



Land Capability Assessment + Biodiversity Survey + Environmental Health + GIS Mapping

Growing Grass Frog Study – Arborline to Horne Road – Future Urban Growth Area (Jan 2019)



FIGURE 1 – GGF has the potential to be present within the study area and proximal study area habitats, due to its cryptic nature and relatively large movement patterns.

SUMMARY

Warrnambool City Council is currently in the planning phases of the Arborline Road to Horne Road Future Urban Growth Area (north Warrnambool).

This report summarises the findings from targeted surveys of the Growing Grass Frog *Litoria raniformis* undertaken during November to December 2018. The aim of the surveys was to determine if the Growing Grass Frog was present or is likely to be present in the habitats within or adjacent to the proposed urban growth area. Presence or likelihood of presence will inform future management actions for the project.

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A total of 59 locations within 5 sites were selected for Growling Grass Frog targeted surveys within the study area. After initial site inspections, suitable habitat for the Growling Grass Frog was found within Tozer Reserve only. These locations were assessed for GGF presence/absence in accordance with Commonwealth survey guidelines (DEWHA 2009a).

GGF was not found within the study area due to absence of connected and protected habitat but may be present within Tozer Reserve. Mitigation actions could be used to further avoid impacts.

It is strongly encouraged that as encroaching development occurs within this area, restoration and relinkage of critical frog conduits such as Russell's Creek; which may in time see enhanced GGF habitat and GGF re-establishment.

Notwithstanding a negative survey result, GGF has the potential to be present within the study area and proximal study area habitats, due to its cryptic nature and relatively large movement patterns. The precautionary principle should be considered where future planning objectives for the area are determined taking into account current and future potential GGF presence.

A GGF Management Strategy should form part of future study area planning and include the key issue regarding GGF; potential and future habitat protection and linkage.



FIGURE 2 - Russell's Creek; the key biological conduit for Growling Grass Frog, now reduced via agriculture to a non-functional system devoid of habitat.

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¹ DELWP (2018). Victorian Volcanic Plain Bioregion Benchmarks. Accessed from:
https://www.environment.vic.gov.au/data/assets/pdf_file/0029/48755/VVP_EVCs_combined.pdf

1.0 BACKGROUND / PROJECT INFORMATION

Landtech Consulting has been commissioned to complete a GGF presence/absence survey within the Arborline Road / Horne Road growth corridor, earmarked for future housing development. Based on historic and more recent GGF presence records it is pertinent to determine 'significant impact' on GGF and its remaining habitat and whether EPBC Act referral is warranted.

The study area has been historically highly modified to the point where little potential GGF habitat exists and linkages between such habitats all but destroyed by past agricultural and housing development activities.

Warrnambool City Council is therefore taking appropriate actions to determine whether populations of GGF and preferred habitat exists within the action/study area and if so how such areas can be conserved, re-linked, and protected.



FIGURE 3 - Russell's Creek seen here traversing the study area (polygon) which is essentially devoid of GGF habitat.

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1.1 SURVEY OBJECTIVES

Biological surveys are usually an essential component of significant impact assessment and should be conducted on the site of the proposed action prior to referral.

Surveys assist in the evaluation of impact on matters of national environmental significance by establishing presence or the likelihood of presence/ absence of a species.²

Survey was undertaken within all areas of potentially suitable habitat within the study area and complying with the EPBC Act Frog Survey Guidelines (DEWHA 2010).

The survey objective was to determine presence/absence of GGF populations and the potential requirement for EPBC referral.

Survey methodology (based on p.45 EPBC Survey Guidelines)³ will include the following EPBC-based methodology:

1. Desktop analysis
2. Site scoping
3. Species survey – using Audio Recording, VES (Visual Encounter Survey), Call playback
4. Data analysis
5. Report / Recommendations / EPBC referral

Determining requirements for an EPBC Act referral

A 'significant impact'⁴ is an impact which is important, notable, or of consequence; having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

To be 'likely', it is not necessary for a significant impact to have a greater than 50% chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility. If there is scientific uncertainty about the impacts of your action and potential impacts are serious or irreversible, the precautionary principle is applicable.

Accordingly, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on the environment.

In deciding whether or not the action that you propose to take is likely to have a significant impact you must consider:

1. The environmental context;
2. Potential impacts likely to be generated by the action, including indirect consequences of the action;
3. Whether mitigation measures will avoid or reduce these impacts, and
4. Taking into consideration the above, whether the impacts of the action are likely to be significant.

^{2 2} Survey guidelines for Australia's threatened frogs; Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

Accessed from: <http://www.environment.gov.au/system/files/resources/ff3eb752-482d-417f-8971-f93a84211518/files/survey-guidelines-frogs.pdf>

⁴ Commonwealth of Australia 2013. Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies Significant impact guidelines 1.2 Environment Protection and Biodiversity Conservation Act 1999. Accessed from: http://www.environment.gov.au/system/files/resources/a0af2153-29dc-453c-8f04-3de35bca5264/files/commonwealth-guidelines_1.pdf

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1.2 CONSERVATION STATUS - Growling Grass Frog *Litoria raniformis*

The Growling Grass Frog is commonly known by several other names; Warty Bell Frog, Southern Bell Frog, Warty Swamp Frog, and Green and Golden Frog. The species is listed as vulnerable nationally (EPBC Act),⁵ and endangered in Victoria (DEWLP 2018).



FIGURES 4 & 5 - Growling Grass Frog *Litoria raniformis* adult and larvae (Source: Museum Victoria 2016).

It is also listed as a threatened taxon under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and the Victorian Flora and Fauna Guarantee Act 1988.

A draft Flora and Fauna Guarantee Action Statement and a draft National Recovery Plan have been developed for the species.⁶ Overall, the species is of national conservation significance.

Although formally widely distributed across south eastern Australia, including Tasmania,⁷ the species has declined markedly across most of its former range.

The decline has been most evident over the past two decades and in many areas, particularly in south and central Victoria where populations have experienced apparent declines and local extinctions.⁸

While historical perturbations have been important factors in GGF population decline (e.g., droughts and the introduction of exotic disease), habitat loss, fragmentation, and degradation continue to be significant issues for the conservation of *L. raniformis*.⁹

Causes of the decline of the Growling Grass Frog are not fully understood however factors likely to have contributed to the decline locally and internationally include:

- habitat loss;
- fragmentation and degradation of habitat (land clearing for agriculture/urban development);
- altered flooding regimes of natural water bodies within catchments;
- predation on eggs and tadpoles by introduced fish, adults by exotic predators;
- salinisation, chemical pollution of water bodies by fertilisers and pesticides; and
- infection by the amphibian chytrid fungus.¹⁰

⁵ Tyler, M.J. (1997). *The Action Plan for Australian Frogs*. Wildlife Australia. Canberra, ACT: Environment Australia. Available from: <http://www.environment.gov.au/biodiversity/threatened/publications/action/frogs/index.html>.

⁶ Robertson, P., G. Heard & M. Croggie (2002). The ecology and conservation status of the growling Grass Frog (*Litoria raniformis*) within the Merri Creek Corridor. Interim report: distribution, abundance and habitat requirements. Report to the Department of Natural Resources and Environment, East Melbourne, Victoria. Wildlife Profiles Pty Ltd and the Arthur Rylah Institute for Environmental Research.

