values are also reducing the habitat efficacy at the dam sites, and urbanization of the catchment is contributing to loss of connectivity. In addition, habitat conditions within drainage lines and riparian corridors across the region are now severely depleted, with little to no wetland / marshland habitat remaining; blackberry infestations; construction activity (not least of which is the urbanization of the Officer PSP); and a high regional fox population.

Furthermore there are few, if any, flooding events within or between aquatic refuges: a necessary component of GGF dispersal (see Section 3.5 for details). Recent works on drainage lines and swale drains to protect infrastructure within the railway corridor (at the southern extent of this study) has resulted in a reduction (elimination) of flooding and the subsequent reduction in wetting and loss of connectivity for GGF to regional areas of habitat on an east – west alignment. The GGF connectivity is now largely restricted to the north – south GSC waterway, with little to no options for connectivity outside of the riparian corridor.

3.2 URBANISATION

Development of the Officer PSP, as well as development of the Cardinia Road and Cardinia Road Employment PSPs, the Pakenham Bypass and various linear infrastructure programs has led to an increase in the extent and rate of urbanisation of the region. Urbanisation is of particular concern for GGF since this species is known to display 'classical metapopulation dynamics' in the Melbourne region (Heard *et al.* 2010). A metapopulation is a "population of populations" distributed in discrete habitat patches that are connected by migration and linked by occasional dispersal (Hanski 1999). A regional population of GGF therefore is largely dependent on its ability as a species to breed and produce young within suitable wetland habitat sites, but also to be able to then disperse and exchange migrants and, through them, exchange genes and maintain gene pool diversity. Any loss of connectivity, or loss of suitable breeding habitat sites therefore has a detrimental effect on the species' fecundity and longevity within a region.

Urbanisation within the Officer PSP has also lead to a significant decline in seasonal flooding across the landscape. The Officer region once supported a Swampy Woodland vegetation community which was lost to clearing for agricultural land use. These areas however continued to flood, thereby supporting connectivity for GGF across cleared pasture areas. It is now understood that natural flooding of floodplains triggers breeding activity in semi-arid areas of NSW (Wassens 2006; Clemann & Gillespie 2012), and it is likely that altered hydrological regimes within the study area has detrimentally affected the GGF population in this region.

Urbanisation and an increasing human population also has an impact on water extraction and water quality within a catchment. Inputs from urban estates can contain chemicals and pollutants that are known to harm GGF and other frog species. An increase in the number of pedestrians, and their dogs and cats, are also likely to have an impact on GGF through direct predation and disturbance of breeding, foraging and dispersal cycles.

3.3 CHYTRID FUNGUS

Chytrid fungus is listed as a threatening process to GGF (Heard *et al.* 2012; DEWHA 2009; Clemann & Gillespie 2012) and has been listed as a contributing factor in the decline of GGF populations in Melbourne (Heard *et al.* 2012).

Biosis Research (2012) has reported on chytrid sampling that was undertaken within a broader study area over the 2010/2011 and 2011/2012 breeding seasons. The swabbing of a variety of frog species captured at four dams (Dams D, E, H and I) confirmed the presence of chytrid fungus at all except for Dam D. Whilst no GGFs tested positive for the presence of chytrid fungus, approximately half the GGF chytrid samples were found to be inconclusive (Biosis Research 2012).

It is worth noting that chytrid fungus was recorded in Dam E in 2012 (Biosis Research 2012), and it is likely that this disease persists. It is therefore likely that any frogs within Dam D may also have become subject to infection by chytrid fungus, given the close proximity to Dam E where the positive samples were obtained (DECC 2008).

3.4 PREDATORY FISH

Predatory fish, including Eastern Gambusia *Gambusia holbrooki* (also referred to as Mosquito Fish or Plague Minnow), have been listed as a threatening process to GGF (DEWHA 2009; DEPI 2013; NPWS 2003). Eastern Gambusia has been shown to kill or injure tadpoles, predate on frog eggs and exert some influence over frog habitat selection (NPWS 2003).

Heard (2010) demonstrated that the occurrence of predatory fish is negatively related to wetland occupancy by GGF. However, GGF are known to inhabit and breed in a number of wetlands around Melbourne containing populations of Eastern Gambusia, so the predators' presence does not necessarily preclude the persistence of GGF (DELWP 2017). Heard *et al.* (2010) suspected that the protective effect of aquatic vegetation is important in reducing predation on GGF eggs and tadpoles by fishes and thus allowing the co-existence of Growling Grass Frog populations.

Whilst the relative importance or degree of impact of Eastern Gambusia on GGF is still to be determined, the presence of Eastern Gambusia is considered likely to be a detrimental influence.

3.5 REQUIREMENTS OF A SUSTAINABLE GGF POPULATION

There is a substantial body of research available on GGF in the broader Pakenham region, supported by the regular monitoring of and reporting on the GGF population and breeding success rates since the 2005/2006 breeding season. It is our understanding from the published research and monitoring that there are four key factors required to maintain a viable, long-term population of GGF; namely a metapopulation as an ongoing source population; habitat connectivity between GGF breeding sites; aquatic and terrestrial habitat availability; and flooding events for breeding and dispersal success. These are discussed below.

3.5.1 METAPOPULATION

The *Sub-regional Species Strategy for the Growling Grass Frog* (DEPI 2013) informed the preparation of the Biodiversity Conservation Strategy for GGF by identifying important populations, areas of habitat to be protected, and habitat corridors to provide connectivity between populations. The Strategy defines a viable GGF population as "…one which is not isolated from other populations or water bodies, such that it has the opportunity to interact with other nearby populations or has the ability to establish new populations when water bodies fill and become available." (DEPI 2013).

Under this model, GGF populations are structured as metapopulations (a group of spatially separated interacting populations) demonstrating spatially clustered patterns of wetland occupancy, where movement between water bodies occurs as habitat conditions change over time, that is, when water bodies dry out or flood (Hanski 1999; DEPI 2013). To paraphrase, the metapopulations act as source populations from which GGF disperse.

There is no metapopulation of GGFs remaining within the study area. In 2005/2006, the northern turkey dam (Dam D) may have acted as a suitable metapopulation with 31 males and 3 females recorded (Biosis Research 2012), however, the declining number of GGF found at this site over the years meant that it was no longer constituting a suitable source for dispersal before the apparent disappearance of GGF from the 2014/2015 breeding season onwards.

This is not to say that a metapopulation could not be created through the construction of suitable habitat within the Gum Scrub Creek corridor. For now, however, the absence of a sizable local source population limits the success of (natural) migration to the newly constructed habitat, and threatens the long-term viability of the Officer-Pakenham GGF population.

It is also our understanding that GGF numbers are low across all four GGF CMP areas active in the region: namely, the Officer CMP area (Biosis Research 2008), the Cardinia Road Precinct CMP area (Ecology Partners 2016), the Cardinia Road Employment Precinct CMP area (Ecology Partners 2010), and the Pakenham Bypass CMP area (Biosis Research 2005). There are now no known GGF metapopulations within proximity of the Quinn Land site.

3.5.2 HABITAT CONNECTIVITY

Another contributing factor to the success of a long-term GGF population is the connectivity of suitable habitat sites. Water bodies that are located within close proximity to each other are more likely to support a population of GGF compared with isolated sites (DEPI 2013; Hamer & Organ 2008; Heard *et al.* 2010; DELWP 2017). The persistence of GGF is dependent on the maintenance of a network of well connected, large permanent or semi-permanent wetlands. This is simply because GGF populations typically exist in flux between population expansion and migration dispersal (Heard & McCarthy 2012). Urban expansion may therefore disrupt or eliminate these dynamics, through the destruction of wetlands, through changes to wetland size and quality, and by interrupting dispersal opportunities between wetlands (Heard & McCarthy 2012).

Adjoining terrestrial environments also support essential habitat for non-breeding activity such as movement, foraging, over-wintering and shelter. Many of the permanent and ephemeral waterways also provide linkages to other suitable sites across the landscape (DEPI 2013; DELWP 2017).

Dispersal is thought to occur primarily along drainage lines or other low-lying areas between water bodies, and unhindered movement between and within water bodies is considered important for population viability (DEPI 2013; Robertson *et al.* 2002). Hamer & Organ (2008) go so far as to suggest that GGF are using the drains in the railway reserve, Gum Scrub Creek and adjoining rough pasture as dispersal corridors.

Habitat connectivity values within the railway corridor however are degrading. Fox activity is very high (foxes were observed nearly every night of survey), there has been no flooding within the railway reserve for several years, drainage-lines have been for the most part dry since berms were constructed on the northern extent of the reserve, and there has been a considerable degree of urban development to either side of the corridor and within the corridor itself (the construction of the Officer Town Centre Siding Avenue (main road) underpass in particular). Habitat conditions within Gum Scrub Creek north and south of the Officer PSP, although degraded, remain relatively stable, however, long-term agricultural land use and stock access to the waterway has led to loss of suitable surrounding GGF habitat.

Whilst GGF breeding habitat and a generous riparian corridor has been provided along Gum Scrub Creek south of the Quinn Land site, the remainder of the Officer PSP has been, or is about to be, urbanized. The establishment of urban dwellings and associated infrastructure has inevitably led to declining water quality in the creek, increased pedestrian activity, and reduced dispersal options for GGF to the east and west.

In short, habitat connectivity for GGF is now limited to the north – south waterway corridor, with east – west links being gradually removed and/or deteriorating.

3.5.3 HABITAT CONDITIONS

GGF is largely associated with permanent or semi-permanent still or slow flowing water bodies. There is a strong correlation between the presence of the species and key vegetation attributes, particularly a diversity of emergent, submerged and floating vegetation (DEPI 2013; Hamer & Organ 2008). Hamer & Organ (2008) noted that occupied waterbodies had a greater proportion of submerged vegetation, a higher pH, and were situated close to other occupied waterbodies, generally less than 200m apart (NB: a higher pH may facilitate the establishment of aquatic vegetation and may not therefore be in itself a determinant factor for GGF occupancy).

The northern and southern turkey dams, the northern and southern Arena wetlands and the two GGF ponds south of the railway (and to some extent Dams H and I) provide fringing, emergent and floating aquatic and semi-aquatic vegetation. However, other habitat preferences for GGF, such as emergent rock platforms for basking and submerged habitat such as logs and snags, are not available. The extent and density of vegetated aquatic margin at the northern and southern turkey dams is also low and generally not considered adequate.

An additional important habitat requirement for GGF is 'open' terrestrial habitat immediately adjacent to water bodies (DEPI 2013). GGF behaviour during winter is not well known, although it is speculated that GGFs hibernate in warm, moist areas such as the mud at the bottom of drying ponds, under logs, rocks and debris or beneath thick vegetation over winter (DCCEEW 2023; DELWP 2017). There is little to no suitable over-wintering habitat at any of the dams. Urban development is now to within 25m of Dams H and I, while the earthen constructed embankments at the northern and southern turkey dams provide almost no suitable terrestrial habitat.

Water quality is also considered important for successful breeding and larval development and it is likely that GGF tadpoles are sensitive to some horticultural chemicals, such as fertilisers and pesticides (DEPI 2013). We are not aware of any water quality testing results at any of the survey sites, however, we would speculate that water quality within Gum Scrub Creek and the turkey dams has remained relatively stable. This is evidenced by the sustainable populations of Common Froglet *Crinia signifera*, Verreaux's Tree Frog *Litoria verreauxii*, Southern Brown Tree Frog *Litoria ewingii*, and Spotted Marsh Frog *Limnodynastes tasmaniensis* at these locations.

We note also that neither of the turkey dams are considered likely to provide suitable terrestrial habitat for over-wintering. Blackberry thickets and rank pasture grass (the study area is no longer grazed) offer limited opportunities, however, these are considered inadequate to support a viable long-term population or to meet the requirements of GGF migration and dispersal.

3.5.4 FLOODING AND DISPERSAL

Flooding is identified as an important factor in both the breeding success of GGF, and the success of GGF dispersal within the landscape (DEPI 2013; Wassens *et al.* 2008; Wassens *et al.* 2010). Altered flooding regimes, and reductions in the complexity of aquatic and fringing vegetation, are even considered likely to increase the probability of localised extinctions of GGF populations (Wassens *et al.* 2010). As well as reducing the availability of breeding habitats across both space and time, reduced flooding has the potential to limit dispersal and recolonisation opportunities, thereby threatening the long-term viability of floodplain populations (Wassens *et al.* 2008). Drying after flooding, and drying of ephemeral water bodies, puts pressure on the species to disperse to more favourable, and more permanent habitat (Wassens *et al.* 2008).

The requirement for both permanent water refuges, as well as ephemeral and/or permanent drainage dispersal corridors, plus flooding / drying cycles, highlights the complexity of habitat requirements for successful dispersal and migration to constructed or natural habitat locations. The long-term persistence of amphibian populations within such temporally variable and highly disturbed landscapes is linked to their ability to opportunistically colonise newly created habitats as well as take refuge in more favourable areas when the temporary habitats dry. Reductions in flood frequency and the extent of ephemeral wetlands due to modified flooding regimes have the capacity to limit dispersal of this species, even when permanent water-bodies remain unchanged (Wassens *et al.* 2008).

Flooding around Dams H and I has now ceased as part of the urbanisation around these sites. Flooding within the railway corridor is also rare in response to the need to protect this transport infrastructure. Dams D and E, as turkey dams, have possibly never flooded. At best, all that remains of likely dispersal corridors for GGF within the Quinn Land site currently is wet marshy habitat that would be seasonally available, depending on rainfall events, when the pasture floods, thereby linking these sites to Gum Scrub Creek.

4. GGF CONSERVATION STRATEGIES

This section looks at management measures that, if implemented, are likely to prevent loss of other populations of GGF in the Officer region, thus addressing Clause 4A(b) of the EPBC Permit Variation.

We note that there are many regional and local conservation strategies that are enacted within the Quinn Land site and the broader Officer region. Development strategies and conservation works that can help maintain GGF populations, as well as provide connectivity between suitable habitat sites, are outlined in the following:

- *Biodiversity Conservation Strategy for Melbourne's Growth Corridors* (DEPI 2013a).
- *Sub-regional Species Strategy for the Growling Grass Frog* (DEPI 2013b).
- *Growling Grass Frog Conservation Management Plan for the VicUrban Development at Officer, Victoria* (Biosis Research 2008).
- *Officer Precinct Structure Plan* (Cardinia Shire Council 2011).
- *Growling Grass Frog Masterplan for Melbourne's Growth Corridors* (Melbourne Strategic Assessment) (DELWP 2017a).
- *Growling Grass Frog Habitat Design Standards* (Melbourne Strategic Assessment) (DELWP 2017b).

In addition, there are several GGF conservation management plans being enacted within the broader region that, if successful, would be likely to contribute to the (re)establishment of a sustainable GGF population. These include:

- *Cardinia Road Employment Precinct, Conservation Management Plan for Growling Grass Frog* Litoria raniformis (Ecology Partners 2010), which addresses impacts and habitat provisions for GGF to the east and south-east of our study area;
- *Cardinia Road Precinct, Conservation Management Plan for Growling Grass Frog* (Ecology Partners 2016), which addresses impacts and habitat provisions for GGF to the east of our study area – to date the authors have not been able to sight this report, however we have been given to understand that it exists;
- *Pakenham Bypass: Conservation Management Plan for the Growling Grass Frog* Litoria raniformis*, Pakenham, Victoria* (Biosis Research 2005), which addresses impacts and habitat provisions for GGF along the Pakenham Bypass corridor to the south of our study area;
- *Officer Precinct Structure Plan: Cardinia Creek Conservation Management Plan* (Ecology Australia 2011), which addresses general conservation actions for the Cardinia Creek, some of which are specific to the requirements of GGF; and
- *Officer Precinct Structure Plan: Conservation Management Plan (excluding Cardinia Creek)* (Ecology Partners 2011a), which addresses site specific CMP requirements within the Officer PSP, as well as GGF specific measures along Gum Scrub Creek.

These Conservation Management Plans are all relevant to this study inasmuch as they may contribute to GGF habitat connectivity and dispersal of the species across the region and the Quinn Land site. However, they are not all considered in great detail, as the conservation management methodologies and habitat structure / systems that have been successful are now detailed in the two most recent documents: *Growling Grass Frog Masterplan for Melbourne's Growth Corridors* (DELWP 2017a) and *Growling Grass Frog Habitat Design Standards* (DELWP 2017b). These two documents operate within the context of the BCS and most directly inform the selection of the management directives and the habitat structural elements that should be considered for rehabilitation of the Gum Scrub Creek corridor, as covered in Section 5 below.

4.1 BIODIVERSITY CONSERVATION STRATEGY FOR MELBOURNE'S GROWTH CORRIDORS

Officer and Pakenham make up much of Melbourne's urban expansion to the southeast and it was evident, in 2010 – 2012, that that expansion would impact numerous species that are listed under the EPBC Act 1999 (Cwlth). In response, and as required under Part 10 of the Commonwealth's EPBC Act 1999, the State and Federal governments developed the *Biodiversity Conservation Strategy for Melbourne's Growth Corridors* (DEPI 2013a), which covered four growth corridors within Melbourne's expanded 2010 Urban Growth Boundary, and a selection of the 28 existing precincts within the 2005 Urban Growth Boundary.