⁷ Amphibiaweb 2018. Ecology of the growling Grass Frog (*Litoria raniformis*). Accessed from: <https://amphibiaweb.org/species/1300>

⁸ Climate-Related Local Extinctions Are Already Widespread among Plant and Animal Species. *PLoS Biol.* 2016;14(12):e2001104. Published 2016 Dec 8. doi:10.1371/journal.pbio.2001104.

⁹ DELWP 2010. Heard G, Scroggie M & Cleemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

¹⁰ Australian Government. Department of Environment, Heritage, and the Arts. Significant impact guidelines for the vulnerable green and golden bell frog (*Litoria aurea*). Nationally Threatened Species and Ecological Communities - Background Paper to EPBC Act Policy Statement. Accessed from: <https://www.environment.gov.au/system/files/resources/e882f6c7-a511-4fba-9116-2f2f7ef941aa/files/litoria-aurea-background.rtf>

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1.3 STUDY AREA

The study area is located between Warrnambool and Wangoom, approximately 4.3km to the north-west of the Warrnambool CBD. The study area is within the *Victorian Volcanic Plain* bioregion which covers a large part of south-western Victoria and extends from the western suburbs of Melbourne to Hamilton in the west.

The DELWP modelled pre-1750 mapping for the region¹¹ shows that the study area would have been dominated by the endangered *EVC55 Plains Grassy Woodland* (now mostly non-existent) and *EVC53 Swamp Scrub* (once distributed along Russell's Creek).



FIGURES 6 & 7 – Former EVC's Swamp Scrub and Plains Grassy Woodland now diminished in extent (Source: DELWP 2019 NVIM).¹²

The study area includes flat to undulating landforms and include ephemeral wetlands, farm dams, and Russell's Creek which traverses the site from west to east, forming part of Russell's Creek catchment, eventually draining to the Merri River.

Land tenure includes Farm-zoned freehold and Crown parcels, with Tozer Reserve (revegetated site) dominating the north central part of the study area and potentially significant future green wedge with encroaching development.

Russell's Creek is the major biological conduit for periodic recharge of localised wetlands and drainage line GGF habitat. The Tozer wetlands are self-filling being upslope from Russell's Creek but potentially form 'seed' populations of frogs to RC and the broader catchment.

The study area consists within the *Victorian Volcanic Plain Bioregion* typically dominated by Cainozoic volcanic deposits; formed an extensive flat to undulating basaltic plain with stony rises, old lava flows, numerous volcanic cones and old eruption points and is dotted with shallow lakes both salt and freshwater.¹³

Soils are generally shallow reddish-brown to black loams and clays. They are fertile and high in available phosphorous. The soils are variable ranging from red friable earths and acidic texture contrast soils (Ferrosols and Kurosols) on the higher fertile plain to scoraceous material, and support *Plains Grassy Woodland* and *Plains Grassland* ecosystems.

¹¹ DELWP 2018 NatureKit Online Database. Accessed from: <http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit>

¹² DELWP 2018 Native Vegetation Information Management; Online Map. Accessed from: https://nvim.delwp.vic.gov.au/Map?_ga=2.73731474.1464341581.1546485379-1562658829.1542253409

¹³ DELWP 2018 Bioregions and EVC benchmarks. Accessed from: <https://www.environment.vic.gov.au/biodiversity/bioregions-and-evc-benchmarks>

Wetland formations include inland salt marshes, permanent and intermittent freshwater and saline/brackish lakes, permanent freshwater ponds and marshes and inland, subterranean karst wetlands.

The region is characterised by a rainfall of 450-840mm per annum, with a relatively even distribution throughout the year. The main river systems include the Maribymong, Werribee, Moorabool, Barwon, Corangamite, Hopkins, Glenelg and Merri Rivers, and Mount Emu and Leigh Creeks.

Based on known habitat requirements of GGF within the study area,¹⁴ Tozer Reserve has the potential to support GGF populations is expected to be impacted by the proposed 'growth corridor'.

The proposed development may have an impact directly, through the removal of wetland habitat, mortality during construction, or indirectly through alterations to Russell's Creek, fragmentation of suitable habitats, increased pollutants, sedimentation, and predation.

Due to the almost complete destruction of linked GGF habitat, the proposed development is unlikely to result in overall reduction in the quality and extent of frog habitat within the study area.

The study area falls within the jurisdiction of Warrnambool City Council and the Glenelg-Hopkins Catchment Management Authority.



FIGURE 8 - Russell's Creek; viewed from Arborline Road to the east; a once important biological connector across the Russell's Creek catchment, an important precursor to downstream urban Warrnambool.

¹⁴ Robertson, P., G. Heard & M. Croggie (2002). The ecology and conservation status of the growling Grass Frog (*Litoria raniformis*) within the Merri Creek Corridor, Interim report: distribution, abundance and habitat requirements. Report to the Department of Natural Resources and Environment, East Melbourne, Victoria. Wildlife Profiles Pty Ltd and the Arthur Rylah Institute for Environmental Research.

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1.4 DESKTOP ASSESSMENT

A desktop review was undertaken to ascertain potential presence of the Growling Grass Frog within and adjacent to the study area, based on known records in the area.

The desktop review included a search of relevant literature, online resources, and the following ecological databases:

- The Commonwealth Government's EPBC Act Protected Matters Search Tool (PMST)¹⁵ for potential species records and species habitat within a 10km buffer of the study area; and
- The DELWP NatureKit¹⁶ and VBA Database (DELWP 2018) for existing records of species occurring within a 10km buffer of the study area. The database records sightings of all species reported to DELWP and indicates whether species are listed under the EPBC Act, Victorian FFG Act or DELWP Advisory Lists.¹⁷

The search of the VBA (Victorian Biodiversity Atlas) showed that two records of the Growling Grass Frog have been reported between 1999 and 2016 within the buffers suggested and includes Mepunga and Maam Reserve wetland areas.

Information from both databases and aerial imagery was then compiled to obtain a preliminary list of locations (survey sites) that may provide suitable Growling Grass Frog habitat within the vicinity of the study area.

On-ground habitat assessments were then undertaken from 25 November to 30 November 2018 to confirm habitat suitability.

Previous fauna survey by Landtech Consulting in 2015 identified the presence of a single calling male within Tozer Reserve. The Victorian Biodiversity Atlas (VBA DELWP 2018)¹⁸ lists two historic records (within a 25km radius of the study area) to the east of the study area, and to the south within the Mepunga district.



FIGURE 9 – The once last intact wetland system connected to Russell's Creek to the south-west of the site (Crown Water Reserve, now unfenced, grazed, and unsuitable for GGF habitat).

¹⁵ Australian Government 2018. Department of Environment & Heritage. Protected Matters Search Tool. Accessed from: <http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf>

¹⁶ DELWP 2018 NatureKit Online Database. Accessed from: <http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit>
<https://www.environment.vic.gov.au/biodiversity/naturekit>

¹⁷ Victorian Government 2013. FFG Act – Threatened Species Advisory List. Accessed from:

https://www.environment.vic.gov.au/data/assets/pdf_file/0014/50450/Advisory-List-of-Threatened-Vertebrate-Fauna_FINAL-2013.pdf

¹⁸ Victorian Government 2013. Victorian Biodiversity Atlas; Species Search Tool. Accessed from: <https://vba.dse.vic.gov.au/vba/#/>

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1.5 HABITAT REQUIREMENTS

GGF is largely associated with permanent or semi-permanent, still or slow flowing water bodies (i.e. streams, lagoons, farm dams and old quarry sites).¹⁹ Frogs can also utilise temporarily inundated water bodies for breeding purposes provided they contain water over the breeding season.