Conservation Management Plans were developed under the Biodiversity Conservation Strategy (BCS) for each of the four expanded urban growth corridors which identified, among other requirements for EPBC-listed species, measures for protecting, enhancing and connecting important populations of GGF within conservation areas, and strategies for the mitigation of losses of habitat that will occur as a result of urban development in Melbourne's growth corridors.

The purpose of the BCS (DEPI 2013a) was to:

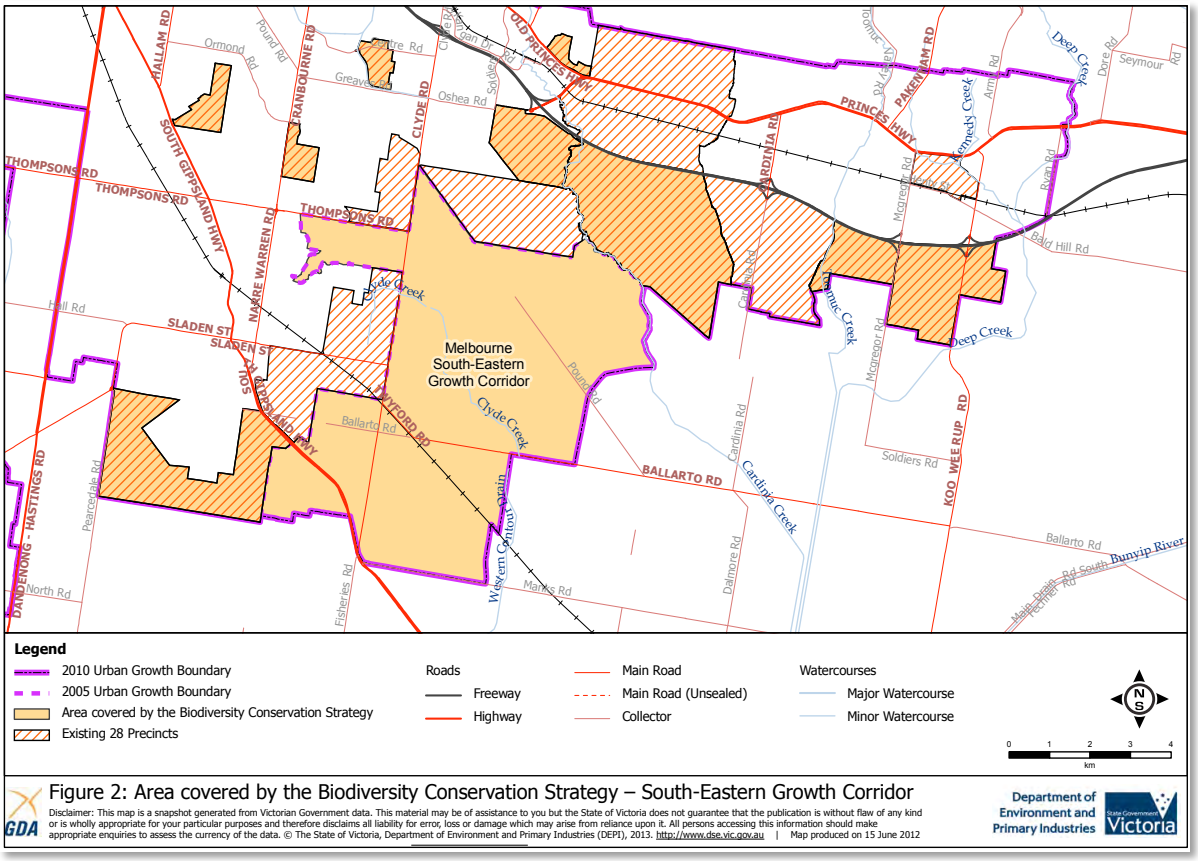
- Inform and guide the preparation of the Growth Corridor Plans and the Melbourne Strategic Assessment (MSA – DEECA 2023);
- Outline how the conservation outcomes for Matters of National Environmental Significance (MNES) in the program report will be achieved spatially within the growth corridors and how impacts on these matters will be mitigated;
- Identify the land within the growth corridors that is required to be protected due to the sub-regional species strategies and the prescriptions for MNES;
- Identify how areas set aside for conservation will be managed; and
- Outline how mitigation measures will be implemented.

The BCS is the overarching strategy for the protection of biodiversity in the growth corridors. It sets out all the conservation measures required for MNES and for matters of State significance, to satisfy the commitments to the Commonwealth Government and to meet State requirements. These conservation measures comprise:

- The protection and management of land of high biodiversity value within defined conservation areas and areas outside the Urban Growth Boundary;
- Requirements to provide offsets for removal of native vegetation and threatened species habitat on land not required for conservation and suitable for urban development; and
- Requirements to salvage and translocate certain threatened species prior to removal of habitat on land not required for conservation and suitable for urban development (DEPI 2013a).

The BCS identifies 36 conservation areas within the growth corridors that will be protected and managed in perpetuity. We note however that the Officer PSP area, and **the Quinn Land site, is not covered by the BCS**. *Figure 2: Area covered by the Biodiversity Conservation Strategy – South-Eastern Growth Corridor* of the BCS identifies the Officer PSP / Quinn Land site as lying within one of the existing 28 precincts within the 2005 Urban Growth Zone that were approved by the Minster and gazetted prior to 1st March 2012; see figure below.

Figure 3. South-Eastern Growth Corridor areas that are covered by the BCS (DEPI 2013a)



Another requirement of Part 10 the EPBC Act 1999 (Cwlth) was the development of sub-regional species strategies for threatened flora and fauna. The sub-regional species strategies were used to help inform the BCS and the MSA. The *Sub-regional Species Strategy for the Growling Grass Frog* (DEPI 2013b) identifies:

- Functioning sustainable populations of Growling Grass Frog with connectivity between populations; and
- Protection and enhancement of important populations.

The strategy further identifies land in the growth corridors that is suitable habitat for the Growling Grass Frog, and designates this land into two categories:

- Habitat that will be protected and managed for the conservation of the Growling Grass Frog (Category 1 habitat); and
- Habitat that can be cleared for urban development, but for which compensatory habitat is required (Category 2 habitat).

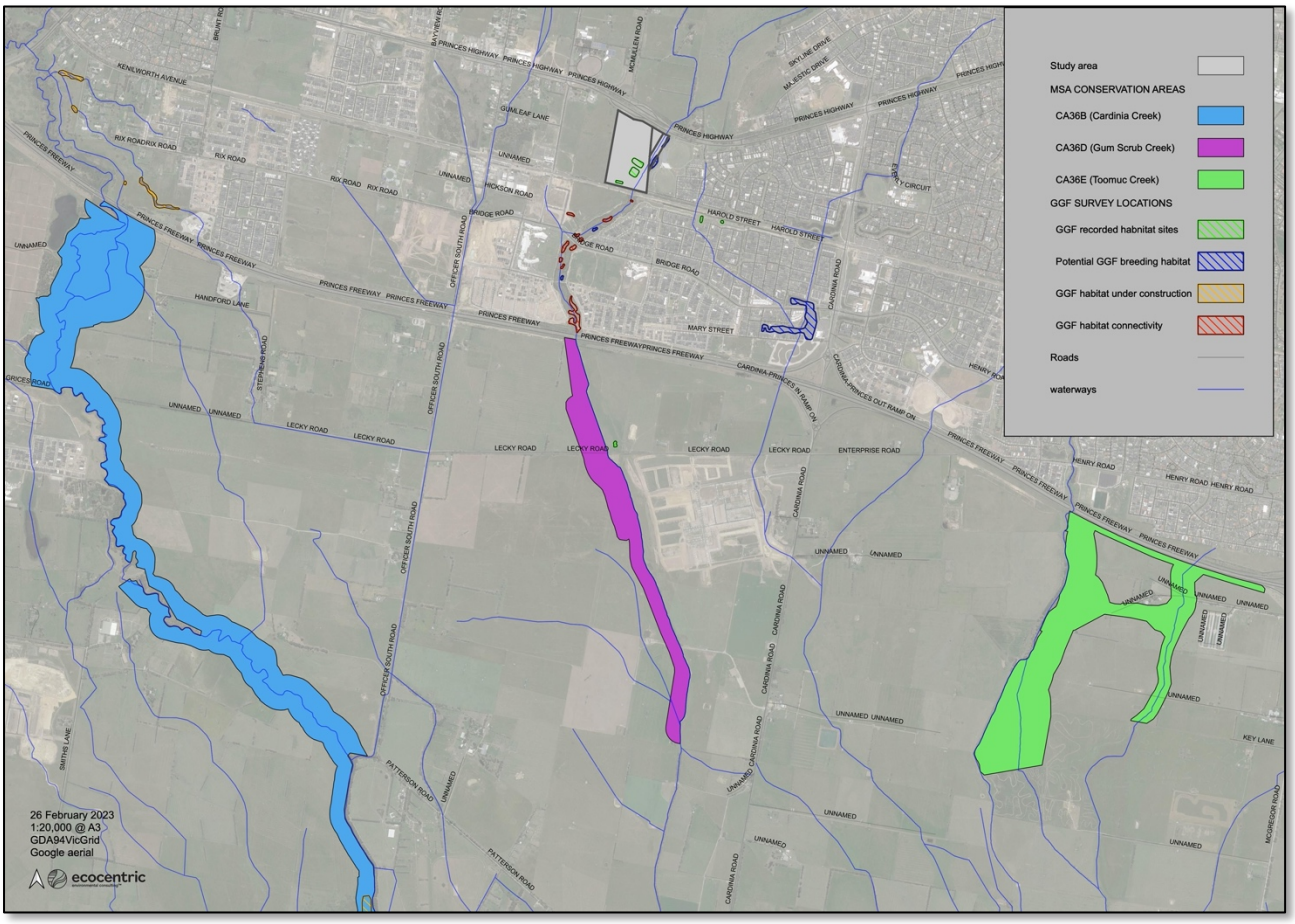
Fees are levied by DEECA whenever areas of Category 2 habitat within the MSA area are developed, and the State government is responsible for spending these monies on the development, conservation and provision of suitable habitat as mitigation against threatened species impacts.