Based on previous investigations there is a strong correlation between the presence of the species and key habitat attributes at a given water body. For example, the species is typically associated with water bodies supporting extensive cover of emergent, submerged and floating vegetation.²⁰

Emergent vegetation provides basking sites for frogs and protection from predators, while floating vegetation provides suitable calling sites/stages for adult males, and breeding, and oviposition (egg deposition) sites. Terrestrial vegetation (grasses, sedges), rocks, and other ground debris around wetland perimeters also provide foraging, dispersal, and over-wintering sites for frogs.²¹

Water bodies supporting the above-mentioned habitat characteristics, and those that are located within at least 300-500 metres of each other, are more likely to support a population of GGF compared to isolated sites lacking important habitat features.

Recent studies have revealed that the spatial orientation of water bodies across the landscape is one of the most important habitat determinants influencing the presence of the species at a given site.²² For example, studies have shown there is a positive correlation between the presence of the species and the distance of freestanding water bodies to another occupied site (see *Figures 10-12*).²³ *Table 1* depicts habitat preference and related behavioural responses of the GGF.



FIGURES 10-12 – GGF preferred habitat is typically associated with water bodies supporting extensive cover of emergent, submerged and floating vegetation (Source: SWIFT 2018).

Table 1 - habitat preference and related behavioural responses of the GGF.

Macrohabitat	Microhabitats	Behaviour		Larval habitat
Refuge		Active	Breeding	
Woodland or open, disturbed habitat near permanent, still water sources.	Soil cracks, flood debris, fallen timber.	In wet weather may move away from water to forage on ground and in surrounding vegetation	Males call while floating among reeds etc.	Hide in vegetation in shallow edges of water body and cruise between mid-water and surface. ²⁴

¹⁹ Ecology Partners, Armstrong Creek North East Industrial Precinct: Growling Grass Frog Conservation Management Plan, May 2010.

²⁰ Ecology Partners, Armstrong Creek North East Industrial Precinct: Growling Grass Frog Conservation Management Plan, May 2010.

²¹ Ecology Partners, Armstrong Creek North East Industrial Precinct: Growling Grass Frog Conservation Management Plan, May 2010.

²² Robertson, P., G. Heard & M. Croggie (2002). The ecology and conservation status of the growling Grass Frog (*Litoria raniformis*) within the Merri Creek Corridor, Interim report: distribution, abundance and habitat requirements. Report to the Department of Natural Resources and Environment, East Melbourne, Victoria. Wildlife Profiles Pty Ltd and the Arthur Rylah Institute for Environmental Research.

²³ Australian Government. Department of Environment, Heritage, and the Arts. Significant impact guidelines for the vulnerable green and golden bell frog (*Litoria aurea*). Nationally Threatened Species and Ecological Communities - Background Paper to EPBC Act Policy Statement. Accessed from: <https://www.environment.gov.au/system/files/resources/e882f6c7-a511-4fba-9116-2f2f7ef941aa/files/litoria-aurea-background.rtf>

²⁴ Brook, A.J. (1980). The Breeding Seasons of Frogs in Victoria and Tasmania. Victorian Naturalist. 97:6-11.

1.6 HABITAT WITHIN THE STUDY AREA

The study area includes flat to undulating landforms and include ephemeral wetlands, farm dams, and Russell's Creek and part of its catchment area which traverses the site from west to east, eventually draining to the Merri River within the north of Warrnambool township.

Russell's Creek is the major biological conduit for periodic recharge of localised wetlands and drainage line GGF habitat. The Tozer wetlands are self-filling being upslope from Russell's Creek but potentially form 'seed' populations of frogs to RC and the broader catchment.

Habitats within the study area and related to GGF preference includes grassland lava-based wetlands, RC watercourse and associated wetlands, depressions, farm dams, and drainage lines; all with generally reduced vegetation to in many cases non-existent.

The degree to which each habitat has been modified is evident from aerial imagery at scoping stage with Tozer's ephemeral wetlands that include aquatic plants to a reduced degree. All other water bodies and watercourses are entirely devoid of aquatic vegetation due to intensive and ignorant agricultural land-use practices. Such overarching landscape processes are difficult to reverse and require regulatory planning support to effect reconstructed GGF habitat.

- Site 1 – Crown Reserve wetland / farm dam
- Site 2 – Russell's Creek west
- Site 3 – Russell's Creek
- Site 4 – Russell's Creek east
- Site 5 – Tozer Reserve

Table 2 – Study area habitat descriptions based on each survey site.

SITE	DESCRIPTION	HABITAT PROVISION
Site 1 – Crown Reserve wetland / farm dam	Existing Crown Water Reserve within Farm Zone; Not fenced as previous aerial imagery depicts therefore no vegetation protection, siltation, soil compaction, erosion; and All aquatic vegetation removed by grazing.	Former aerial imagery suggests when once fenced this feature supported some aquatic species diversity and therefore possible GGF habitat.
Site 2 – Russell's Creek west	Existing Crown 5m buffer on either side of the creek partly fenced however cattle observed accessing the area; Sporadic woody weed species (<10% cover) persist within this area; Ephemeral nature not assisted by the current non-existent management of the Crown buffer; Flows commence in Winter periods of higher relative rainfall.	Site lacks typical hydrologic flood patterns as grazing and lack of management continues contributing to complete suppression of aquatic and riparian vegetation. Local landowners continue to contribute to negligent use of such areas.
Site 3 – Russell's Creek	Existing Crown 5m buffer on either side of the creek	Exotic pasture grasses persist to the ephemeral waterline with creek lacking localised wetland connections for GGF connected and protected habitat. The site is devoid of indigenous vegetation apart from some regenerative plantings within Site 4.
Site 4 – Russell's Creek east	Existing Crown 5m buffer on either side of the creek	Complete suppression of aquatic and riparian vegetation with minor area of some regenerative plantings.
Site 5 – Tozer Reserve	Department of Education owned site with restored but modified indigenous vegetation. Includes a number of ephemeral wetland and soakage sites.	Common floating and emergent aquatic species in most wetlands within Tozer with only a single wetland inundated post-Winter period.



FIGURE 13 – Initial site scoping in late November 2018 identified sub-sites of potential GGF habitat.

Site 1 – Crown Reserve wetland / farm dam



FIGURE 14 – Previously fenced and protected and therefore vegetated, now un-fenced and reduced to an eroded waterbody.

Site 1 includes a formerly fenced wetland/farm dam (Crown Water Reserve) now denude of aquatic and woody vegetation, reduced to an unfenced, silted, and highly eroded waterbody, bereft of Growling Grass Frog habitat potential.



FIGURE 15 – Aerial imagery (2018) depicting high waterbody turbidity, surface scalding, and habitat fragmentation and simplification, not conducive to GGF habitat (Source: WCC 2018).

Self-regeneration of fringing and within waterbody aquatic vegetation requires cessation of grazing.

This site may have had the vegetation cover and diversity in the past to support GGF populations.

Such a site also has the potential to respond rapidly to cessation of impacts and to once again provide useful GGF habitat into the future.