Please note that the Officer PSP area, and **the Quinn Land site, is not covered by the *Sub-regional Species Strategy for the GGF***. Rather, the Quinn Land site and impacts on GGF associated with its development are subject to conditions under EPBC Controlled Action Permit 2006/3001 and the EPBC

Permit Variation considered in this report. Whilst the Quinn Land site is identified in the *Officer Precinct Structure Plan: Cardinia Creek Conservation Management Plan* (Ecology Australia 2011) as Parcel 412, it is not subject to contributions set out therein. Rather, Federal GGF impact mitigation and Offset requirements for this site are already considered under the EPBC Controlled Action Permit 2006/3001.

It is worth noting that the *Sub-regional Species Strategy for the GGF* (DEPI 2013b) does identify potentially important GGF habitat in the form of Conservation Areas for the development of GGF habitat, which, when constructed, will contribute to the regional connectivity of habitat and the viability of a GGF population. Figure 4 Identifies these Conservation Areas for the Cardinia, Gum Scrub and Toomuc Creeks.

Figure 4. GGF MSA Conservation Areas



It is noted that GGF wetlands are being developed by Melbourne Water at the southern end of the Cardinia Creek Conservation Area (see Figure 4 above for details). This is encouraging as, with the development of more of these Conservation Areas, there is a chance that GGF will re-populate the Officer region from their strongholds in the Koo Wee Rup region to the south.

4.2 GGF MASTERPLAN AND HABITAT GUIDELINES

Two key documents have been developed for the BCS aimed at improving GGF conservation within the MSA growth corridors. Whilst the Quinn Land is not in the MSA, these documents do provide guidance for the species and set out conservation measures that directly relate to Clause 4A(b) and 4A(c) of the EPBC Permit Variation addressed in this discussion paper: the *Growling Grass Frog*

Masterplan for Melbourne's Growth Corridors (DELWP 2017a) and the *Growling Grass Frog Habitat Design Standards* (DELWP 2017b); both are discussed further below.

4.2.1 GROWLING GRASS FROG MASTERPLAN FOR MELBOURNE'S GROWTH CORRIDORS

The *Growling Grass Frog Masterplan for Melbourne's Growth Corridors* (DELWP 2017a) provides guidance on implementing protection measures and investing in habitat creation and enhancement within Growling Grass Frog Conservation Areas as identified in the MSA (see Figure 4 for details). It is our understanding that GGF conservation measures, including construction of GGF breeding wetlands as set out in the *Officer Precinct Structure Plan: Cardinia Creek Conservation Management Plan* (Ecology Australia 2011), will also be implemented to the west of the Quinn Land in the Cardinia Creek riparian corridor (approx. 3.5km west of this study area) under the auspices of MSA using contributions collected from the Officer PSP contributions scheme.

The Masterplan consists of a package of linked components:

- Two design standards that update the *Sub-regional Species Strategy for the Growling Grass Frog* (DEPI 2013b) guidance on habitat construction and design of infrastructure crossing conservation areas;
- Identification of high-level priority reaches for habitat creation; and
- Areas of Strategic Importance mapping to inform decision making for the protection of existing and potential breeding habitat.

The Masterplan used a Growling Grass Frog population model to prioritise and select scenarios that would maximise the benefits (in terms of numbers of wetlands occupied over the long term) of investment. The prioritisation process showed that the biodiversity outcomes are most effectively delivered by creating clusters of wetlands that would support metapopulations (multiple populations linked by migration) in the most important waterways for GGF. Ten high priority reaches were selected within five waterways across the four growth areas, including the Cardinia Creek west of the study area.

The areas outside the high priority reaches identified in the Masterplan will not receive investment from the MSA scheme in habitat creation. Whilst these reaches are identified as valuable habitat for GGF, the prioritisation process showed that additional wetlands constructed in these other reaches would be less effective overall than creating clusters in the high priority reaches.

The section of Gum Scrub Creek within the Quinn Land site is not identified in the Masterplan as a *high priority* for GGF habitat development.

4.2.2 GROWLING GRASS FROG HABITAT DESIGN STANDARDS

The Masterplan updates some elements of the *Sub-regional Species Strategy for the Growling Grass Frog* (DEPI 2013b), particularly the habitat design standards that underpin the investment prioritisation. Through the *Growling Grass Frog Habitat Design Standards* (DEPI 2017b), the Masterplan sets out habitat protection and threat abatement measures that are key elements of the Growling Grass Frog conservation program.

The *GGF Habitat Design Standards* underpin planning to protect existing habitat and create a network of reliable breeding wetlands to support connected populations of GGF in conservation areas. They apply to the creation of dedicated GGF wetlands and adjacent terrestrial habitat within conservation areas, and are informed by contemporary studies of GGF occupancy and breeding in a variety of habitats including creek pools, swamps, quarry pits, farm dams and stormwater assets (sediment ponds and treatment wetlands).

The *GGF Habitat Design Standards* are based on the following principles:

- Achieve "metapopulation capacity" by creating clusters of breeding wetlands to support multiple interacting populations;

- Replicate the microclimate, physical and chemical attributes of successful Growling Grass Frog habitat, especially “anti-chytrid” features such as rocky perimeters with warm and moderately saline water, without requiring intensive management;
- Ensure that new wetlands are large enough to provide extensive areas of permanent deep water containing dense submergent vegetation, and avoid overgrowth of emergent reeds and rushes;
- Provide drainage infrastructure to allow water levels in wetlands to be manipulated as required to provide optimal ecological conditions, and also to allow wetlands to be dried out when required for management purposes; and
- Prevent predatory fish entering the wetlands from stormwater systems or floods by providing structures such as gravel filters and embankments, respectively.

Options for the incorporation of these structural elements and design standards / principles at the Quinn Land site are discussed in Section 5.4.

5. GGF CONSERVATION OPTIONS

The following section outlines options for the management and conservation of GGF. GGF were not recorded as part of this study, and long-term monitoring suggests that this species will not be found within the Quinn Land site without the instigation of well-designed habitat rehabilitation programs. Nonetheless, the presence of GGF populations south of this site, as well as the current and forecast development of suitable connecting habitat across the broader region, suggests that It may be beneficial to provide habitat that would be suitable for this species within the Gum Scrub Creek riparian corridor, and as part of Development Victoria's obligation to provide for open space as part of the *Officer PSP* (Cardinia Shire Council 2011) developments. We note however that any incorporation of GGF habitat should be considered in the context of a negligible to non-existent extant GGF population, engineering constraints associated with flooding of the corridor, and must consider constraints associated with the willingness of relevant Authorities to accept the engineering design, and long-term management and maintenance of the assets.

This section also investigates options for satisfying condition 4A(c) of the EPBC Permit Variation; namely options for development aimed at avoiding, minimising and mitigating impacts on GGF to enable populations to survive or thrive despite development (see also Appendix 8.2 for details).

5.1 GUM SCRUB CREEK WATERWAY DEVELOPMENT (OUTSIDE OF QUINN LAND)

There are two dedicated GGF ponds and areas of habitat and wetlands within the Gum Scrub Creek riparian corridor south of the Quinn Land site that incorporate Water Sensitive Urban Design (WSUD) principles of stormwater harvesting from the development area and biological improvement of water quality. Dedicated GGF habitat is also incorporated within the riparian development area (identified in this study as the northern and southern GGF ponds) in the form of *off-line* frog ponds designed to provide for the ecological needs of this species. The detailed design of the wetlands and waterway habitat was developed by Outlines Landscape Architecture in consultation with Ecocentric, and constructed by Australian Ecosystems Pty Ltd in 2014 (sign-off from Melbourne Water (February 2014) and Cardinia Shire Council (March 2014)). The Gum Scrub Creek rehabilitation works provide:

- Provision of permanent and semi-permanent, still and slow flowing water bodies;
- Aquatic margins vegetated with a diversity of emergent, submerged and floating vegetation;
- 'Open' terrestrial habitat immediately adjacent to water bodies for non-breeding activity such as movement and dispersal, foraging, over-wintering habitat and shelter;
- A 'chain' of water bodies that are located within close proximity to each other and connected via the Gum Scrub Creek waterway;
- Dispersal opportunities via the Gum Scrub Creek waterway and low-lying areas between water bodies, as well as opportunity for unhindered movement between and within water bodies;
- Good water quality for successful breeding and larval development (it is likely that GGF tadpoles are sensitive to some horticultural chemicals, such as fertilisers and pesticides);
- Dedicated GGF ponds (shown in Figure 2 as the northern and southern GGF ponds) that can be drained outside of breeding and dispersal periods to eradicate Eastern Gambusia *Gambusia holbrooki*; and
- Dual purpose sedimentation ponds / GGF ponds (shown in Figure 2 as GSC1-8 and the Arena northern and southern wetlands) which can also be drained outside of breeding and dispersal periods to eradicate Eastern Gambusia *Gambusia holbrooki*.

Many of these design elements meet the GGF habitat design guidelines provided in the *Growling Grass Frog Habitat Design Standards* (DEPI 2017b). It is disheartening to know however that GGF are not currently present within this stretch of Gum Scrub Creek. There is capacity, however, for a GGF population to (re)establish at this location if the development guidelines set out in the BCS, the *Sub-*

regional Species Strategy for the Growling Grass Frog (DEPI 2013b) and the *Growling Grass Frog Masterplan for Melbourne's Growth Corridors* (DELWP 2017a) are delivered.

5.2 OFFICER PSP OBJECTIVES

The *Officer Precinct Structure Plan* (Officer PSP) was prepared by the Cardinia Shire Council (2011) in conjunction with the Victorian Planning Authority (VPA) to develop and implement a long-term strategic plan to guide future urban development. It describes how the land is expected to be developed, the infrastructure and services planned to support the new community, and how these will be delivered.

The Officer PSP requires that development proposals enhance biodiversity values in the region and enhance planting opportunities within urban areas by:

- Utilising Gum Scrub Creek to provide for vegetation buffers as well as the protection and enhancement of the creek system;
- Protecting and retaining significant vegetation, including remnant vegetation within open space areas; and
- Maximising opportunities for revegetation in urban areas, particularly on ridgelines (Cardinia Shire Council 2011).

The Officer PSP further sets out objectives for open space areas including requirements to enhance and preserve areas of conservation significance and protect sensitive areas from vehicle or pedestrian traffic by:

- Providing appropriate buffer zones between native vegetation conservation areas and 'hard' infrastructure such as paths, furniture, picnic shelters;
- Ensuring passive or low impact activities are provided closest to offset / conservation areas, with more high impact or formal activities to be located further away;
- Ensuring that trees planted in open spaces adjoining Gilbert, Leber and Gum Scrub Creek open space / conservation reserves are all of local provenance.
- Providing 40 metre wide patches of continuous native vegetation along Cardinia Creek and Gum Scrub Creek to create habitat for Southern Brown Bandicoot, spaced 20 to 30 metres apart.
- Providing terrestrial grassed areas and dedicated Growling Grass Frog ponds spaced 200 to 300 metres apart along the Cardinia Creek and Gum Scrub Creek corridors.
- Ensuring a 30 metre buffer zone is provided around all Growling Grass Frog ponds, with lights, paths and any other activities that would cause direct impacts to be located outside this buffer.
- Designing vegetation for drainage reserves to ensure that habitat appropriate for Swamp Skink, Glossy Grass Skink and the Southern Toadlet is provided, in accordance with the *Officer Precinct Structure Plan Conservation Management Plan (excluding Cardinia Creek)* (Ecology Partners, 2011).

As part of the Officer PSP, the proposed development of the Gum Scrub Creek reserve and riparian corridor is required to address these objectives.

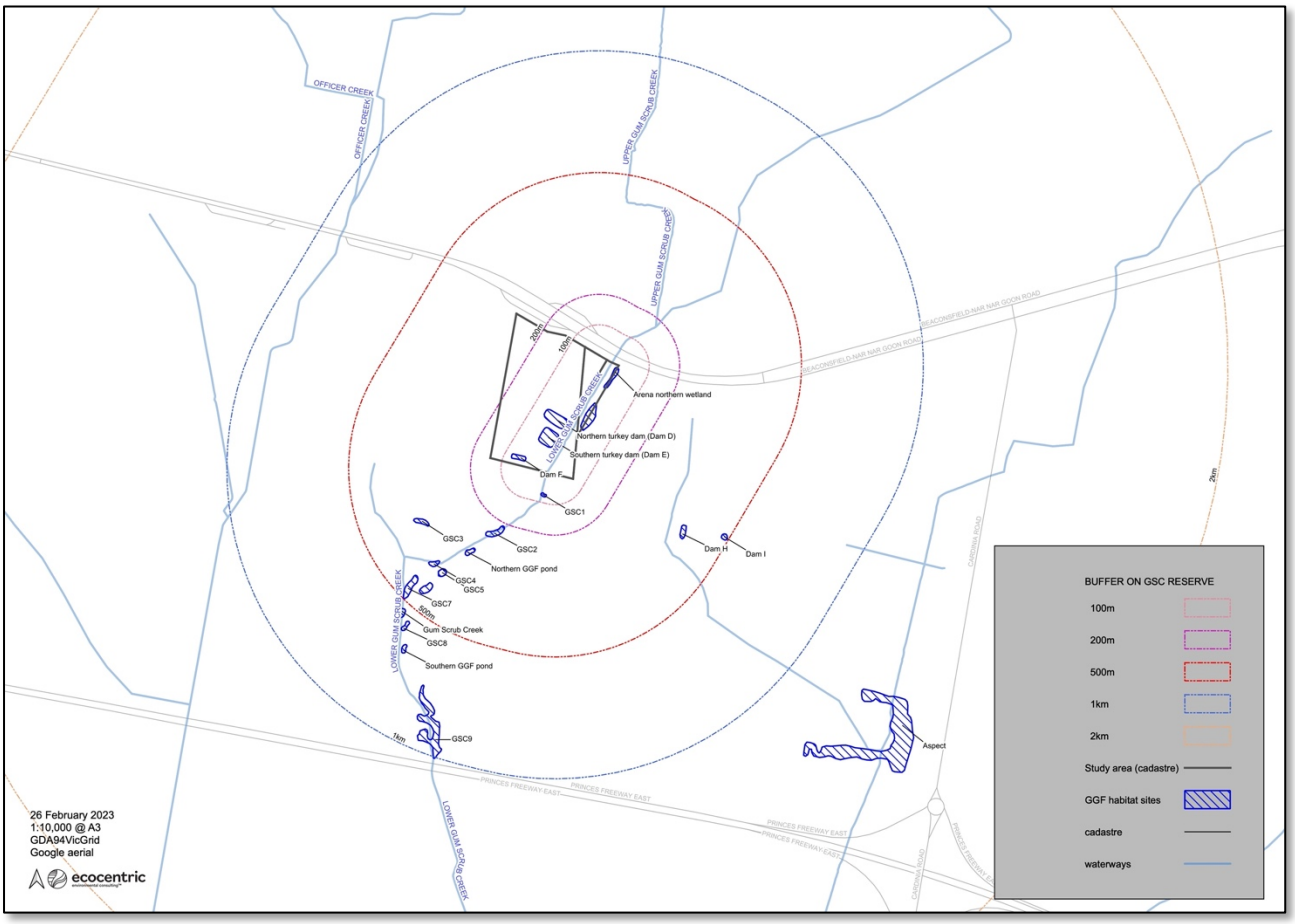
5.3 GGF CONSERVATION AND HABITAT OPTIONS

A 50m buffer west of the waterway that will potentially be handed over to and managed by Melbourne Water is set aside for the rehabilitation of the riparian corridor for drainage purpose, with an additional 25m buffer on the eastern side of the waterway that has connectivity to the constructed wetlands within the Arena development. In total there is over 3 hectares available for the Gum Scrub Creek riparian corridor and, potentially, provision of GGF habitat. There is also passive open space and an area set

aside for community facilities which will provide a buffer to the conservation values within the Gum Scrub Creek corridor.