Site 2 – Russell's Creek west

Site 2 includes a focal area within Russell's Creek adjacent to Arberline Road (east of study area) where marginally increased vegetation exists however of exotic woody and pasture growth forms.

Via site scoping observation the local land owner provides unfettered access to the watercourse Crown reserve area destroying habitat potential within this site.

Woody weed species such as Gorse, Hawthorn, and Boxthorn dominate the only vegetation remaining through this site.



FIGURES 16 & 17 – Western part of the study area which includes broader watercourse areas typically holding water in higher relative rainfall periods.

Site 3 – Russell's Creek

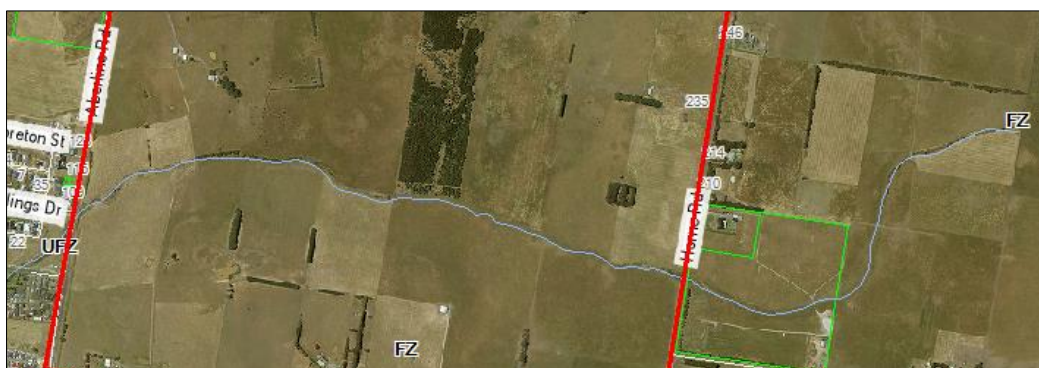


FIGURE 18 – Aerial image of the central Russell's Creek area; devoid of vegetation and therefore GGF habitat.



FIGURE 19 – For extensive areas of Russell's Creek within the study area, the watercourse is reduced to a 'drain' due to lack of protection and local landowner Crown Reserve use.

Site 3 includes the majority of Russell's Creek between Arborline and Horne Road's apart from areas within Site's 2 and 4.

As can be seen from aerial imagery and on-ground site scoping, this site is made up a 5m watercourse Crown Reserve completely denude of indigenous vegetation whilst providing no GGF habitat.

Creek-bank edges are heavily modified and simplified to resemble a drain edge. Exotic pasture grass due to land-use therefore dominates the length of the watercourse.

There is potential for effective riparian and aquatic vegetation restoration along this section.

Site 4 – Russell's Creek east



FIGURES 20-21 – A useful hectare of riparian vegetation has been planted within the site and acts as a sediment trap for downstream sites.

Site 4, to the eastern part of the study area includes areas of vegetation restoration, flow retention, and therefore some reduced but potential GGF habitat.

Revegetation includes riparian tree, shrub, and sedge species which assists in slowing flows, increased pooling, and therefore aquatic species growth and potential GGF habitat.

Lack of controlled flows and a vegetated watercourse over time reduces this possibility however.

It is suggested future GGF survey efforts target such sites due to the intact and stable nature of this semi-restored site.

Site 5 – Tozer Reserve



FIGURE 22 – Key wetland within Tozer typically holding water for longer periods but dominated by exotic pasture grasses reducing habitat quality.

Tozer Reserve provides the greatest potential for relic populations of GGF to exist due to a number of small (<30m²) ephemeral wetlands generally not persisting through the year but including reduced diversity and common aquatic species.

Exotic pasture grasses dominate surrounding and pond edge sites.



FIGURES 23-24 – Ephemeral soakage areas, now vegetated potentially providing GGF habitat when inundated.



FIGURE 25 – Ex-quarry site with soakage areas has potential to provide effective cover habitat for the GGF.

It includes 5 sub-sites with varying water permanence, and aquatic vegetation diversity and quality.

It beneficially also includes intervening grassland and forested buffer and movement areas acting as potential GGF habitat.

Tozer includes the following sub-sites:

1. 3 x ephemeral wetlands (rock-based)
2. 1 x quarry area (rock-based)
3. 1 x wetland soakage
4. 1 x open grassland area
5. 1 x man-made drainage line (south of site)



FIGURE 26 – Ephemeral wetland site dominated by exotic pasture grasses which diminish GGF habitat value.

All sub-sites require ongoing maintenance to sustain key GGF habitat requirements. Most sites are dominated by exotic pasture grasses which require long-term restoration processes are enacted to reverse the existing state.

Increased diversity of aquatic vegetation stratum revegetated within each sub-site would provide key elements of GGF habitat.

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2.0 SURVEY METHODS

Executing a survey and identifying listed species presence does not in itself predict a significant impact. Species presence is one of many factors that increase the likelihood of significant impact.

A wide variety of survey techniques have been developed in order to cater for the diverse ecological and behavioural requirements of amphibian species.²⁵ The suitability of a given survey technique for a target frog species will be influenced by the species' general habits, preferred habitat and microhabitat, life history and behaviour.²⁶

It is important to employ survey techniques most suited to the target species and the environment to maximise the probability of detection. It may be necessary to use multiple techniques and greater survey effort to establish the presence/absence of some threatened frog species.

The ecology of the species, timing of the surveys, local environmental conditions, and observer competence can all affect the performance of survey techniques and the detection probability for the target species.

Where possible, surveys should be conducted during the breeding season when frogs are most active. In many cases surveyors will need to employ multiple survey techniques, during repeated surveys of both the target survey site and a reference site, to detect rare or cryptic species.



FIGURE 27 – Ephemeral wetlands, soakage, and former quarry habitat areas persist within Tozer Reserve.

²⁵ Heyer E 1994. Measuring and Monitoring Biological Diversity. Standard Methods for Amphibians. Accessed from: <https://www.scribd.com/document/143928038/Heyer-Et-Al-1994-5-e-6-Measuring-and-Monitoring-Biological-Diversity-Standard-Methods-for-Amphibians-Preface-and-Cap1>

²⁶ Heyer E 1994. Measuring and Monitoring Biological Diversity. Standard Methods for Amphibians. Accessed from: <https://www.scribd.com/document/143928038/Heyer-Et-Al-1994-5-e-6-Measuring-and-Monitoring-Biological-Diversity-Standard-Methods-for-Amphibians-Preface-and-Cap1>

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2.1 METHOD & TIMING OF SURVEYS

Surveys were timed to coincide with optimum weather conditions during the peak of the breeding season from October to May, specifically in November-December.

Landtech utilised a combination of active search, visual survey, call detection, call playback and fixed audio recording in remaining depauperate habitat.