It is important to note that the Gum Scrub Creek Corridor reserve area, as shown above, is within 1km of several GGF habitat wetlands as shown below in Figure 5. Most notable of these are the northern and southern GGF ponds downstream that were created as a condition of EPBC Controlled Action Permit 2006/3001 (350m and 750m downstream respectively), and the southern and northern wetlands on the east side of the creek within the Arena Estate (both are adjacent to and within the Gum Scrub Creek Corridor reserve). There are in total 19 wetlands (including the two turkey dams) within 1km of this development site which are connected – either directly along the Gum Scrub Creek and riparian corridor, or indirectly via the railway reserve and drainage lines – that can also accommodate GGF and their breeding requirements; in total these wetlands comprise a total surface area of 2.38 hectares of GGF wetland habitat (excluding the waterway itself).

Figure 5. GGF habitat cluster



It is our recommendation therefore that the provision of GGF habitat within the Gum Scrub Creek Corridor reserve area be explored since:

- There is space within the proposed Gum Scrub Creek Corridor reserve to accommodate GGF habitat wetland systems (explored below in Section 5.4);
- Any GGF wetlands developed within the Gum Scrub Creek Corridor reserve would contribute to the available GGF habitat network across the region (and as being expanded across the region);

- Developments within the Officer PSP are required to accommodate habitat for GGF (and other threatened species);
- There are wetlands being constructed within the Cardinia Creek corridor (west of this site in accordance with the *Officer Precinct Structure Plan: Cardinia Creek Conservation Management Plan* (Ecology Australia 2011) and south of this site by Melbourne Water as part of a GGF critical habitat development objective under the MSA);
- There are populations of GGF downstream of the development area that have connectivity to the Gum Scrub Creek Corridor reserve; and
- Development Victoria has provided dedicated GGF habitat downstream of this site which contribute to the regional habitat connectivity programs, and which provide a template for any proposed works at this site.

5.4 GGF HABITAT WETLAND OPTIONS AND DESIGN RECOMMENDATIONS

There are several development constraints within this area that are to be considered before determination of GGF habitat construction options can be explored; namely flooding of the creek and riparian corridor, approvals from the Authority tasked with long-term maintenance of the site and the availability of land within the Gum Scrub Creek Corridor reserve for development of ecological purposes.

5.4.1 FLOODING OF THE GUM SCRUB CREEK CORRIDOR

Much of the Quinn Land is within a Land Subject to Inundation Overlay (LSIO), and it is Ecocentric's experience that land around the two turkey dams, particularly to the south, is frequently inundated for up to 6 – 8 months of the year (generally April – December). An earthen berm at the southern boundary of the Quinn Land, which was constructed to mitigate flooding of the railway corridor, now also holds surface waters and contributes greatly to the duration of flooding on site.

Any development of GGF wetland habitat within the proposed Gum Scrub Creek Corridor reserve will therefore have to accommodate flooding and the flashiness of flows within the creek. Engineering options to protect against a 100-year ARI are to be explored at the detailed design phase of any proposals for the reserve. The *GGF Habitat Design Standards* (DELWP 2017b) do not specifically state that flooding of wetlands is not permitted, however, we know from experience that flooding can damage wetland structures, degrade water quality and established aquatic vegetation within the wetlands, and can introduce predator fish species including the exotic Mosquito Fish (*Gambusia holbrooki*) which is known to prey on GGF tadpoles (DEWHA 2009; DEPI 2013b; DELWP 2017a; NPWS 2003).

The *GGF Habitat Design Standards* do however identify that wetlands are to be constructed above at least the 10-year and preferably the 20-year flood line, with an exclusion structure incorporated in the connection between stormwater systems and GGF wetlands to prevent predatory fish from entering breeding ponds (DELWP 2017b). A 20-year ARI may be more compatible within the Gum Scrub Creek Corridor reserve given that this site is prone to flooding, however, it will be a requirement to engineer capacity to drain and dry the wetlands for predator fish control post-flooding.

Similarly, any efforts to re-meander and rehabilitate riparian habitat values along the waterway itself, such as has been successfully implemented by Development Victoria south of the railway, will have to accommodate flooding events. The use of gabion baskets to line the waterway bed and establish stable banks has been very successful downstream, and it is recommended therefore that this process be incorporated with the Quinn Land Gum Scrub Creek Corridor reserve.

5.4.2 MELBOURNE WATER APPROVALS

It is understood that any wetlands and/or the upgraded waterway will eventually pass, after a maintenance period, to Melbourne Water for ongoing management. Melbourne Water's approval of

any design and implementation aspects will therefore be a prerequisite of the planning and development process.

It will also be a necessity to work with Melbourne Water to determine flood and flow levels in order to develop plans that, where practicable to do so, will accommodate 100 year ARI events. It will also be necessary to refer any flood modelling, and/or flood mitigation modelling to Melbourne Water as part of the Permit Application process.

The turkey dams, as waterbodies that are immune to flooding and separate to, but within close proximity of the Gum Scrub Creek waterway, historically provided refuge habitat for GGF. We note however that GGF have not been recorded at these locations since the 2013/14 breeding season, and their removal may increase flood water holding capacity and mitigate flooding of any future wetland development on site. There is also capacity to increase the flood water carrying capacity within the riparian corridor through the re-meandering of the waterway (as has been done south of the railway), widening and/or deepening of the waterway, and through the incorporation of in-stream pools and floodwater mitigation structures.

5.4.3 DESIGN STANDARDS / RECOMMENDATIONS

The *Growling Grass Frog Habitat Design Standards* (DEPI 2017), sets out ideals for the construction of GGF wetland habitat. The standard covers aspects such as wetland water depth and quality, siting and contribution to cluster patterns, aquatic vegetation requirements, and the incorporation of habitat elements and structures that have been shown to be an important part of maintaining a sustainable population of GGF. Much of the recommendations outlined below are detailed in the standard, and we note that it is not possible at this stage to determine which of these recommendations will, or even can be incorporated at the Quinn Land site. These are simply guidelines to be considered by Development Victoria when working on detailed design options for the future development of the Gum Scrub Creek Corridor reserve adjacent to the Quinn Land. Development Victoria will take these guidelines into consideration, given its previous experience with many of the design and construction delivery requirements outlined below, through the rehabilitation works already completed within the Gum Scrub Creek riparian corridor south of the railway however this will be subject to the approval of the responsible Authority (and as summarised in Section 5.1 above).

WETLAND SIZE AND DEPTH

Larger wetlands are more likely to support Growling Grass Frogs because they are more likely to be permanent and less likely to dry out in drought conditions, and the extinction risk for GGF populations increases when wetlands are not permanent (Heard & Scroggie 2009). Larger wetlands also generally contain a larger quantity and diversity of food and shelter vegetation types favoured by GGF (Heard *et al.* 2010).

GIS modelling of the area available for development of a GGF wetland within the Quinn Land Gum Scrub Creek Corridor reserve has identified that it may be possible to construct a wetland within the riparian corridor. The *GGF Habitat Design Standards* (DELWP 2017) state that new wetlands in a cluster must be at least 0.3ha where space allows, but where space is limited, the surface area of wetlands can be reduced but not below 0.15ha, and, in all cases, the submergent zone must be at least 0.1ha in area. A wetland of this capacity would compare favourably with the northern and southern GGF-dedicated ponds constructed to the south of the railway (0.0447ha and 0.0338ha respectively), and also with the northern and southern wetlands on the east side of Gum Scrub Creek within the Arena Estate (0.0905ha and 0.2220ha respectively).

There is potential capacity within a wetland of this size to incorporate many of the *GGF Habitat Design Standard* recommendations, including:

- A submergent zone of greater than 0.1 hectares in area;
- Permanent water retention (permanent hydroperiod during the GGF breeding season) and water depth of 1.5 – 2m within a deep-water zone (for up to 60–70% of the total wetland surface area at normal water level);

- Emergent vegetation zone with a variety of slopes incorporated into the design of the banks, including steep drop-offs wherever this can be accommodated within Melbourne Water's safety standards;
- A sediment pond for interception of introduced fish species (such as Gambusia), litter and pre-treatment of stormwater prior to discharge into the wetland habitat;
- Potential capacity to establish:
    - Tall emergent vegetation such as reeds and rushes for male calling platforms during the breeding / calling season and protection of adult frogs from predators;
    - Submerged and floating attached vegetation, which protects eggs and tadpoles;
    - A littoral zone with fluctuating water levels at the wetland margin and the connecting sediment pond; and
    - Surrounding terrestrial vegetation and ground habitat (such as logs, rocks and ground crevices) for GGF overwintering;
- GGF wetland habitat that is off-line to the Gum Scrub Creek waterway, but with good terrestrial connectivity to the riparian corridor and downstream GGF habitat ponds (to facilitate dispersal within the corridor and migration to the waterway during wetland drying cycles).

The water source for a GGF wetland habitat pond on site is likely to be from stormwater interception (via a sediment pond).

THERMAL PROPERTIES STANDARDS

It is now understood that GGF living in waterbodies with warmer water temperatures (up to 27 degrees) and moderate salinity have been found to have lower rates of chytrid fungus infection and mortality compared with those living in colder and fresher water sites (DELWP 2017b; Heard *et al.* 2012). The incorporation of structures to manage thermal water properties within GGF breeding habitat is a recent outcome of studies of successful constructed wetland sites. Key properties are detailed in the *GGF Habitat Design Standard*, and are summarised below:

- Wetlands must be large and deep to provide thermal inertia;
- Wetlands must incorporate an extensive, shallow, permanently inundated emergent zone where water temperatures will be elevated due to the heat of the sun;
- All wetlands should incorporate jumbled piles of rocks around at least 20 per cent of the margin, extending into the wetland at least one metre from normal water level;
- "Anti-chytrid" wetlands in the basalt region (where excavated material can be used on site rather than paying for disposal offsite) should incorporate rocks around 50 per cent of the wetland margin if within budget; and
- Embankments to cut prevailing winds may be useful, and can be constructed from excavated material.

There is potential capacity to incorporate some / all of these structural elements and management actions in a GGF wetland within the Quinn Land Gum Scrub Creek Corridor reserve subject to the approval of the Responsible Authority.

6. CONCLUSIONS AND RECOMMENDATIONS

The regional population status of GGF has been recognised to be in severe decline for some time, and the results of GGF surveys that were conducted in parallel with development of the Officer PSP indicate that GGF may have become locally extinct in Officer in about 2015. In keeping with this, recent (December 2022) surveys conducted to help inform this paper found no sign of GGF within the vicinity of the Quinn Land site. Development of the Quinn Land site is therefore unlikely to have a Matter of National Environmental Significance impact on GGF under the EPBC Act.

The loss of GGF from Officer however prompted DCCEEW (then DAWE) to issue a variation of the EPBC Controlled Action Permit for this site which revoked conditions 1(c), 1(e), 2, 3 and 4 attached to the approval and required that Development Victoria (Condition 4A) undertake a study to determine factors likely to have contributed to the loss of GGF in Officer, management measures that, if implemented, are likely to prevent loss of other populations of Growling Grass Frog in the Officer region and more broadly measures that future developments should implement to avoid, minimise and mitigate impacts to Growling Grass Frog and to enable populations to survive or thrive despite development in Officer.

Locally, factors leading to the decline of GGF were found to be habitat loss, fragmentation and declining connectivity, urbanisation, chytrid fungus, and predatory fish. Despite these ongoing factors, the *Biodiversity Conservation Strategy for Melbourne's Growth Corridors* (DEPI 2013a) continues to provide for improvement of GGF connectivity and conservation, and with ongoing rehabilitation works across the region, there is potential for GGF to repopulate Officer. GGF habitat has already been incorporated into the Gum Scrub Creek corridor, both to the south of Quinn Land (the northern and southern GGF ponds created south of the railway corridor as part of the original EPBC Controlled Action Permit 2006/3001), and immediately to the east of Quinn Land (the northern and southern wetlands on the east side of the creek within the Arena Estate). The proposed development of Quinn Land provides potential opportunity for further development of GGF habitat within the Gum Scrub Creek corridor, and establishment of a cluster of GGF habitat wetlands in line with the *GGF Masterplan for Melbourne's Growth Corridors* (DELWP 2017a) subject to the approval of the responsible Authority.

It is recommended that Development Victoria consider opportunities to develop GGF habitat within the proposed Drainage reserve, as per the standards and design principles set out in the *GGF Habitat Design Standards* (DELWP 2017b), and with due consideration of engineering constraints associated with flooding and approvals required by Melbourne Water.

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8. APPENDICES

8.1 DEFINITIONS

8.1.1 GROWLING GRASS FROG

Growling Grass Frog habitat is defined by still or slow-moving water bodies such as lagoons, swamps, lake and farm dams with emergent vegetation consisting of sedges and rushes, and submerged vegetation such as eel grasses and mil-foils (DSE 2007). The species is dependent upon permanent freshwater lagoons for breeding and are observed in amplexus at the shallow margins of wetlands where there is generally a complex vegetation structure. Submerged vegetation is also important for breeding success as it provides sites for egg-laying, calling stages for males, and food and shelter for tadpoles (Mann *et al.* 2010).

Favourable habitat features include abundant aquatic vegetation, rock piles around the margins and in the shallows, minimal tree canopy cover, moderate to low water salinity levels, and water for at least six months of the year over the breeding season (DELWP 2017).

Growling Grass Frog living in waterbodies with warmer water temperatures (up to 27 degrees) and moderate salinity have been found to have lower rates of chytrid fungus infection and mortality compared with those living in colder and fresher water sites. Wetlands with warm, moderately salty water also appear to act as refuges from chytrid fungus for the resident Growling Grass Frog populations, which therefore have a lower probability of extinction (Heard *et al.* 2012; Heard *et al.* 2014, Heard *et al.* 2015).

It is also understood that GGF utilise habitat areas that surround the breeding wetlands where they take refuge over colder months, over-wintering in soil cracks, fallen timber, debris and dense vegetation, and in muddy sites of low, frequently inundated floodplains (DELWP 2017; DCCEEW SPRAT profile 2023).

The Growling Grass Frog is currently listed as Vulnerable under the EPBC Act 1999 (Cwlth), Vulnerable under the *Flora and Fauna Guarantee Act 1988* (FFG Act), and Vulnerable under a National Action Plan (Tyler 1997).

A detailed review of current information on the biology of GGF is provided in Pyke (2002) (see also Hero *et al.* 1991).

GGF at Harewood (reference site for this study). Photo credit: author

8.2 EPBC PERMIT VARIATION

Australian Government
Department of Agriculture, Water and the Environment

VARIATION TO CONDITIONS ATTACHED TO APPROVAL

VicUrban Residential Development, Officer (EPBC 2006/3001)

This decision to vary a condition of approval is made under section 143 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Person to whom the approval is granted	Development Victoria (formerly VicUrban) ABN: 61 868 774 623
Approved action	To develop a 370.52 hectare site which will include residential dwellings, a major activity centre and a commercial industrial business park, at Officer, Victoria and as described in the referral under the EPBC Act dated 12 August 2006, and in an email received on 25 July 2007 from Biosis Research on behalf of VicUrban requesting variation of the original proposal to include the property of 15 Harold Street, Officer in the proposal.

Variation	
Variation of conditions of approval	The variation is to: Revoke conditions 1(c), 1(e), 2, 3 and 4 attached to the approval; and Add condition 4A and the definition specified below.
Date of effect	This variation has effect on the date the instrument is signed.

Person authorised to make decision

Name and position	Richard Chadwick Assistant Secretary Environment Compliance Branch
Signature	
Date of decision	

Conditions attached to the approval

4A. The person taking the action must ensure that a Growling Grass Frog study is undertaken by a suitably qualified expert to determine:

a) the factors likely to have contributed to the loss of Growling Grass Frog on the site of the action since the approval of the action;
b) management measures that, if implemented, are likely to prevent loss of other populations of Growling Grass Frog in the Officer region and more broadly; and
c) measures that future residential or industrial developments should implement to avoid, minimise and mitigate impacts to Growling Grass Frog and to enable populations to survive or thrive despite development.

The person taking the action must publish the report of the Growling Grass Frog study on its website within 12 months of this variation decision, using metadata that will assist its discovery in relevant internet searches. The person taking the action must provide evidence of publication to the Department within 7 days of the report being published on its website.

Definitions:

Suitably qualified person means a person who has professional qualifications, training, skills and/or 5+ years' experience related to the nominated subject matter and can give authoritative independent assessment, advice and analysis on performance relative to the subject matter using the relevant protocols, standards, methods and/or literature.