Five sites were targeted within the study area based on the following survey methods:

1. Active search
2. Manual (mobile) call recording
3. Call stimulation via playback
4. Fixed call recording

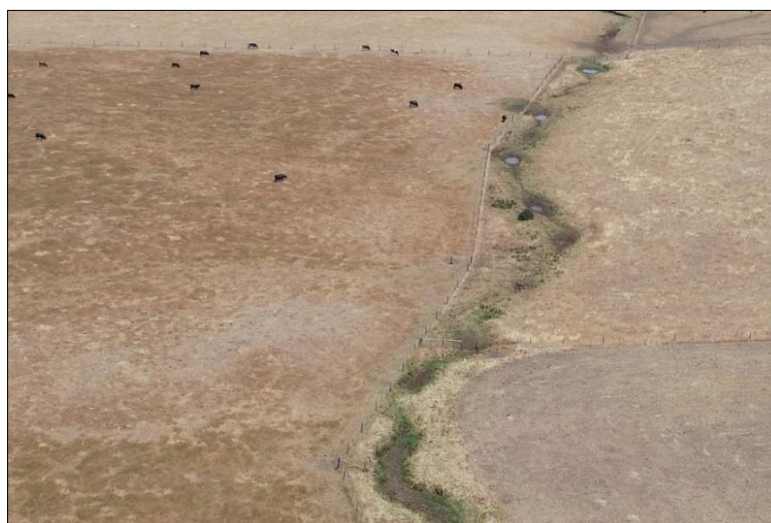


FIGURE 28 – RC clearly showing areas of depression that would restore with fencing and assisted revegetation.

1. Active search

A visual encounter survey involves field personnel walking through a defined area or distance for a prescribed time period, systematically searching for animals.

Another method is 'spatially constrained searches' where the observer searches a set area with a defined method and intensity over a variable time period. The technique is not generally effective for species that reside underground, in thick vegetation, or in the canopy.

2. Manual (mobile) call recording

This method involves the observer visiting each discrete breeding site and waiting for a predetermined time at a fixed point to listen for calling males.

3. Call stimulation via playback

In some frog species, present but non-calling males can be stimulated to call either by imitating the call or by playing a previously recorded call using an audio recorder/player or mobile phone.

The technique requires that males will respond to the stimulation; although some species will respond readily during the breeding season, others will respond only under certain environmental conditions or not at all.

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4. Fixed call recording



FIGURE 29 – Audio-recording device used.

Males of most frog species use species-specific calls during the breeding season to advertise their presence to females and to other males.

Call surveys exploit this habit, where a frog can be heard even if they are hidden from visual observation, which is often the case due to the small size, cryptic colouration or position, and/or their microhabitat use.

Both arboreal and terrestrial species can be surveyed simultaneously.

This method uses a remote recording device (Frontier Labs, Qld), consisting of a microphone and digital recorder attached to a timer, to record calling frogs in the absence of the observer.

The automation of call surveys facilitates continuous sampling throughout the day and night.



FIGURE 30 – Areas within the western part of the study area on RC; depicting natural pooling sites ready for aquatic and riparian revegetation (and entire fencing).

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FIGURE 31 – Raw survey site data detailed in Appendix 1 and covering applicable potential habitat zones.

3.0 RESULTS

A total of two amphibian species were recorded from the five locations surveyed between 23 November 2018 and 27 December 2018.

As can be seen from Table 3, Growling Grass Frog was not detected at all 5 sites within the study area. It is clear from ground scoping and survey that this is a result of diminished/non-existent suitable aquatic and terrestrial habitat within the study area and beyond.

Common species such as the Striped Marsh Frog (*Limnodynastes peronii*) and Eastern Froglet (*Crinia signifera*) were however detected at 3 of the 5 sites and occurred where temporary standing water was available. These species occurred in areas of higher relative habitat quality and retention of soakage water.

Such species are indicative of highly modified landscapes however shows the reduced habitat requirements for such species, appoint that should be taken into consideration when all future development planning is undertaken.

Table 3 – Survey results within all survey sites.

Site	Survey Period	Method	Result
Site 1 – Crown Reserve wetland/dam	Nov 23 – Nov 30 2018	Active search	GGF not detected
		Manual call recording	
		Call stimulation via playback	
		Fixed call recording	
Site 2 – Russell's Creek west	Nov 30 – Dec 6 2018	Active search	GGF not detected
		Manual call recording	GGF not detected
		Call stimulation via playback	GGF not detected
		Fixed call recording	GGF not detected
Site 3 – Russell's Creek	Dec 6 – Dec 13 2018	Active search	GGF not detected
		Manual call recording	
		Call stimulation via playback	
		Fixed call recording	
Site 4 – Russell's Creek east	Dec 13 – Dec 20 2018	Active search	GGF not detected
		Manual call recording	GGF not detected
		Call stimulation via playback	GGF not detected
		Fixed call recording	GGF not detected
Site 5 – Tozer Reserve (5 sub-sites)	Dec 20 – Dec 27 2018	Active search	GGF not detected
		Manual call recording	GGF not detected
		Call stimulation via playback	GGF not detected
		Fixed call recording	GGF not detected

4.0 DISCUSSION

Results from this survey suggest an absence of Growling Grass Frog within the study area and proposed growth corridor. The *precautionary principle* should be considered here due to the highly mobile and cryptic nature of this species. Persistence of relic populations across modified landscapes such as the study area are possible in sites such as Tozer Reserve, which provides key habitat in high rainfall years for the species.

It is not unexpected that GGF was not detected in the study area due to the complete removal of habitat along Russell's Creek, the key localised conduit and potential habitat for GGF populations. Such a watercourse requires reinstatement of fencing containing the 5m Crown buffer, long-term exclusion of stock access and grazing, and revegetation, using species from historic EVC associations such as EVC53 Swamp Scrub.



FIGURE 32 – Building blocks for future aquatic and riparian restoration across the study area potentially restoring previous GGF sites.

Such actions not only reinstate key habitat with downstream benefits to the entire Russell's Creek catchment, but also encourage natural water retention and pooling through the system, to support the growth of key aquatic vegetation required for specialised species such as the GGF.

Frog activity varies spatially, seasonally and temporally according to current or recent weather conditions.²⁷ Consequently, the probability of detecting frogs also varies. The probability of non-detection may be high for rare or cryptic species and those species that are only active for short periods of time. Therefore, the survey effort required to detect a species which is present will vary with season, habitat conditions, the targeted species' activity patterns, and the sampling techniques used.²⁸

²⁷ Researchgate 2018. Variation in Abundance and Efficacy of Tadpole Predators in a Neotropical Pond Community. Accessed from: https://www.researchgate.net/publication/297599590_Variation_in_Abundance_and_Efficacy_of_Tadpole_Predators_in_a_Neotropical_Pond_Community

²⁸ Australian Government. Department of Environment, Heritage, and the Arts. Significant impact guidelines for the vulnerable green and golden bell frog (*Litoria aurea*). Nationally Threatened Species and Ecological Communities - Background Paper to EPBC Act Policy Statement. Accessed from: <https://www.environment.gov.au/system/files/resources/e882f6c7-a511-4fba-9116-2f2f7ef941aa/files/litoria-aurea-background.rtf>

Habitat Loss, Fragmentation

Various factors interchangeably act on potential GGF populations with localised habitat loss and fragmentation the greatest impacting processes.

Increased subdivision and housing development will contribute to continued reduction and modification to wetland and grassland habitat within the study area. Existing vegetation and water quality should be protected during construction phases.

Notwithstanding the almost complete non-existence of preferred GGF habitat, potential future habitat such as Russell's Creek and Tozer Reserve demand vegetation/habitat enhancement, 'stepping stone' type relinkage, hydrological reinstatement, and site protection.

Any further loss of potential GGF habitat should compensate for such loss through additional key habitat revegetation along Russell's Creek and buffering Tozer Reserve.