8.3 EPBC PERMIT 2006/3001

Australian Government

Department of the Environment, Water, Heritage and the Arts

APPROVAL DECISION

VicUrban Residential Development, Officer (EPBC 2006/3001)

This decision is made under (Section 133) of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Proposed action	
person to whom the approval is granted	VicUrban
proposed action	To develop a 370.52 hectare site which will include residential dwellings, a major activity centre and a commercial industrial business park, at Officer, Victoria and as described in the referral under the EPBC Act dated 12 August 2006, and in an email received on 25 July 2007 from Biosis Research on behalf of VicUrban requesting variation of the original proposal to include the property of 15 Harold Street, Officer in the proposal.

Approval decision	
relevant controlling provisions	The approval has effect for: • Listed threatened species and communities (sections 18 & 18A)
conditions of approval	This approval is subject to the conditions specified below.
expiry date of approval	This approval has effect until July 2033.

Person authorised to make decision	
name and position	Marina Walkington Acting Assistant Secretary Environment Assessment Branch
signature	Marina Walkington
date of decision	14/10/08

Conditions attached to the approval

1. To protect the threatened species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), in particular the Growling Grass Frog (*Litoria raniformis*), the person taking the action must implement the recommendations outlined in the *Growling Grass Frog Conservation Management Plan September 2008* (GGFCMP). In particular the following actions must be undertaken:
    a. At least 39.4ha of Growling Grass Frog habitat and associated open space must be created and / or retained, including breeding, foraging and connectivity habitat. Growling Grass Frog habitat must be designed by a suitably qualified person;
    b. At least seven specifically designed Growling Grass Frog wetlands must be created. These wetlands must vary in shape and size and each wetland must be a minimum 20m long by 5m wide;
    c. The two existing Growling Grass Frog breeding habitats (D and E identified in Figure 1) must not be removed until successful breeding can be proven in the created wetlands. Successful breeding is defined by the presence of Growling Grass Frog metamorphs at at least two constructed wetlands within the action area for at least three non-consecutive years. The person taking the action must provide this evidence to the Department and approval must be obtained from the Department prior to the removal of this habitat;
    d. Existing dams must be removed in a staged manner to ensure suitable Growling Grass Frog habitat is always available; and
    e. Monitoring for the presence of predatory fish species, including the Mosquito Fish *(Gambusia holbrooki)* in dedicated Growling Grass Frog wetlands must be undertaken on a six-monthly basis. If predatory fish species are present the wetlands must be drained during the Growling Grass Frog non-breeding season (March-August) and must be refilled prior to the onset of the Growling Grass Frog breeding season (October).

2. Prior to construction in each of the areas defined in the GGFCMP, a Water Management Strategy (WMS) must be prepared by a suitably qualified person, to protect the dedicated Growling Grass Frog wetlands. The WMS must be approved by the Department. The WMS must be implemented and must include:
    a. Stormwater treatments on site must be designed using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) with suitable meteorological data for the site;
    b. Water quality in the dedicated Growling Grass Frog wetlands must be monitored every six months for the length of this approval, or as recommended by a suitably qualified person. Water quality must comply with specified water quality criteria identified in Clause 56 of the Victorian Planning Provisions 2006 (Appendix 4 of the GGFCMP); and
    c. Best practice remedial actions must be immediately implemented where it is identified that the requirements of Clause 56 of the Victoria Planning Provisions 2006 are contravened. The effectiveness of these actions must be monitored on a monthly basis until Clause 56 requirements are met. In this event, the Department must be provided within 2 months of the monitoring results being known, with a report stating the remedial actions implemented and their effectiveness.

3. A Growling Grass Frog management and monitoring program must be prepared by a suitably qualified person, to manage the Growling Grass Frog habitat and to monitor the Growling Grass Frogs at appropriate life stages to reflect the state of the population over time in the created and retained wetlands. The program must be approved by the Department. The program must be implemented. The land manager responsible for management and monitoring must provide the Department with a report every 2 years for the length of this approval on the state of the Growling Grass Frog population over time in the created and existing wetlands. If responsibility for monitoring and management of Growling Grass Frog habitat is transferred to another party, the Department must be

provided with evidence that the other party has agreed to assume the responsibility subject to the conditions of this approval.

4. If, after five years, the Growling Grass Frog monitoring results reported in accordance with condition 3 indicate that the Growling Grass Frog populations have not continued, the proponent must, within two months of the monitoring results, provide the Department with corrective actions and contingency measures to be approved by the Department prior to being implemented.

5. To protect the threatened species listed under the EPBC Act, in particular the Matted Flax-lily (*Dianella amoena*), the person taking the action must undertake the agreed propagation and translocation of the Matted Flax-lily in accordance with the *Translocation Plan for Matted Flax-lily within the VicUrban Officer Horizons Development December 2006*. The person taking the action must provide the Department with the propagation and translocation results.

6. If the person taking the action wishes to carry out any activity otherwise than in accordance with the documents identified in the above conditions relevant to EPBC listed species, the person taking the action must submit for the Department's approval a revised version of the document. If the Department approves a revised document, that document must be implemented in place of the document originally approved.

7. The person taking the action must maintain accurate records of all activities associated with or relevant to the above conditions of approval, and make them available on request by the Department. Such records may be subject to audit by the Department, and used to verify compliance with the conditions of approval.

8. If the person taking the action has not commenced construction of the action within 5 years of this approval then they must notify the Minister in writing and not commence construction without the Minister's agreement.

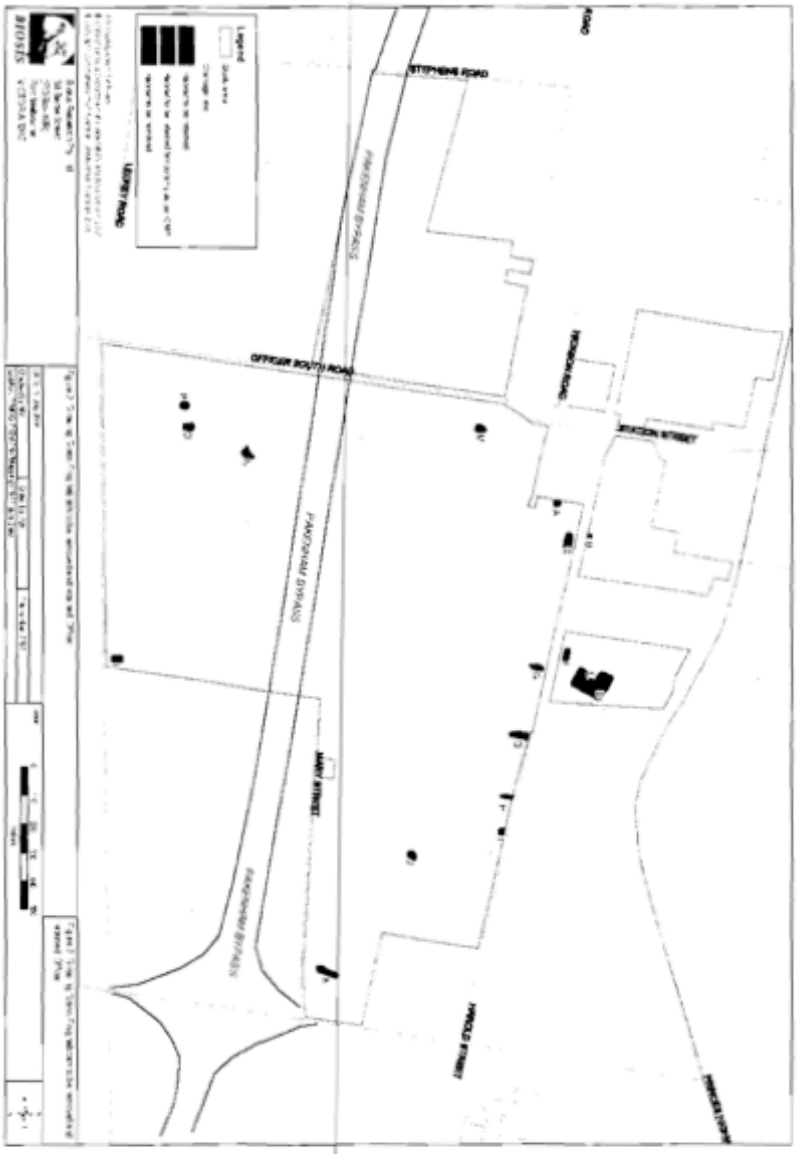
Definitions:

Department: The Australian Government Department responsible for administering the *Environmental Protection and Biodiversity Conservation Act 1999*.

Minister: The Australian Government Minister for the Environment, Heritage and the Arts.

Construction: Includes any clearing of vegetation, excavation, erection of fencing, installation of service infrastructure and construction of buildings.

Figure 1


STEPHENS ROAD
PARDEWELLS ROAD
OFFICER SOUTH ROAD
PARDEWELLS ROAD
MAIN STREET
PARDEWELLS ROAD
HEALES ROAD