Attempts should be made whilst development occurs to reconstruct Russell's Creek's aquatic habitat via staged revegetation, addition to creek banks of logs, rocks, ground debris, and via creating levies and back-ponding, based on slowing water flow through the system. In time, such as in 10-20 years, natural processes take over and such enhancements occur naturally/self-repeating.



FIGURES 33 & 34 – Two significant aquatic elements within the site that require restoration and reconnection to provide effective and long-term habitat for specialised species such as the GGF.

Potential development impacts may include habitat fragmentation, changed hydrology (reduced & increased flows), increased sedimentation and siltation, impacts to water quality and aquatic life, reduced/altered habitat connections, increased human and vehicular access, increased weed invasion/distribution, exotic predators (aquatic/terrestrial), and impacts from non-responsible dog and cat ownership.

The key issue for sustaining populations of GGF includes the provision of connected habitat,²⁹ which must be managed during design and construction periods, with attempts made to maintain/protect/link potential GGF sites across the study area. Such detail and how to manage connected habitats should form part of any Environmental Management Plan for future growth projects.

²⁹ DELWP 2010. Heard G, Scroggie M & Cleemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

Hydrology and Water Quality

Construction activities associated with proposed urban developments have the potential to result in sedimentation of nearby waterways and produce sediment-laden runoff into Russell's Creek.

Sediment-laden water has the potential to be transported offsite, downstream to areas containing potential habitat/relic populations of GGF throughout the catchment. This includes the potential for accidental spillage of chemicals from construction areas. The increase in sediment input and input of toxic substances into Victorian creeks and rivers due to human activities are both threatening processes under *Schedule 3 of the FFG Act*.



FIGURE 35 – Useful native plants (some non-indigenous) acting as a sediment filter and potential GGF habitat.

Roads and Vehicular traffic

Significant international research points to the impact of road traffic on amphibian mortality. This however typically impacts movement of frogs between key habitat which is essentially non-existent within the study area, but must be considered within effective future design processes. Mitigation measures to support safe frog passage between sites is typically the aim here.

Human access

As has been observed at Tozer Reserve, impact of pedestrian and un-restrained dog/cat access leads to predation of birds and small mammals, and accelerated weed dispersal. Human occupancy within the study area has the potential to result in disturbance and degradation of habitat due to rubbish dumping, mechanical disturbance of vegetation from trampling, and weed invasion etc.

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Weeds

Where little habitat exists within the study area, most is dominated by exotic grasses, herbs, and woody shrubs. Increased activity within such areas leads to weed encroachment into terrestrial and aquatic indigenous vegetation due to such activity and lack of weed hygiene, but also via increased runoff from proposed development.

Weed spread must be managed during all stages of the design, planning, and construction phases to minimise weed transport and dispersal. Invasion of native vegetation by 'environmental weeds' is a threatening process under *Schedule 3 of the FFG Act*. Excessive weed growth can smother frog habitat rendering it unsuitable as a breeding and foraging site.³⁰



FIGURE 36 – Ephemeral wetland within the north-eastern part of Tozer Reserve; providing habitat for amphibian, reptile and aquatic invertebrate species.

Cats, Dogs, Foxes

Unrestrained dogs and cats have the potential to (as currently occurs) roam the study area. Cats in particular are known to predate upon dispersing or sheltering frogs. Predation of native wildlife by the Cat is a threatening process under *Schedule 3 of the FFG Act* and must be part of future environmental education initiatives supporting future urban growth projects.

The Red Fox, recorded throughout the study area, is known to eat adult members of the adult bell frog species complex.³¹ GGF is however considered a species of low sensitivity rating indicating reduced population impacts on adult frogs, nonetheless some background predation is thought to be typical.

³⁰ DELWP 2010. Heard G, Scroggie M & Cleemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

³¹ NSW Government 2010. Department of Environment, Recovery Plan for Green and Golden Bell Frog. Accessed from: <https://www.environment.nsw.gov.au/resources/nature/recoveryplanGreenGoldBellFrogDraft.pdf>

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4.1 RECOMMENDATIONS

Future recommendations should include 'wetland-level and landscape-level' design objectives for habitat management, in addition to ongoing surveys aimed at determining study area occupancy by the frog.³² This latter activity could be deployed to appropriate school groups to monitor using basic and informative learning-based technologic procedures.

GGF is a highly aquatic species but is active on land during the warmer months of the year foraging for prey. It has been increasingly recognised in recent years that the terrestrial surrounds of wetlands are a crucial resource for many amphibians.³³ The terrestrial zone of wetlands provides cover such as rocks, logs and soil cracks, which are important shelter and overwintering sites.

The implication is that resident populations of GGF will be sustained largely by immigration from neighbouring populations, because aquatic vegetation cover is thought to be a fundamental determinant of reproductive success for GGF.³⁴ Larger wetlands are more likely to be occupied by GGF and where wetland hydroperiod and aquatic vegetation cover were found to be more important wetland-level determinants of extinction probability for the species.³⁵

Larger, deeper wetlands are less likely to dry out from year to year, which means that resident populations of GGF have an inherently lower chance of extinction and have a greater propensity to support diverse aquatic vegetation that GGF requires, where shallow wetlands have a tendency to be 'choked' by emergent vegetation.

In most situations all three of the following is suggested to be required to achieve an appropriate level of connectivity:³⁶

- Habitat protection is the preservation of existing populations of GGF within a 1 km radius of the focal population/s, by preserving and maintaining the wetlands in which they occur.
- Habitat enhancement is the improvement of existing wetlands close to the focal population/s so that they can be colonised by GGF and support additional neighbouring populations.

An example is the enhancement of farm dams, which are numerous across the range of the species but are frequently unoccupied because of short hydroperiods or poor aquatic vegetation cover.

However, habitat enhancement need not be restricted to the improvement of artificial wetlands such as farm dams; it includes enhancing pools along streams, creeks and other drainage lines.

- Habitat creation is the construction of purpose-built wetlands for GGF near the focal population/s, so that they be colonised and support additional populations. This option primarily entails the construction of wetlands to be filled by surface run-off, drainage diversions or pumping. Although the construction of pools along ephemeral streams or drainage lines may be considered habitat creation, it is really a form of habitat enhancement because it essentially involves enhancing the hydroperiod of an existing wetland.³⁷

³² DELWP 2010. Heard G, Scroggie M & Clemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

³³ https://www.fs.fed.us/rm/pubs_other/rmrs_2006_cushman_s001.pdf

³⁴ DELWP 2010. Heard G, Scroggie M & Clemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

³⁵ DELWP 2010. Heard G, Scroggie M & Clemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

³⁶ DELWP 2010. Heard G, Scroggie M & Clemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

³⁷ DELWP 2010. Heard G, Scroggie M & Clemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

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In typical habitat management situations experimental approaches to management are also considered; underpasses under roads to facilitate dispersal and translocation of populations from wetlands ear-marked for destruction.³⁸ Guidelines developed should aim to promote a scientifically validated and consistent approach to the species' management in these landscapes.

Two examples of such experimental approaches to management for GGF are the construction of underpasses under roads, and the translocation of populations from wetlands designated for destruction.³⁹



FIGURES 37 & 38 – Simple underpass solutions utilising directive frog fencing to maximise passage
(Source: The Globe Mail BC 2018).⁴⁰

The intention is that these tunnels would be used by frogs during dispersal, thereby helping to maintain the ability of populations to interact. The tunnels are usually concrete pipes or culverts, with drift fences of wire mesh designed to funnel dispersing frogs towards the pipes.

However, there is no evidence that such underpasses will be used by GGF during dispersal, nor that they are effective in maintaining historical (i.e. pre-road) rates of dispersal between populations.⁴¹

Translocation entails the capture and movement of GGF from wetlands that are to be destroyed to make way for urban development, to either existing nearby wetlands or newly created ones. The aim of translocation is to ensure that there is either no net reduction in the abundance of GGF, or no net reduction in the number of populations present.⁴²

There is currently no evidence that populations of GGF can be successfully relocated. There are inherent risks involved in translocation at both the population and individual-level. The possible spread of disease is an example of the former, and heightened predation-risk an example of the latter.

Any application of these techniques should be seen as a management experiment, secondary to the primary goal of managing habitat appropriately, and whose outcome is not crucial to the conservation of the target population or populations.⁴³

³⁸ DELWP 2010. Heard G, Scroggie M & Clemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

³⁹ DELWP 2010. Heard G, Scroggie M & Clemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

⁴⁰ The Globe and Daily Mail, British Columbia. Article: Endangered Red-legged Frog. Accessed from: <https://www.theglobeandmail.com/news/british-columbia/bcs-endangered-red-legged-frog/article1380611/>

⁴¹ DELWP 2010. Heard G, Scroggie M & Clemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

⁴² DELWP 2010. Heard G, Scroggie M & Clemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

⁴³ DELWP 2010. Heard G, Scroggie M & Clemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

Habitat protection measures

- **Potential movement corridors**

All remaining and suggested additional key wetland/dam/watercourse sites must be permanently fenced therefore protecting any habitat existing and to be restored.

Due to being a highly mobile amphibian species and being impeded by barriers to passage, GGF requires protected and hydrologically sound corridors of diverse indigenous habitat to support all life-cycle stages.



FIGURES 39 & 40 – Barrier fencing used to direct or restrict frog passage within urban development construction site.⁴⁴

- **Buffer/protect Tozer Reserve**

In addition to revegetating Russell's Creek, it is suggested that the addition of a 10-25m buffer zone around Tozer Reserve would provide the capacity for enhanced habitat protection within a site providing habitat for not only the GGF, but a suite of bird, small mammal, and reptile species.

The protection and internal enhancement of Tozer Reserve provides a store of biological resources and specialist habitat for such species, and more specifically providing a core area of indigenous vegetation and landscape-level structure to re-link potential restored key habitat. Effective landscape-scale habitat provision provides the framework to support a range of faunal species and their specific habitats.

- **Feral and domestic animal control, education, by-laws**

Increased education or the use of by-laws may be considered by Council to reduce domestic animal roaming and potential frog predation.

Increased resourcing and integration with local landowners and regulatory stakeholders should be sought to strategically control Red Foxes across the catchment and beyond.

As urban development increases within the study area such issues will only increase pressure on remaining habitat areas such as Tozer Reserve and the Russell's Creek watercourse.

⁴⁴ NSW Government 2010. Department of Environment, Recovery Plan for Green and Golden Bell Frog. Accessed from: <https://www.environment.nsw.gov.au/resources/nature/recoveryplanGreenGoldBellFrogDraft.pdf>

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- **Population monitoring, further survey**

Non-detection within this survey may not be entirely indicative of GGF presence/absence due to recent observations within Tozer Reserve and reduced survey timing and effort in this survey. Frog larval and adult survey is a simple but biologically informative task that could be undertaken by the public and school groups and is essential to population monitoring and future land use planning.

- **Community education and participation**

It is critical that Council resources and supports a community engagement and education program that includes enhanced public participation in Russell's Creek catchment revegetation programs. Volunteer and philanthropic-based support should be accessed to assist Council with potential GGF monitoring, revegetation, fencing, public information provision, water quality testing, frog site protection and enhancement works, supervising school group programs (survey, water testing, tree-planting etc).

Collaborating with and engaging existing and future residents provides a framework for publicly-driven environmental programs which provides community empowerment and ownership over part of their living environment.

- **Sediment traps prior to Russell's Creek**

It is obviously essential that all upstream and feeder stormwater drainage is investigated and planned for the provision of effective and maintained sediment traps. The control and reduction of sediment movement into the catchment requires cooperation of all responsible regulatory authorities and their asset/engineering design teams.

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Habitat enhancement measures

Planning and design stages must include habitat enhancement measures within and proximal to the key potential GGF habitat areas such as Russell's Creek, Tozer Reserve and to a lesser extent the Crown reserve dam. Suggested key design measures should include:

Enhanced habitat features should also be considered during design and planning stages within all key habitat sites such as minor water impoundment/damming, creation of pools/back-eddy's, logs, and later stage revegetation with floating, emergent, and submergent aquatic species.

- **Revegetate Russell's Creek Russell's Creek corridor**

The Russell's Creek catchment must be managed to support enhanced GGF habitat. This may include multi-layered restoration of Swamp Scrub EVC within at least the existing 5m Crown Reserve.

The area is currently not fenced and used by adjoining farmers which must cease. Direct-seeding could be carefully used in sections/along the entire watercourse depending on planning decisions regarding provision of such reserve areas.

If Russell's Creek was entirely revegetated, such key habitat features develop self-regeneratively over time. The key is to direct or trigger these systems to self-sustain and self-regulate into the future.



FIGURES 41 & 42 – Areas of restored farm dams incorporating key landscape elements required for GGF life-cycle completion.

- **Hydrological reinstatement**

Due to the lack of vegetation along Russell's Creek, water is not stored after minor to major rain events and where in a natural system flows are captured and slowed through vegetation, back-ponding, and debris providing slow release and movement of water through the catchment.

Increased hard surfaces due to urban development will further increase such movement which is being managed by regulatory authorities such as Melbourne Water via tank storage and release over time.

- **Create reserves around existing farm dams**

The study area contains between 5-10 existing farm dams in varying states of modification. Such dam potentially provides 'stepping-stone' pathways when restored with a diverse range of aquatic plant species. Such actions have been successfully completed within Victoria, Tasmania, and NSW

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to support additional/restorative GGF habitat.⁴⁵ CMA's should be included in negotiation and planning stages who can provide wetland restoration and catchment management support.



FIGURES 43 & 44 – Useful habitat creation for GGF utilising staged aquatic fringe plantings which could be utilised within the study area.

5.0 CONCLUSION

Provided that the construction and long-term management of the study area is in accordance with information in this plan, there is likely to be a net improvement in habitat quality for the Growling Grass Frog and other fauna species (e.g. waterbirds).

There is also a possibility that the Growling Grass Frog may naturally colonise the study area, particularly if wetlands are constructed and managed appropriately, and connection within and between waterbodies is available.

The primary objective of this plan is to provide design and management recommendations required to potentially support Growling Grass Frog habitat within the study area.

While several recommendations have been provided there are opportunities to modify these if additional information becomes available during construction and/or monitoring.

An important element of the effective implementation of the management plan is the ongoing commitment from land developers/owners, and relevant agencies, such as Warrnambool City Council and DELWP.

Similarly, there needs to be continual communication between future land developers, referral authorities and specialist consultants experienced in undertaking monitoring and management of the Growling Grass Frog and its habitats.

⁴⁵ DELWP 2010. Heard G, Scroggie M & Cleemann N 2010. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Arthur Rylah Institute for Environmental Research 123 Brown Street, Heidelberg, Victoria 3084.

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APPENDIX 1 – SURVEY RESULT DATA

Site	GPS easting	GPS northing	Survey Period	Method	Result
Site 1 – Crown Reserve wetland/dam	633007.455	5752213.427	Nov 23 – Nov 30 2018 Weather (max. temp range): 13.3-20degC	Active search	GGF not detected
	632924.9049	5752200.727		Manual call recording	
				Call stimulation via playback	
				Fixed call recording	
Site 2 – Russell's Creek west	632647.4728	5752423.87	Nov 30 – Dec 6 2018 Weather (max. temp range): 17-31degC	Active search	GGF not detected Eastern Froglet (<i>Crinia signifera</i>)
	632590.5344	5752395.718		Manual call recording	GGF not detected Eastern Froglet (<i>Crinia signifera</i>)
	632570.6377	5752379.632		Call stimulation via playback	GGF not detected Eastern Froglet (<i>Crinia signifera</i>)
	632669.0629	5752446.095		Fixed call recording	GGF not detected Eastern Froglet (<i>Crinia signifera</i>)
Site 3 – Russell's Creek	633430.7451	5752405.295	Dec 6 – Dec 13 2018 Weather (max. temp range): 17-39 degC	Active search	GGF not detected
	633488.2921	5752407.941		Manual call recording	
	633624.5528	5752366.269		Call stimulation via playback	
	633676.1467	5752343.779		Fixed call recording	
	633726.4176	5752333.857			
	633776.6885	5752307.399			
	633828.2824	5752288.216			
	633371.2138	5752411.909			
	633322.5052	5752433.356			
	633274.8322	5752435.221			
	633872.4326	5752269.043			
	633915.2952	5752260.312			
	633954.189	5752245.23			
	633996.2005	5752225.625			
	633807.4429	5751223.771			
	634002.1766	5751365.588			
	633257.1084	5751397.338			
	632689.5946	5752465.992			
	632733.6213	5752475.94			
	632761.138	5752485.465			

Site	GPS easting	GPS northing	Survey Period	Method	Result
Site 4 – Russell's Creek east	634045.4704	5752227.768	Dec 13 – Dec 20 2018 Weather (max. temp range): 16.1-35.2 degC	Active search	GGF not detected Striped Marsh Frog (<i>Limnodynastes peronii</i>)
	634083.5705	5752223.005		Manual call recording	GGF not detected Striped Marsh Frog (<i>Limnodynastes peronii</i>)
	634120.8768	5752211.099		Call stimulation via playback	GGF not detected Striped Marsh Frog (<i>Limnodynastes peronii</i>)
	634151.0394	5752199.987		Fixed call recording	GGF not detected Striped Marsh Frog (<i>Limnodynastes peronii</i>)
	633991.7775	5752410.508			
Site 5 – Tozer Reserve (5 sub-sites)	633553.2629	5753279.33	Dec 20 – Dec 27 2018 Weather (max. temp range): 16-33 degC	Active search	GGF not detected Eastern Froglet (<i>Crinia signifera</i>)
	633705.6632	5753357.911		Manual call recording	GGF not detected Eastern Froglet (<i>Crinia signifera</i>)
	633696.9319	5753407.521		Call stimulation via playback	GGF not detected Eastern Froglet (<i>Crinia signifera</i>)
	633701.6944	5753497.612		Fixed call recording	GGF not detected Eastern Froglet (<i>Crinia signifera</i>)
	633586.2036	5753441.255			
	633606.0474	5753334.893			
	633611.4383	5753218.079			
	633614.4148	5753151.933			
	633539.3392	5752998.606			
	633526.11	5753039.352			
	633564.21	5753028.769			
	633620.3018	5752815.779			
	633537.2225	5752772.916			
	633500.1807	5752721.058			
	633627.4632	5752931.949			
	633514.7505	5752530.311			
	633506.1515	5752485.993			
	633501.5213	5752451.597			

APPENDIX 2 – EVC 53: Swamp Scrub - EVC/Bioregion Benchmark for Vegetation Quality Assessment - Victorian Volcanic Plain bioregion⁴⁶

Description: Closed scrub to 8 m tall at low elevations on alluvial deposits along streams or on poorly drained sites with high nutrient and water availability.

Soils vary from organic loams to fine silts and peats which are inundated during the wetter months of the year and is dominated by Woolly Tea-tree *Leptospermum lanigerum* which often forms a dense impenetrable thicket, outcompeting other species.

Emergent trees (eg. Swamp Gum *Eucalyptus ovata*) may sometimes be present. Where light penetrates to ground level, a moss/lichen/liverwort herbaceous ground cover is often present.

Recruitment: Continuous

Organic Litter: 20% Cover

<u>Canopy Cover: 60%</u>	<i>Leptospermum lanigerum</i> Woolly Tea-tree <i>Melaleuca squarrosa</i> Scented Paperbark <i>Acacia melanoxylon</i> Blackwood
<u>Large Herb 5 10%</u>	<i>Persicaria decipiens</i> Slender Knotweed <i>Villarsia reniformis</i> Running Marsh-flower <i>Epilobium pallidiflorum</i> Showy Willow-herb
<u>Medium Herb 13 30%</u>	<i>Hydrocotyle pterocarpa</i> Wing Pennywort <i>Lilaeopsis polyantha</i> Australian Lilaeopsis <i>Hydrocotyle muscosa</i> Mossy Pennywort
<u>Small or Prostrate Herb 2 5%</u>	<i>Lobelia pedunculata</i> s.l. Matted Pratia <i>Crassula helmsii</i> Swamp Crassula
<u>Large Tufted Graminoid 9 15%</u>	<i>Juncus procerus</i> Tall Rush <i>Gahnia clarkei</i> Tall Saw-sedge <i>Deyeuxia quadriseta</i> Reed Bent-grass <i>Amphibromus recurvatus</i> Dark Swamp Wallaby-grass
<u>Medium to Small Tufted Graminoid 7 15%</u>	<i>Schoenus maschalinus</i> Leafy Bog-sedge <i>Lachnagrostis filiformis</i> (perennial variety) Wetland Blown-grass <i>Juncus planifolius</i> Broad-leaf Rush

⁴⁶ DELWP 2018 Bioregions and EVC benchmarks. Accessed from: <https://www.environment.vic.gov.au/biodiversity/bioregions-and-evc-benchmarks>

APPENDIX 3 – FROG SURVEY HYGIENE PROTOCOLS

The state or territory agency responsible for the management of threatened species should be consulted regarding specific measures for the target species and/or area, and any relevant protocols complied with.

In addition, the following precautionary procedures were employed by all persons undertaking survey work:

- thoroughly clean and disinfect footwear at the start of fieldwork and between each sampling site
- thoroughly clean and disinfect nets, balances, callipers, bags, scalpels, headlamps, torches, wetsuits and waders etc between each sampling site
- spray/flush vehicle tyres with a disinfecting solution in high risk areas where necessary
- only handle frogs when necessary, and minimise of the risk of pathogen transfer between frogs by:
 - cleaning or disinfecting hands between samples or using a new pair of disposable gloves for each sample, and
- adopting a 'one bag, one frog' approach to frog and larvae handling. Bags should not be reused.

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